# Entomological Work for 1895.

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## *The Chinch Bug.*

(*Blissus leucopterus Suy.*)

This insect has been so much written about that it would seem as if every farmer should be posted regarding it, but it is of so much importance to the farming interests of the state, the need of more thorough knowledge concerning it on the part of cultivators is so apparent and so much new matter concerning its habits and treatment can be presented that no apology is necessary for making it the leading topic of the year's report.

Since its first recognition, nearly a century ago, it has made a record of losses, running into the millions of dollars in single years, a summary of which, though instructive, is hardly possible in the space at hand. For a very complete historical account of the insect as well as an admirable discussion of methods of treatment, up to 1887, the reader is referred to an article on the Chinch Bug by L. O. Howard (Bull. No. 17, Div. Ent. U. S. Dept. Agr'l) or, perhaps more accessible on application to congressmen, in the report of the U. S. Dept. of Agr'l for 1887.

DISTRIBUTION IN IOWA DURING THE PAST TWO YEARS.

The damage in this state during the past two years has had a somewhat peculiar distribution and one which may have an instructive lesson if we can determine the conditions which underlie it. During 1894, as reported in last year's bulletin (No. 27) the losses were practically all confined to the southeast quarter of the state and in this quarter mainly to a region included in a row of two counties on the southern and eastern border. For the past season, 1895, this area has been somewhat extended, but still the most serious injuries, if we except a portion of Jackson county, has been in the same counties.

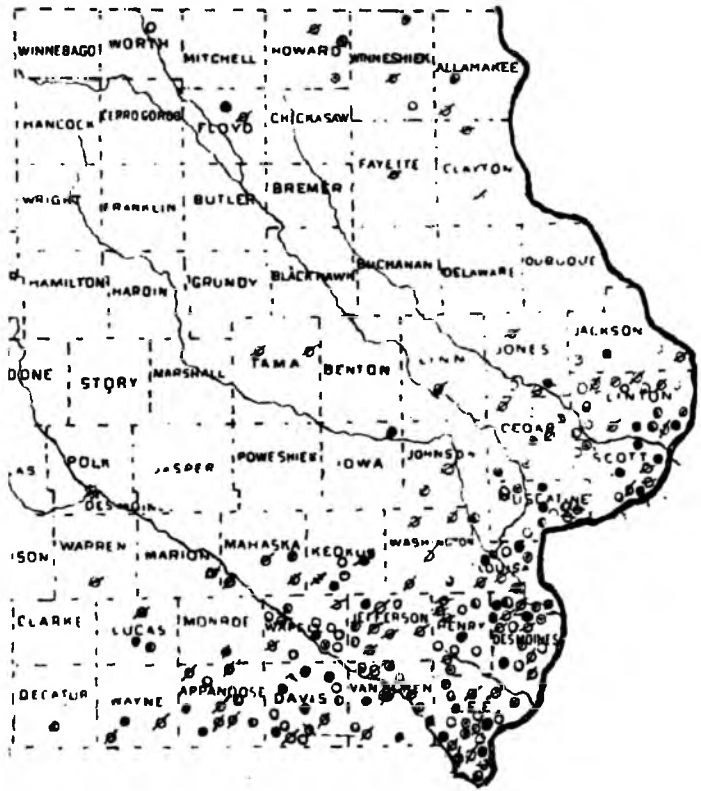
In order to make this distribution clear, maps (Plate I)* have been prepared to show the points from which we have received reports of chinch bug injury and to which we have sent infection material. The effect of this infection material will be considered under another head.

If now we compare the map of chinch bug distribution with the distribution of winter wheat cultivation, we will find that they are almost identical, and it would seem from this that during these seasons there has been some relation between the winter wheat crop and the increase of bugs. This is fully as striking, if we remember, that, during 1894 at least, the conditions of weather were fully as favorable to increase of bugs in the northwest, or spring wheat counties, as in the southeast. It is doubtless usually the case that the injuries of chinch bugs are less noticed in fields of winter wheat but this may be because the crop ripens before the bugs reach their most destructive stage or the dry weather of mid-summer makes their work more conspicuous. It would seem, so far as wheat crop is concerned, more profitable to grow win-

*Plate I. (1894 to the left: 1895 to the right.) 1895—Open circles indicate failure of fungus; circles half black indicate partial success; circles full black, success; circles with dot in center, doubtful; with line across, not reporting. 1894—Map shows simply localities reporting bugs that year.

PLATE, I:


WORTH
MITCHELL
HOWARD
WINNESHIEK
ALLAMAKEE
FLOYD
CHICKASAW
FAYETTE
CLAYTON
BUTLER
BREMER
GRUNDY
BLACKHAWK
BUCHANAN
DELAWARE
DUBUQUE
JACKSON
TAMA
BENTON
LINN
JONES
CLINTON
CEDAR
JASPER
POWESHIEK
IOWA
JOHNSON
SCOTT
MUSCATINE
MARION
MAHASKA
WASHINGTON
LOUISA
LUCAS
MONROE
WAPELLO
JEFFERSON
HENRY
DES MOINES
WAYNE
APPANOOSE
DAVIS
VAN BUREN
LEE


WINNEBAGO
WORTH
MITCHELL
HOWARD
WINNESHIEK
ALLAMAKEE
HANCOCK
FLOYD
CHICKASAW
FAYETTE
CLAYTON
WRIGHT
FRANKLIN
BUTLER
BREMER
HAMILTON
HARDIN
GRUNDY
BLACKHAWK
BUCHANAN
DELAWARE
DUBUQUE
JACKSON
STORY
MARSHALL
TAMA
BENTON
LINN
JONES
CEDAR
POLK
JASPER
POWESHIEK
IOWA
JOHNSON
SCOTT
MUSCATINE
WARREN
MARION
MAHASKA
WASHINGTON
LOUISA
CLARKE
LUCAS
MONROE
JEFFERSON
HENRY
DES MOINES
DECATUR
WAYNE
APPANOOSE
DAVIS
VAN BUREN
LEE

ter wheat but that if it is grown preparation should be made to prevent the distribution of bugs from this crop to other crops which they destroy so completely after the ripening of wheat.

The fact that the area has increased the last year is reason for us to look for a still larger area of injury during the coming season and, since we have many reports of great abundance of chinch bugs in the area covered this season, we feel it a special duty to warn all farmers in the state and especially in all localities where wheat, barley or rye is grown, to take special pains to determine before corn planting what the prospects are for chinch bugs, and to prepare in advance to fight them. If this is done it is certain that much of their injury may be prevented.

CROPS AFFECTED.

The chinch bug works only upon grasses or members of the grass family and it has lately been shown quite conclusively that its ancient home was upon the sandy ridges along seashores and that in these localities it fed upon the wild grasses which grow mostly in tufts and bunches and that it inhabits these the year through. This point in its hibernation is of great importance and we will refer to it again in considering the winter habits of the species. Notwithstanding this maritime habit, the chinch bug has become thoroughly domiciled in the Mississippi Valley and it is not at all improbable that the great increase and destruction it occasions may be due to the fact that it is out of its native habitat where a greater supply of appropriate food without the attendant natural checks, enables it to increase at a prodigious rate.

It may be put down as one essential fact that it feeds by preference upon wheat, rye, Hungarian grass or barley; that it will work in oats when other crops are not at hand and that corn is quite to its taste though it will leave this for fox-

tail grass where that occurs in the same field. Millet and other grasses, even timothy may be seriously injured, but blue grass seldom suffers. Potatoes, buckwheat, beans and other leguminous crops, flax, turnips, mangels, beets and root crops generally, are not affected.

LIFE HISTORY AND HABITS.

This subject has been so thoroughly treated in many papers that are accessible to any one that only the briefest summary, stating facts essential in prevention and treatment, will be given here.

The adult chinch bug is about three-sixteenths of an inch long, black in color and with white wings, upon which there is a prominent black spot on the margin. Bugs surviving the winter deposit eggs on wheat under ground around the roots, during April or early May, the young, hatching, feed on the plants and become partially or some of them fully grown by the time wheat ripens. At first they are light reddish but as they pass successive moulting stages they become darker until when adult they are black except the wings. (Plate II. Fig. 1.)

The adults that mature in July lay their eggs on corn, foxtail, etc., and the young from these eggs develop during autumn, become full grown before winter and crawl away into suitable shelter to hibernate. Just what places they seek will be discussed more fully in the next paragraph.

HIBERNATION.

The chinch bug passes the winter in the adult stage. The usual statement has been that it is secreted under rubbish in fence corners, leaves and thickets, corn stalks etc. Recently Mr. C. L. Marlatt,* Ass't. Entomologist U. S. Dep't. Agriculture, has advanced the idea that hibernation is normally effected in stools of grasses and later Mr. E. A. Schwarz† has given strong proof to show that its ancient home was near the sea coast and that it hibernated beneath the dense stools of grasses.

*Insect Life, Vol. VII p. 232.
†Insect Life, Vol. VII p. 420.

While there is every reason to accept these conclusions as representing the normal or primitive habit of the species, we have yet to bear in mind that in actual conditions here (and of special importance in farm treatment) the tendency of the insect to retire to any convenient shelter must be recognized and kept in mind in planning winter treatment. Aside from hosts of records in various places giving leaves, rubbish, cracks in fences, corn stalks, etc., as places of hibernation, the writer can state from personal observation that they may occur under loose bark of fallen trees and he has published‡ records of their occurrance in Nov. under sods and tufts of grass and also in Dec. in cabbage heads while Mr. Mally has collected them in company with other Lygaeide,—*Trapezonotus nebulosus*, *Lygyrocoris sylvestris*, *Nysius angustatus*, *Geocoris bullatus*—and Hemiptera of other families under a pile of brush in an orchard. During the past four weeks, Nov. and Dec, '95, we have had over thirty letters reporting live chinch bugs in cornfields at time of husking. So many reports in fact that we fear a serious extension of injury another year. It is clearly evident from this that every farmer especially every grain grower should know where to look for hibernating bugs and be able to recogize them certainly when found. While special search should be made in stools of grasses by pulling them up and separating them or beating them over a paper, the examination should include rubbish in hedges, slough grass, leaves and husks on corn stalks and in short any available shelter. All such retreats when practicable should be subjected to fire.

## REMEDIES AND PREVENTIVE MEASURES.

With an insect which has so general a distribution and can survive on so many different crops it is very difficult to apply any one method for control and the idea seems quite

‡Osborn, Bull. Iowa Agr'l College, Entomological dept. 1888, p. 6.

wide spread that it is of little use to adopt preventive measures or attempt to destroy the bugs in seasons when they are numerous. In some localities cultivation of wheat is abandoned simply because it is considered the means of multiplying chinch bugs, the farmer prefering to resort to other crops rather than attempt to contend with the pest. There seems scarcely any justification for this unless other crops can be raised to greater advantage or with greater profit than wheat, for we believe with proper attention to chinch bug seasons and the adoption of known preventive and remedial treatment the chinch bugs may be kept within bounds. It seems to us, however, that in its treatment we must recognize the insufficiency of any one remedy and give the necessary attention to the insect throughout the entire year; that we should become sufficiently familiar with its appearance so that we may recognize it in any locality and be able to determine the fall before what chances there may be for chinch bug invasion the succeeding year. With this knowledge and the adoption of certain simple measures at the proper times we believe that the chinch bug can be controlled and that even where wheat is raised as a continuous crop that both this crop and oats and corn which may be raised on the same farm may be so protected as to suffer very little loss.

Let us consider first the methods of prevention. We have seen that in autumn the chinch bug creeps away into stools of grass, under old corn stalks or rubbish in the fields, under dead leaves and rubbish accumulated under hedges and fences and into the borders of thickets and with the shelter thus secured a large number of the bugs survive the winter. Clearly any destruction of this shelter will affect the survival of the bugs. In the first place if stubble, corn stalks etc., are destroyed the bugs will not find the necessary shelter, and, if this material, and especially the rubbish collected along fences and hedge rows can be burned after the bugs

have gone into it for shelter their complete destruction will result. Where fences border the fields it may be necessary to rake out the grass and weeds so as not to burn the fence and if this is done rather early in the fall the material raked into piles where it can be conveniently burned the bugs will naturally collect in such piles or wind rows of rubbish and firing these late in autumn or early in spring, in case the weather is too damp in fall will be an effectual plan. Where hedges border the fields and it is desired to preserve them, the rubbish accumulated under them should be raked away far enough so that the fire would not affect the hedge and the same method adopted. For much of the state we are inclined to think that the total destruction of the hedges would prove the most salutary measure not only for the chinch bug but for many other insects which are protected by them. If preserved they should certainly be kept closely trimmed and free from rubbish. The bugs move from places of shelter into the fields to deposit their eggs and as a general thing we believe their spring movement is but for a very short distance if food material is at hand, it is possible then for places of shelter which can not be subjected to fire, to so arrange the crops as to be able to control the pest. If wheat or barley is planted directly beside the point of shelter, which will be possible by close watching to detect the areas in which the eggs may be deposited, the radical treatment of these patches may prevent further destruction by the pest. Almost invariably the work of the bugs will appear in certain limited patches either directly contiguous to the places of shelter or in parts of the field which present rather loose dry soil, favorable for the entrance of the bugs. Such areas may be gone over with kerosene emulsion, applying it in such quantities as to thoroughly drench the plants and so that the liquid will soak down around the plants and to the roots so as to come in contact with the old bugs depositing eggs or the young larvae if hatched. Even if the emulsion is applied strong enough so

as to destroy the wheat in these limited patches the loss of a few square rods of the field will be abundantly met by the preservation of the rest of the field and the adjacent corn and oats to which the bugs spread later.

If such large areas are infested as to make the use of kerosene emulsion impracticable or the destruction of the field probable, the whole field or the infested portions may be plowed under, burying the insects deeply underground. To be effectual they should be covered with about five or six inches of earth and the soil of the field immediately rolled so as to pack the earth and prevent their issuing from the ground. A little later this area can be planted to millet, buckwheat or any other crop which will make a growth during the midsummer and autumn.

### DECOY CROPS.

Another plan which may be of very considerable advantage is to plant a small area of wheat or barley, planting this as early as possible so as to be able to furnish an attraction to as many bugs as possible in early spring and other grain crops, oats, millet. etc., if planted, to be planted later. The bugs will then accumulate on this small area and if the season is favorable they may of course so increase there as to make the growth of the crop out of the question and in such case the whole strip should be plowed under or if far enough advanced to burn, it should be mowed close to the ground, allowed to dry for a day or two and then burned and immediately afterwards the strip plowed under, turning the surface to a depth of five or six inches and in this way the great bulk of the bugs on the farm may be destroyed and the other crops protected. The loss of the small patch of wheat thus used as a bait would be a small item as compared with the gain in the protection of other crops while if the season should prove unfavorable to the bugs it might, of course afford a good crop which would repay the trouble involved.

## PREVENTING MIGRATION.

Where considerable fields of wheat or barley are raised and the bugs appear in such numbers along in the season as to threaten adjacent crops, even if they do not destroy the wheat or barley some definite plan to prevent the migration of bugs into oats and corn should be adopted and by the adoption of such methods a large proportion, at least, of the injury can be prevented. If the wheat and barley are nearly ripe they may be cut a little earlier than they would be otherwise and if cut pretty high so as to leave considerable stubble it may assist in further operations. The crop should be removed as soon as possible and as soon as the stubble is dry enough it should be burned to destroy all of the bugs possible. If bugs are moving towards the corn fields a strip can be left adjacent to this in which the bugs can accumulate and then just as it is dry enough cut and burn it as bugs are leaving.

## DUSTY FURROWS.

If these measures are not practicable under the circumstances, the next best plan is to plow a strip a few yards wide between the fields and thoroughly pulverize this with the harrow and then make two or three deep furrors or a series of shallow ones, the sides of which are left sloping and dusty. The shallow furrows left by the harrow teeth are sometimes most effective and if care is taken to have the teeth follow in line such a series is especially good. If the bugs are in such numbers as to pull the dust into these furrows and get the walls hard enough so as to crawl over they should be renewed by drawing a log or a V shaped trough weighted with stones along them, or by repeating the harrowing. The plan adopted in some cases is to make a rather deep furrow as before and at intervals of two or three rods to dig holes into which the bugs will fall as they crawl along the furrow and then occasionally sprinkle the accumulated

bugs in these holes with kerosene or with a strong solution of kerosene emulsion. Another plan which may be adopted even if the bugs have commenced to enter the corn is to plow a furrow and along this lay stalks of corn cut from one of the rows and allow the bugs to accumulate on these for a day or so when they may be drenched with kerosene emulsion. If straw is at hand the sides of the furrow next to the corn field may be covered with a layer of straw and the bugs accumulated under this can be destroyed by burning the straw. The bugs seem especially inclined to gather on broken down and partly wilted corn and it is believed by many that feeding on the wilted corn kills them. It is certain they are decidedly checked in progress by a line of cut stalks and that in some cases they die there in large numbers. Whether this is due to the moisture promoting the spread of disease amongst them or to some possible effect of the wilted food is not yet satisfactorily explained. In some instances there is the probability that this check comes simultaneously with the final moult of the insect and that the insects then scatter. However, the method can be recommended as serving a very useful purpose in protecting the corn beyond the cut row. It is also possible when the bugs are accumulating on corn to use kerosene emulsion as a spray upon the first few rows and in this way destroy large numbers of the pest, much easier of course while yet on first few rows. With any and all of these measures it may be impossible to kill every bug that occurs in sight, but it is easy to see that if only one-half or two-thirds of the bugs are killed that it will make a great difference in the effect upon the corn and this difference may mean all the difference between no crop at all and a fair one or a full average crop. Aside from the work which these migrating insects would do it must be remembered that as soon as mature they deposit eggs and thus immensely increase the numbers of insects to feed upon the corn.

Much interest has been manifested in this method of contending with the chinch bug and experiments with it have occupied a large share of our time the past season.

The disease is due to a fungus which grows in the tissues of the insect and which may be compared with the rust of wheat. It is a living plant organism and therefore must have suitable conditions for growth and material upon which to grow. If this is fully appreciated it is easy to see why it must lie inactive if moisture is wanting, or during cold weather or in the absence of a suitable soil (insect tissues or similar substances) and how it may be killed entirely by too great heat. Moreover we can understand how it will be affected by slight variations in conditions of air, spreading rapidly in moist warm weather and very slowly, if at all, in extremely dry and hot or in cold weather. While developing

Fig. 1. Fungus covered chinch-bugs.
(Original) Enlarged, above, natural size below.

within the insect no signs of its presence are visible unless possibly it shows in the sluggish action of the infested insect. But, with the formation of spores on the outside of the insect, which usually takes place with the death of the diseased bug, the body becomes covered with a fine white mold which under the microscope can be seen to consist of innumerable minute spores formed on whitish threads. The appearance of the dead fungus covered bugs is shown in Figure 1, and where bugs have died in numbers the ground will have the appearance of being covered with little flecks of pure white flour.

Healthy bugs become infected by running over dead or diseased ones, or spores carried by the wind or in the gentle currents of air at the surface of the ground may rest upon their bodies and take root in their tissues. Infection then, depends on conditions favoring the formation of immense numbers of spores. The more numerous the bugs and the more they mingle together the more rapid will be the spread of the disease.

In artificial propagation these necessary conditions are secured by confining a large number of healthy bugs with a few dead or diseased ones and by keeping the box containing them moist within and in a fairly warm place to furnish the most favorable conditions for infection. When scattered in the field these conditions can not of course be preserved. But by breaking down a little patch of wheat or a few hills of corn where bugs are plenty, or even going to the trouble of sprinkling the ground where the infection centers are established, more rapid field infection may be secured.

BEEF BROTH AND CORN MEAL CULTURE.

Early in the season we commenced the use of cornmeal and beef broth as a culture medium for the fungus, using the proportions given by Prof. Forbes. The great difficulty of getting a sufficient supply of bugs from infested places at such times and in such quantities as we needed made this necessary. It was also an important line of experiment in itself. Our success with this method, where pure cultures were used, was everything that could be wished and enabled us to send out to all applicants and to dispense in the end with requests for bugs from outside localities. While it may be necessary to use insects as a medium in order to keep up the virulence of the disease, it is certain that the culture material of one or two removes from the insect will produce the disease in healthy bugs in most active form. In fact some of our most successful distributions were from this culture material. The success in this direction leads us to hope that

with suitable facilities for production on a large scale the disease could be used much more effectively than appears from this season's experiments.

### THE YEAR'S EXPERIMENTS WITH INFECTION.

Infection material was sent direct to 525 individuals and in a few cases a number of packages were sent to certain parties who were kind enough to distribute to farmers in their vicinities. We are especially indebted to Hon. C. M. Dunbar of Maquoketa, and to Mr. W. R. Buchanan of Mt. Pleasant for active help in this manner. We have had so far (Dec 18) reports from 239. Of these thirty report the material unused which leaves 209 that represent actual trial of material. Of these eighty per cent report good success in securing infection of bugs in their infection boxes, with an average length of time of nine days. In the field results there is an almost exact division of one-third of the reports for "successful," "doubtful" and "unsuccessful" result. That is, 33 per cent. report decided success with distinct protection to crops, 33 per cent. are uncertain as to the effect and 33 per cent. report distinct failure.

The publication of the reports in detail is impossible in the space that can be allotted to this paper; but many of them contain very instructive and valuable notes on the use of this material and extracts from a few with some observations that cover a number of the points suggested will be in place.

J. R. MATTHEWS, Salem, Iowa.—"I got some started in three places under corn blades that I piled up but I could not get them to spread."

J. H. MCCORMICK, Tipton.—"The success in the field was poor, if any."

J. N. M. MENSCH, Springdale.—"Had fine success in getting infected bugs in the box. Was unable to detect any success in the field. We had occasional showers during time of experiment. It took about two weeks for the disease to develop in the box. We had two very heavy rains before I had any bugs to put out and the bugs were scattered all through the field and I could not notice much damage done afterward. The bugs were there but the corn was growing so vigor-

ously that they seemed to have no effect. My son says he saw a few infected bugs in the field and as I have not husked that yet, I may find what I have not been able to find heretofore."

WESLEY MEYERS, Winfield, Henry Co.—"By careful observation, I could see no difference in the field. The weather was very dry."

W. J. OLDT, Oakland Mills.—"I had pretty good success in getting infected bugs in infection boxes. Crops were not protected at all. I think if I had got the bugs sooner they might have done some good."

JOHN PRUHS, Lost Nation, Clinton Co.—'I had no trouble in getting infected bugs in infection boxes but had slight success in the field as the damage was mostly done. The bugs, however, seemed to disappear. The weather was warm and dry."

J. Q. POTTER, Davenport.—"Had fair success in getting infected bugs but very poor puccess in the field. It was too late and the weather was very dry."

F. G. BURKHOLDER, Kingston.—"I put infection in boxes as soon as received and then commenced to ditch. I run a ditch along the side of two pieces of corn next to the rye field where the bugs were and then made another ditch out in the corn as far as the bugs had travel ed. The bugs moved mostly in the afternoon. I had straw hauled along the ditch and would burn the bugs from one to three times in the afternoon and succeeded in keeping them from doing any damage to amount to anything. Could have kept them out entirely if we had not had several showers that dampened the ditches so they could crawl over. I had four tenants that made no effort to keep them out of their corn and they lost twenty to twenty-five acres entirely and considerable more was injured."

L. P. BLAKE, Northfield.— 'I placed them in the field immediately and in about two weeks the bugs were all exterminated and they d d me no damage to speak of at the time. In August it became very hot and dry and the second crop of bugs hatched and injured the corn about ten per cent in this vicinity. During the time of the experiment the weather was hot and dry. At present there are plenty of bugs in the cornstalks and in protected places. We are all expecting another raid of bugs next year unless we have plenty of rain at the proper time. If they come again you will have a request from me at once as I have great faith in the remedy."

W. V. BISHOP, Danville.—"At the eighth day they showed the fungus growth and on the ninth day, July 3d, I put about half of them in the field. On the eleventh day, July 5th, after saving a few sick bugs, I put the rest in the field. Up to that time they had literally *taken*, as far as they went, two pieces of corn adjoining wheat. From twenty to thirty rows next to the wheat were as dead as they could be, and I scattered the infection just ahead of the way they were working. In two weeks seventy-five percent of them were gone, I could not at that time find many dead bugs for a good rain had packed the ground and buried most of them. Two weeks afterward, about August 1st, I could only find a stray bug now and then, but by pulling up some of

the damaged stalks I found many perfectly white dead bugs among the roots. From the first of September bugs began to appear again and are now plentiful in the fields although they were too late to do any harm except to dry up the corn. It is my opinion that if I had secured the infection about June 1st and put it in the wheat that the bugs would have done little or no damage. After putting it among them they did not damage five rows of corn. From my experience I would say that if taken in time the damage can be reduced to a minimum if not prevented entirely. If there are any signs of bugs next spring I will call on you about June 1st for another supply and by taking them in time can fix them before they do any damage."

J. A. CUNNINGHAM, Floyd.—"We received the two boxes of infection material the 20th of July. On the 22nd we prepared the boxes, being careful to follow all directions as nearly as possible. The box containing the pure culture first showed the white fungus the sixth day after starting, while the second box showed nothing until the ninth day and never developed satisfactorily. On the 29th of July, or the eighth day, when the first box showed the bugs well covered with the white fungus, they were taken to the field, when we observed that the bugs were not working. The ground and corn were full of them but they did not seem to eat much nor to advance further into the field. In a few days we found a great many dead bugs; some of them, perhaps half, were covered with a white fungus. The disease appeared to have entered the field before the infected bugs were introduced. They gave no further trouble and finally disappeared entirely. During this time we had one or two light showers, enough to moisten the ground slightly. In a field about a mile from us the bugs entered in great numbers and threatened to destroy the corn completely, but suddenly stopped working and dssappeared in the same way. They used no preventative measures whatever. We used several barrels of kerosene emulsion which is sure wherever it touches the bugs but in a forty acre field is rather slow."

IRA LENKER, Maquoketa.—"We placed infected bugs from infection box first started, also bugs from boxes sent by you, in Mr. Current's field. We examined the field from day to day and, wherever there was enough moisture in stalk of corn or soil, after four or five days, lots of fungus covered bugs, dead or alive, could be seen. The conditions in the fields were wholly against good results for the weather was dry as powder. But for all that both Mr. Current and I, after carefully noting all conditions and results, were firmly convinced that with a very little moisture and getting infection earlier good results would surely follow."

Mr. Lenker also reports a general destruction of chinch bugs in that locality but is in doubt whether it was due to introduced material or to a natural outbreak. While the latter is quite possible it is worthy of note that we sent a great

number of packages of infected material to that locality prior to the outbreak and it is quite possible that the general distribution started from some of these centers, being carried by wind to adjacent farms.

Mr. C. A. Harter of Floris did some very successful work with infection material on his own farm and distributed material widely among his neighbors. A statement of his result was given in the Davis County Democrat for July 4, 1895 from which we extract.

"I wish to say a few words to the farmers of Davis county regarding my experience in using diseased chinch bugs to kill the pests. The bugs were very numerous on my farm before I received the diseased ones. On June 8th I received from Prof. Osborn of the Iowa Agricultural College at Ames, Iowa, one-fourth teaspoonful of the diseased bugs. It took about one week to get the healthy bugs infected-but since that time the disease has spread very rapidly, crossing a trench and plowed ground and infecting another field. The dead bugs covered with the white fungus lie thick all over the ground. My field of corn that was covered with bugs one week ago is nearly free from them now and is again growing nicely.

Anyone wishing to get a supply of the diseased bugs can gather them up in my field with little trouble and no expense. My advice to farmers is to try this experiment as it has proved successful in my experiment and it will pay well for the time and trouble."

Some parties were evidently disappointed with the small amount of material received, apparently not realizing that a single diseased chinch bug or a small particle of the culture material bearing the living spores of the fungus would be just as effective in infecting a box full of bugs as one hundred would have been.

Much difficulty is reported in keeping the bugs in the infection boxes. The use of chalk which we recommended in one set of instructions proved unsatisfactory in some hands. Some boxes which we personally inspected were guarded in this way with good success. So far it seems, however, that the best success in this regard is secured with a perfectly tight box with a lid free from cracks and the joint between the lid and box made tight when lid is closed with a strip of

cloth tacked along the inner edge of the box. The bugs that collect on the lid may be jarred down before opening the box and the rest brushed with a wing or whisk broom.

Many report no success or a doubtful result and at the same time say the bugs were carried away by rain or wind or disappeared. In some of these cases the bugs may have become diseased as in such cases they are apt to crawl under clods or into the ground before dying and so disappear from view.

A number report the appearance of the disease in adjacent fields sometimes before and sometimes after the artificial introduction. In many of these cases (in all of course, where it preceded the introduction) there can be no question that the disease broke out independently and it should be remembered that it is from this source that the disease was secured for artificial propagation and distribution. All that we can do is to distribute it in localities where it is not present or by artificial culture so increase the area of its activity as to make it of practical service.

It is evident that, even with practically identical external conditions, there is a great difference in the activity of the disease, a difference that must be attributed to varying activity in the growth of the fungus and a variable resistance to it offered by the chinch bug. This being recognized we cannot be surprised at the great difference in results reported even from adjacent farms. No doubt some of this difference may be due to treatment in different hands and that with more exact knowledge of the most favorable methods better result may be uniformly secured.

Whether to consider the year's work as a whole a success or not depends upon the point of view. For the considerable number of farmers who succeeded in destroying the bugs promptly and who saved considerable portions of their crops as a result of its use it certainly paid. If some who used it depended upon this remedy to the neglect of measures that

might have been more successful it was no doubt a detriment. The rational view seems to be to consider it as one available means of fighting this most pernicious insect to be used when conditions permit and with every known means to make it successful, to adopt at the same time, if necessary, such other measures as may be practicable to prevent loss in case unfavorable conditions render the disease entirely inoperative.

We have at no time advocated reliance upon this method to the exclusion of other methods of warfare. We have carried on the work the past two years purely as an experiment to determine results under conditions prevailing in this state and to meet the demand which has naturally come from the infested localities.

### RECOMMENDATIONS FOR FUTURE WORK.

In view of the experience of the year, we believe that it will be a much more successful plan to grow the infection material in large quantities at the central station and send enough to each applicant to make an immediate distribution in the fields. This will save from ten days to two weeks that usually passes between the time that the infection material reaches the farmer till the fungus is sufficiently developed in the box for him to be able to make a field distribution. This two weeks may often mean the loss of much of the crop or the missing of a few days of moist weather that would favor the spread of the disease.

It is, however, out of the question for this section of the Experiment Station to bear the expense of making cultures on such a scale as to distribute material in this manner. The cost of beef and corn-meal to make the preparation on a large scale is in itself something of an item of expense, but the attention of a thoroughly competent person is a much greater item. I see no way out but to ask that the state give some support to such a method of distribution. The only other plan open would be to put the matter in the hands of some

one competent to manage it and then to charge the applicants for material a sum sufficient to support a station. This, however, would have the objection that such support would be uncertain and material might be wanting when most needed, and, moreover, parties not inclined to contribute to such expense would depend upon their neighbors getting material the benefit of which would come to them as the infection spread. This method is one in which there should be community of effort. As the introduction of the disease on one farm, if successful, will benefit all the farms in the neighborhood it would seem entirely proper for the work to be provided for by the state. Kansas, Nebraska and Illinois are supporting such work liberally. With the prospect of much greater wheat production and of constant danger from chinch-bug invasion it may well have such support here. With such support it would be possible to keep a supply of freshly prepared infection material constantly on hand at the Central Station, to arrange for sub-stations in specially infected localities, to inspect and determine in advance the prospect of chinch-bug injuries and arrange to send full supplies to farmers in such localities, or specially trained agents to make the distribution in the most favorable positions so as to secure the best conditions for the spread of the disease and to perfect details of management. At the same time it would be possible to encourage other preventive measures in seasons unfavorable to spread of disease and to make more extensive experiments and investigations in methods for the suppression of this pest.

### INSECTS RESEMBLING THE CHINCH-BUG.

In determining the prospects for chinch-bug injury in the future it is essential to distinguish this species from a number of other insects which resemble it so closely that they are frequently mistaken for it.

Of the species that may be confused with it, even by per-

sons quite familiar with its appearance, the false chinch-bug, the *Trapezonotus* and the *Peliopelta*, are perhaps most frequently received. In order to furnish every reader of this Bulletin a certain means of determining whether the bugs he finds in the winter retreats are chinch-bugs or not, we have prepared figures, not only of the chinch-bug, but of a number of the forms most frequently met with in similar places in this state. All these figures are enlarged considerably, the true length being shown by a fine line at the right of the drawing. It will help a great deal if, in examining specimens, a small hand lens is used (Lenses magnifying abundantly can be bought for fifty cents to one dollar.). By careful examination of the inectss without any lens or with a pair of strong spectacles the points of difference shown in the figures may be seen.

To further assist in this direction let us note the most important points, referring to a fuller description of the chinch-bug in a preceding paragraph for additional characters.

Chinch-bug: (Plate II Fig. 1.) Length, three sixteenths of an inch, black, wings white with black spot on margin; body covered with fine hairs.

False Chinch-bug, Nysius angustatus (Fig. 2, plate II.): Same size as Chinch-bug; gray; wings white with some dark dots, but no heavy black spot; very scantily haired. This species is in size and shape almost like the Chinch-bug, but its light-gray color will always distinguish it. The young (Fig. 2.), which often occur in great numbers in autumn, are lighter and broader than similar stages of the chinch bug. It often swarms in immense numbers under purslane, Amaranth, etc., and has been reported as damaging apples and potatoes, but it has been shown* that it lays its eggs and feeds normally on Amaranth. In general it need not be counted injurious.

*Osborn, Report U. S. Dept. Agriculture for 1887, p 162.

The long chinch bug (*Ischnodemus falicus*, Say) (Fig. 3, Plate II) about as wide as chinch bug but very much longer and the sides parallel. This species feeds on grasses and sometimes becomes quite numerous in low ground but has never been known to occasion a devastation.

*Ischnorhynchus didymus* Zett (Fig 4, plate II). This is a light tawny species with a rather broad body and very glassy wings. Seldom very abundant.

*Peliopelta abbreviata.* (Fig. 5, plate II). Very similar in proportions and color to chinch bug and one of the species most easily mistaken for it. It often occurs in considerable numbers in similar locations. It is however thicker, the head broader and the wings shorter, usually very short, but we have found occasional specimens with well developed wings so it may be considered as having a short winged and a long winged form.

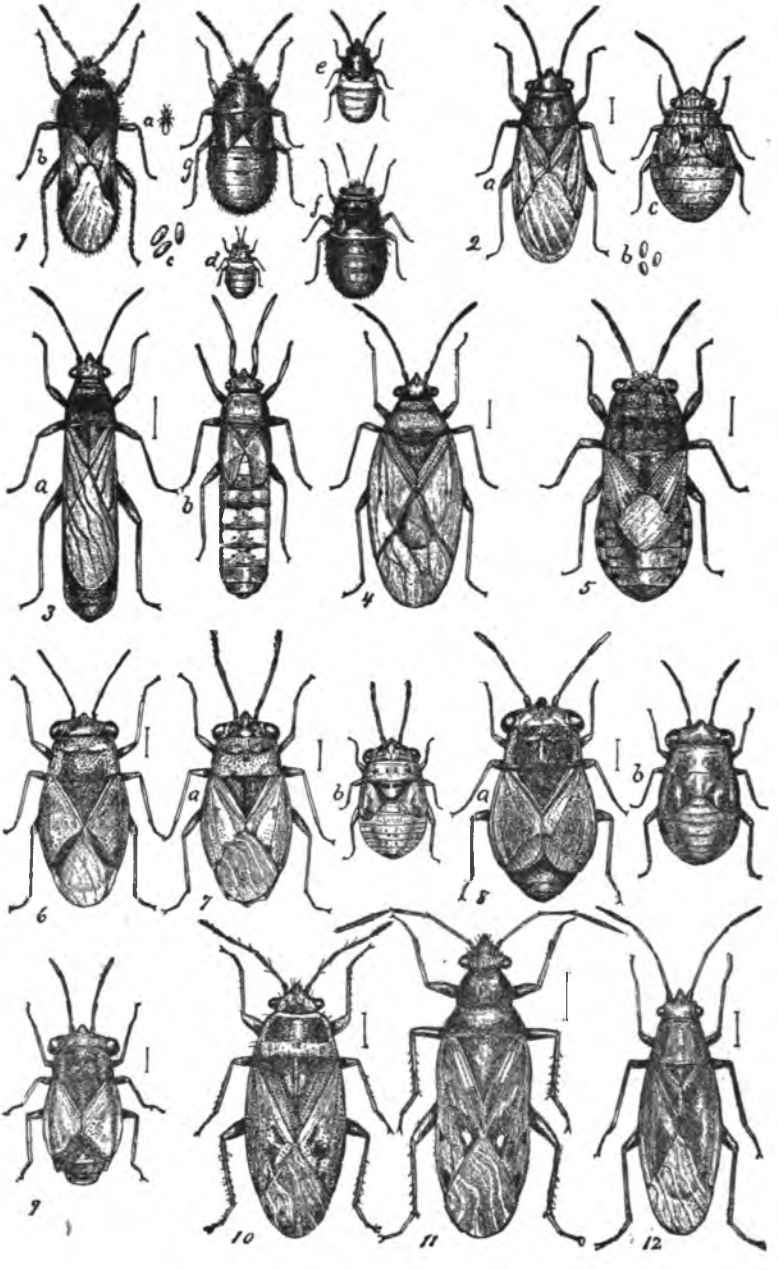
*Geocoris* sps. (Plate II) The common species in this state are borealis, Fig. 6; fuliginosus, Fig. 7; bullatus, Fig. 8 and limbatus, Fig. 9. All can be distinguished from the chinch bug by the broad rather flat body and the very prominent out-standing eyes.

*Ligyrocoris sylvestris L.* This species is considerably larger than the chinch bug, the front part of the body more slender and the wings quite dark.

*Trapezonotus nebulosus.* (Fig. 11, plate II). A trifle larger than the chinch bug, not so black, with body broader, the front portions with a sharp edge.

*Cymodema tabida, Spin* (Fig. 12 plate II). This is light brown in color, a trifle longer than the chinch-bug and the ends of wings glassy.

PLATE II.



## SUMMARY.

1. The area of chinch bug injury has increased the past year and from present indications there is every probability of more extended and serious injury another year.

2. Chinch bugs winter in stools of grasses and also in rubbish along fences and in corn fields.

3. The prospects of chinch bugs for the coming year should be determined in each locality by carefully searching for hibernating bugs and determining positively as to their identity.

4. Measures of control should consist of destruction by burning during hibernation; arrangement of crops with sacrifice of decoy crops or small patches of infested fields; early cutting with burning or plowing of stubble; maintenance of barriers between wheat, barley or rye and oats or corn; use of fungus where possible.

5. The white fungus disease has this year been considered of value in 33 per cent of the cases reporting, with a doubtful result in as many more. By earlier and more complete distribution it is probable that it may be made effective in a larger per cent of cases in the future.

NOTE—While the foregoing notes omit comparisons with results in other states or reference to them we would by no means ignore the valuable work done in late years, especially by Professors Forbes and Snow upon the subject of insect diseases. The purpose of this paper however is to give a faithful account of results here and not to enter upon a full discussion of the subject.

## *The Four-Spotted Pea Weevil.*

### (*Bruchus quadri-maculatus, Fabr.*)

This species is rapidly coming into prominence as a pest in the northern states. It has been known to occur in the southern states, being reported as occurring in "black-eyed table beans" from Texas exhibited at the Atlanta Cotton Exposition in 1885 (Insect Life, Vol. V, p. 165.) During the World's Fair it was reported as "swarming in beans from Brazil and Venezuela," being one of the many economic insects found to occur in the agricultural exhibits. Later on in the same article the late Dr. Riley, speaking of the economic importance of the listed pests, in summing up those in the family Bruchidae (Bean Weevils) said: "Those most to be feared are *B. 4-maculatus* and *B. chinensis*, both already introduced, but as yet limited to the more southern states." Since then the first named species has been introduced into Iowa.

F 2.—Bean Weevils, and beans, showing eggs on surface and the holes eaten by weevils. (From photo.)

#### APPEARANCE IN AMES.

It was first reported as being very numerous in some whip-poor-will peas and black cow peas purchased in Virginia in the spring of 1895 and kept in the seed room of the ex-

periment barn. Further investigation showed that it was not confined to the peas, just mentioned, but had spread to a number of other varieties of peas and beans kept in the same room. On examining the whip-poor-will peas in the field quite a number were found to be infested. Mr. E. D. Ball also reports finding one specimen in a patch of white field beans Sept. 19, 1895.

A number of peas were isolated Oct. 27, and over two per cent were found to be infested, counting only the adults that had actually issued up to date, Nov. 29. There are some pupae yet in the peas, perhaps enough to raise the number infested to three per cent. The adults that issued from the peas just mentioned had already deposited numerous eggs.

LIFE HISTORY.

In the seed room the development is as follows: The eggs are deposited on the surface of the peas and beans and held very firmly by means of a transparent glue.*

In about two weeks the eggs hatch and the larvae, without loosening the egg shell, eat through it into the peas and as they advance fill the egg shell with fine borings so as to give themselves more room and perhaps help furnish protection from outside influences. The newly hatched larva is very small and the opening made by it as it enters the peas is so small that it would scarcely be noticed without the aid of a lens. The exact time required for the different larval stages cannot be stated as yet; but the adult appears in about eight weeks after the deposition of the egg. They do not appear in distinct broods but can be found throughout the year in all stages from egg to adult. During the winter months they are undoubtedly checked, but make some progress as is indicated by the fact that the adults are very active on an occasional warm day.

*In the quotation from Insect Life given in the next paragraph, the eggs are said to be deposited *in* the beans, but we have proved by actual observation that they are deposited on the surface, as shown in photograph reproduced. Fig. 2.

In the sacks kept in the seed room they preferred to work near the surface; the peas at the bottom being only slightly injured while those on top were entirely ruined.

No direct observations concerning the development in the field are on record for this species. In the article "On the Nomenclature and on the Oviposition of the Bean Weevil" (Insect Life, Vol. V, p. 32) reference is made to the possibility of the work of B. 4-maculatus Fabr. in the field being mistaken for that of B. obtectus, Say. In the discussion of the oviposition of the various species we find the following statement:

"We were thus forced to the conclusion that there was some other species working upon beans in the field, as we know there are other species working upon stored beans. Thus we received in January 1885 *B. 4-maculatus* Fabr., swarming in what are called "black-eyed table beans" from Texas which were exhibited at the Atlanta Cotton Exposition. In oviposition in the stored beans this species differs from the common bean weevil under discussion in that it deposits its eggs in the beans. We have also received an allied species, *B. scutellaris*, in 1885 from F. M. Webster, breeding in beans at the New Orleans Exposition. It is more than probable, therefore, that the eggs that are attached externally to the pods of beans in the field belong to one or the other of these last mentioned weevils and in fact they compare in form and color to those of *B. 4-maculatus* Fabr."

The above is the only reference to its deposition in the field that we have. As the presence of this pest was discovered so late in the season we have no field observations with reference to oviposition. It is quite certain, however, that the eggs were deposited by adults that were taken to the field with the seed or else migrated thither from the seed room.

A large number of whip-poor-will peas in the field were examined Oct. 27. Most of the larvae had then changed to pupae and some of the pupae were just transforming to adults. As the peas ripen in this locality before October 27, they will already be in the granary before the adults issue and thus secure an easy spread of the weevils during the winter and early spring.

Egg. (Fig. 3, c) Freshly deposited egg glistening white, transparent. □Usually slightly pointed at one end and broadly rounded at the other. Length, .56mm. width, .35mm.

Larva. (Fig 3, b) When first hatched the larva is of a whitish color except the head which is dark brown. The legs are present. After the first moult the head is lighter, less conspicuous and capable of being slightly retracted. Body largest at middle, tapering gradually to posterior end, segments more distinct.

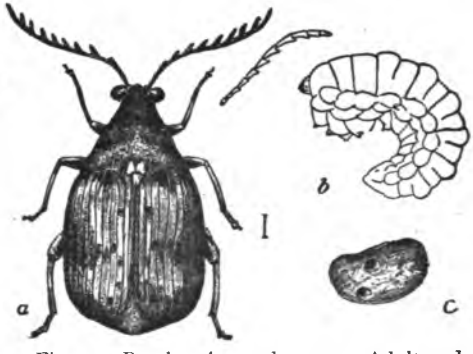



Fig. 3. Bruchus 4 maculatus. *a*, Adult. *b*. Larva. *c*. Bean with eggs and holes eaten by weevil. (Original, from drawing by Miss King.)

Fully grown larva 3-16 inch long, creamy white, body largest at middle, tapering gradually to posterior end, segments conspicuous, each one with a slight fold in the middle; thoracic segments somewhat smaller than the abdominal segments; legs on prominent mammiform protuberances each of which terminates in a small tubercle-like portion showing indications of a joint in the middle. Head visible, but not especially prominent, dark brown. Body without bristles.

Pupa. (Fig. 4). Same length and color as fully grown larva; wing pads large, prominent, showing striations same as in adult: legs comparatively large showing segments of tarsi; antennae conspicuous, folded backward and just over the basal part of wing pads; joints distinct for both male and female; abdomen showing four segments.

Adult. (Fig. 3, a.) The adult is comparatively small, head black, eyes globose, conspicuous; antennae prominent, reddish at base; thorax grayish black with two oblong gray-

ish elevations at center of base just in front of small light colored scutellum; elytra striate, sometimes with two short white lines on either side near the middle and with a dark red or black spot at the middle of the exterior margin, tips black. Tip of abdomen capable of being extended or drawn downward and forward, sometimes grayish, sometimes darker with two especially dark spots on either side usually separated by a light longitudinal line; legs reddish.

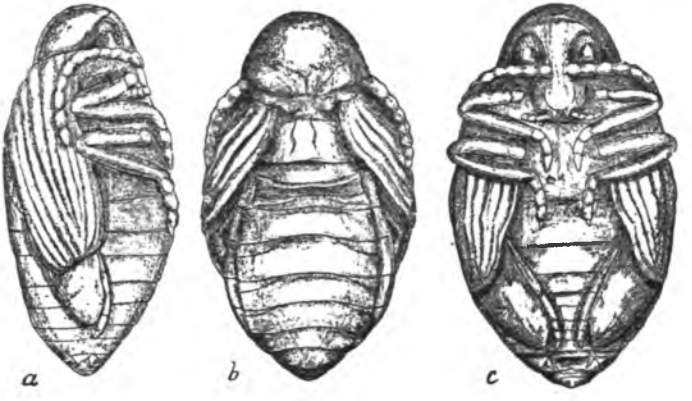



Fig 4, B. 4 maculatus. Pupa. *a*. Side view. *b*. Dorsal view. *c*. Ventral view. (Original, from drawing by Miss King.)

The color markings vary considerably, some individuals being almost uniformly reddish brown. Male, smaller than female, antenna large, serrate; female antenna gradually enlarged toward tip, serrations only slightly indicated.

### EXPERIMENTS WITH CARBON BISULPHIDE.

The value of carbon bisulphide treatment for grain insects is well known, but the actual record of work under the conditions presented in this case and for this particular species seems worthy of brief statement.

The room in which the weevils were found was not filled with grain but was especially arranged for keeping seeds for experimental purposes. Hence it cannot be stated that the results obtained would hold exactly for the same room

filled with grain. However, the results were practically the same as those reported by experimenters supposed to be working with bins and cribs full of grain. The room would hold about 1150 bushels. According to the usual recommendations this would require 11 to 12 pounds of carbon bisulphid. The amount actually used in this case was 13½ pounds.

The infested peas and beans were placed in a tight box covered with heavy blankets and under these was placed an amount of carbon bisulphide in proportion to the space occupied. This precaution was taken so that in case the fumes escaped from the rest of the room the most badly infested seeds would still be in the fumes. The rest of the bisulphide was poured into shallow vessels and placed near the ceiling in different parts of the room and left for 24 hours. Although the doors and windows had been previously packed with cotton and strips of cloth, a slight odor of carbon bisulphide could be noticed outside during this time.

On opening the door, there still remained one pound and ten ounces of the liquid, thus making eleven pounds and thirteen ounces the total amount evaporated.

A few live weevils were found on the edges of the shelves. They were not protected in any way, but probably dropped from places of concealment in the ceiling a short time before doors and windows were opened. A few days later examination showed that the destruction was quite complete except the few mentioned above. In a few weeks, however, the weevils were observed to be more numerous than they were a few days after treatment. Frequent examinations showed that they were gradually increasing. A month after the first treatment it was considered best to treat them again with about the same amount of carbon bisulphide but to prolong the time to thirty hours. The detail of the experiment was just as before except that fifteen pounds of carbon bisulphide were used and placed in a larger number of shallow

pans so that it was not more than one-fourth to one-half inch deep in any pan. On opening the room at the end of this time the weevils were all apparently dead. They were examined about a week later and only a very few live weevils could be found.

EFFECT ON THE LARVAE AND PUPÆ.

A quantity of whip-poor-will peas was isolated soon after the first treatment for the purpose of noting the effect on the eggs that had been recently deposited and also on the contained larvæ and pupæ. Although none of the pupæ examined immediately after treatment were alive, yet at this date, Nov. 29, some adults have emerged, deposited eggs and died; others still alive and depositing eggs and still others ready to emerge from the peas. As the jar was kept carefully closed these weevils must have been preserved alive in the peas. However, since specimens of larvae, pupae and newly formed adults were found dead in the peas, their survival must depend on the amount of injury to the peas and whether the pellicle has been sufficiently loosened by the adult to admit the fumes. We therefore conclude that for carbon bisulphide to be effective for *Bruchus 4-macultatus* there must be a second treatment about three or four weeks after the first, and this probably followed by a third about three or four weeks after the second.

EFFECT ON THE GERMINATION OF THE SEEDS.

To determine the effect on the germination of the different kinds of seeds in the seed room, two sets of seeds were germinated at the same time and under the same conditions. The first set (marked "check") were taken from the seed room before the fumigation. The second set (marked "exposed" were taken from the room after the fumigation. The following table shows the results:

| NAME | No. of each Planted | | Germinated | | Dif. in favor of | Dif. in favor of |
|---|---|---|---|---|---|---|
| | Check | Expo'd | Check | Expo'd | Check | Expo'd |
| Keyusunke Soy Bean | 50 | 50 | 36 | 32 | 4 | 0 |
| Yellow Soy Bean | 50 | 50 | 45 | 37 | 8 | 0 |
| Horse Bean | 23 | 23 | 23 | 23 | 0 | 0 |
| Rennie's Green Field Peas | 50 | 50 | 50 | 50 | 0 | 0 |
| White Field Peas | 50 | 50 | 44 | 49 | 0 | 5 |
| Black Cow Peas | 50 | 50 | 2 | 4 | 0 | 2 |
| Whip-poor-will Peas | 50 | 50 | 0 | 0 | ..... | ..... |
| Wheat | 50 | 50 | 47 | 48 | 0 | 1 |
| Corn | 12 | 12 | 12 | 12 | 0 | 0 |
| Sunflower Seed | 50 | 50 | 50 | 49 | 1 | 0 |
| Total | 435 | 435 | 309 | 304 | 5 | 0 |

It will be seen that the horse beans, Rennie's green field peas, corn, wheat and sunflower seed germinated almost perfectly. The black cow peas and whip-poor-will peas were almost a total failure, in both cases, probably due to the fact that they had been almost entirely destroyed by the weevils; in many cases only the seed coat and a few fragments of the cotyledons being left. In the others the germination was somewhat variable. Taking them collectively, there is a difference of five in favor of the check, indicating slight injury by the treatment. But, considering the total number germinated, the low percentage of germination in some and the fact that three cases indicate an increase of germinating power, this slight difference has little weight either way. Similar sets of seeds germinated after the second treatment show practically the same results. So we may conclude that the germinating power of the seeds was not impaired.

### DIFFERENT SEEDS AS FOOD FOR THE WEEVILS.

As there was quite a variety of seeds in the room it was necessary to determine whether the weevils can live in anything but peas and beans. Consequently some of the adults were placed on a number of different seeds with the results shown below.

Including the "black-eyed table beans" (cow peas being included in the experiment) mentioned in Insect Life, Vol. VI, p. 165, they lived in the following seeds: "Black-eyed

table beans," black cow peas, whip-poor-will peas, white field peas, Rennie's green field peas, horse beans and keyusunke soy beans.

They did not live in the following: Yellow soy beans, corn (common yellow dent), wheat, clover, cane and sunflower seed.

In the yellow soy beans it is quite probable that a few mature, for a number of beans have been found in the seed room showing an opening similar to the ones made by the weevils in the whip-poor-will peas. But in all the specimens of this, as well as of the other seeds in the last list, examined the contained larvae were dead, only having entered the seeds a short distance and they probably never survived the first moult.

From this it is quite evident that in stored grain they are confined to peas and beans.

SUMMARY.

(1) This species is liable to be introduced into uninfested localities and prove to be a serious pest. Therefore seedsmen should be very careful not to send out infested seeds.

(2) Its development is very rapid, the adults appearing in about eight weeks after the eggs are deposited.

(3) The contained larvae, pupae and newly formed adults are not all destroyed by bisulphide, their survival depending on the amount of injury already done to the peas or beans.

(4) For carbon bisulphide to be effective there must be two or three applications about three or four weeks apart.

(5) The weevils will apparently thrive in any of the peas and beans, but not in other seeds.

(6) The germinating power of the seeds was not impaired by the fumes of the carbon bisulphide.

# On the Early Stages of the Imbricated Snout Beetle.

(*Epicaerus imbricatus* Say.)

While this species has been recognized as a pest since its first economic treatment by Walsh in 1863, our knowledge of its life history has remained as meagre as at that time, nothing being known as to its early stages, except the record of egg laying by Prof. Forbes.

This led us, on receiving specimens of the beetle with the report of their injury to strawberry plants, to attempt their breeding upon this food plant. While we did not succeed in tracing the full history of the species the securing of eggs and the partial development of the larvae and the possibility that this clue may assist in the further elucidation of its history is our excuse for presenting this fragmentary account.

On May 14th, 1895, the adults were placed on a strawberry plant having three or four open leaves and a number of small berries. They immediately crawled up the stems and soon began feeding upon the leaves, cutting a crescent corresponding to a line described by the end of the snout. The crescent was apparently quite uniform but soon became irregular when the beetle had to move in order to reach the tissue; so in reality there is no regularity in devouring the leaf and finally nothing is left but the veins and a few angular fragments of leaves. By the following day the effect on the leaves was quite apparent, the beetles eating rapidly and by the 20th the leaves were all devoured except a few, dry, curled pieces and the stems. They did not attack the berries but in some cases ate the sepals at the base.

The beetles began pairing the first day and continued for five or six days. No eggs were observed till the 21st when a number of small, white, glistening eggs were found under a fold of a leaf and as no folded or dry leaves had been left on the plant these eggs had certainly been deposited by the *Epicaerus*. On the 22nd another leaf containing eggs was

found and these with those previously found were placed by a fresh leaf that had been carefully freed from all matter that might possibly contain eggs of other species and the beetles removed to avoid possibility of their injuring the egg. The eggs appeared in all cases to be protected by a fold of leaf carefully glued down.

Fig. 5. *Epicaerus imbricatus* eggs. (Drawn by Miss King.)

Forbes* says of *Epicaerus* that they "were found by experiment to feed freely on pear leaves, and also to lay their eggs upon these leaves, concealing their deposit by gumming another leaf to the surface."

The eggs are 1.3 mm long glistening white, nearly cylindrical, sometimes very slightly curved, the ends broadly rounded, the surface smooth, transparent and the shell very thin.

The first larvae to hatch escaped before being seen, the empty shells being first noticed on the 30th. Hatching therefore occurs within ten days from time of deposition. Other eggs isolated and kept under close observation showed that the larvae immediately work their way into the ground and these observed in root cages, during the following three weeks, could be seen to move about among the roots and as they very evidently increased in size and appeared to thrive it is safe to say that they fed upon the roots of the strawberry plant.

The death of the plants in the root cages and loss of the larvae unfortunately brought the observation to an end.

* 16th Report State Entom. Ill., p. 76.

The young larvae are two mm. long without any trace of eyes or legs. They are yellowish white in color, the head from above oval with a few strong bristles and the mandibles very conspicuous. The maxillary and labial palpi are short, stumpy and in the living larvae stand out rather prominently from the underside of the head. The body segments are provided with a few small hairs.

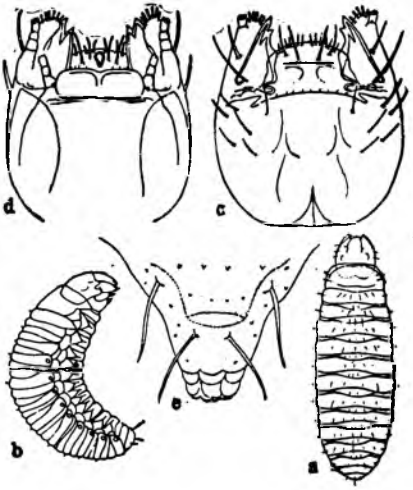



Fig. 6. *Epicaerus imbricatus*. *a*, *b*, Young larva, back and side view. *c*, head above, *d*. head below, *e*, terminal segment. (From drawings by Miss King.)

Adult beetles have been observed in autumn, as early as August, but the probability is that only one brood occurs each year, the adults surviving the winter.

This fragmentary result enables us to say with certainty that the eggs are deposited in dry and folded leaves of the food plants of the adults and that the larvae immediately enter the ground to feed upon the roots. To this extent they show what measures of control must be adopted for this insect.

Evidently spraying the plants with an arsenical solution should kill the adults before egg deposition has taken place and should operate as a check on the increase of the species.

The literature upon the species, which is considerable, includes reference to its feeding upon the following plants: apple, cherry, gooseberry,* cabbages, corn,† onions, radishes, beans, watermelons; musk melons, cucumbers, corn, beets,‡ potatoes‖, pear, grass.§ It would seem a little strange if the strawberry, which seems not to have been recorded heretofore as a food plant, should prove to be the food plant of the larva.

The past history of the species indicates that it is subject to great fluctuation in numbers so that it hardly seems probable that it will become a permanent scourge. If increasing at any time to injurious numbers the treatment suggested above applied to whatever food plants it may be injuring or the adoption of collecting by hand where they occur on plants that can be shaken would serve as an efficient check.

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## *The Ground Cherry Seed Moth.*
## (*Gelechia sp.*)

Every season some new pest appears, either an entirely unknown insect, one that has heretofore been harmless or one that by attack on some new food plant becomes especially important.

The insect under treatment seems never to have been noted as injurious if indeed it has been recognized and described scientifically.

Our attention was called to it by Dr. J. C. Milnes of Cedar Rapids, who reported it as very destructive on Wild Ground Cherries under cultivation; writing further, that this cherry being very prolific and of excellent quality would be a

*Riley 3rd Mo. Report p. 58. †Riley, Amer Ent., p. 260 ‡Dept. Agriculture for 1879 p. 249. ‖Weed, 13th Report Ohio Exp. Station p. 122. §Forbes 16th Report State Entomologist Ill., p. 76.

desirable garden plant were it not for the great injury from this pest. The specimens sent contained the insect in the pupa stage.

"This cherry makes very fine preserves, as I have occasion to know, and it is a prolific bearer as you can see. A moderate estimate of yield would be 400 bushels per acre under cultivation and if cultivated would prove quite an article of commerce. I presume it would take a little while to introduce it and thus create a demand for it, but if this destroyer can be successfully combated, I shall try some as a crop for experiment."

Cultivated ground cherry at Ames suffered from similar attack, and the pest seems likely to occasion much loss.

Examination of Wild Ground Cherries in the vicinity of Ames revealed a considerable injury from the pest and steps were taken to secure the early stages and determine as fully as possible the habits of the insect.

Out of one thousand berries examined one hundred and thirty, or thirteen per cent. were infested. All of these infested berries contained the pupae enclosed in a white silken cocoon which filled most of the cavity of the berry, the seeds being entirely devoured. Near the stem end of the berry and opposite the head of the pupa was an opening presumably prepared for the emergence of the moth.

Observations on these berries would favor the conclusion that the larvae develop within a single berry, no injured berries being found which did not contain pupae. However, two berries were found with an opening on the side and containing well developed larvae with very little of the inside of the berry devoured, suggesting that the larvae under exceptional conditions migrate from a berry of insufficient food material to a fresh one.

But very few larvae were found and these during the last week in September. They were at that time mature and apparently ready to pupate; so of the early molts and even of the full grown larvae we can not give a satisfactory description. Those observed were rather contracted, spindle-shaped,

whitish, with a reddish brown head, sparsely haired.

Pupation occurs during last two weeks of August and is in nearly all cases completed by the last of the month.

The pupae are dark brown six mm. long and no distinctive characters that would separate them from related species were detected. The cocoon is thin but of tough, close woven silk. In forming the cocoon the larva attaches itself to the blossom end of the berry by means of the caudal prolegs and then builds the cocoon which practically fills the cavity of the shriveled berry.

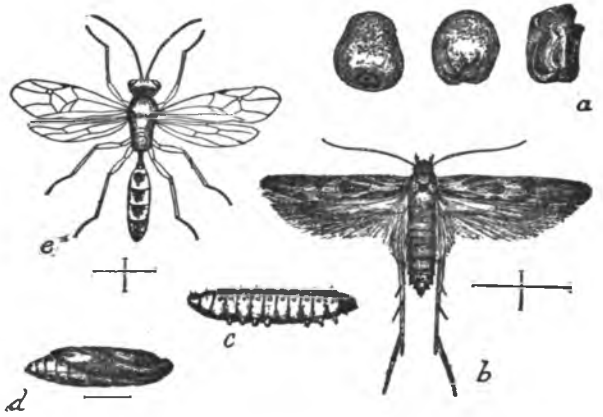


Fig. 7. (*Gelechia sp.*) *a*, injured berries. *b*, moth. *c*, mature larva. *d*, pupa. *e*, parasite *Centeterus suturalis*.

Moths first appeared October 3rd, so the period of pupation may be stated as from two to three weeks.

The moth shown at *b* in Fig. 7 is of a gray color with darker spots on the wings. It closely resembles *G. quercifoliella.*

Out of the one hundred and thirty berries containing pupae mentioned above we secured four specimens of moths. This low per cent. of adults is due to the fact that a large proportion of the pupae, over 100, were destroyed by a fungus, apparently quite similar to Sporotrichum, and of the remainder a number were attacked by a Hymenopterous parasite (*Centeterus suturalis Ash.*) seven of which issued prior to September 24th.

The fungus was not observed to attack healthy berries always making its appearance after the hole had been made near the stem and while it seemed to develop in the tissues of the berry there seems scarcely any doubt but that it is a parasite of the insect. Some of the Hymenopterous parasites issued from berries showing fungus growth so that it would appear possible for these to resist the fungus even when pupae were infected with it, that is, supposing the fungus to infest primarily the *Gelechia*. Doubtless a parasitized larva would be a more easy victim of fungus attack.

The appearance of moths so late in the season, the impossibility of their producing another brood and the improbability of their depositing eggs in any situation where they would winter and assure the larvae access to their food plant the following spring almost forces us to the conclusion that the moths hibernate and deposit eggs when ground cherries bloom the following season. This view is strengthened by the fact that a specimen has been captured in an office room of one of the college buildings Dec. 7th '94. Nevertheless so long an existence of the adult for so delicate a lepidopterous insect seems doubtful and the possibility of some pupae hibernating or of a spring brood of larvae, even in some situation different from the berries of *Physalis*, must not be overlooked.

This species, as already intimated, very closely resembles *G. quercifoliella* and it was so determined with some doubt by Mr. Marlatt from specimens sent to Washington for identification. The fact that it affects a totally different plant indicates it to be quite distinct from that species. It is certainly different from *physaliella* as described by Chambers and has a totally different larval habit, that species being said to mine the leaves of *Physalis* in September, to pupate in leaves and rubbish on the ground and to issue as adult in April. Still another species described as *Physalivorella* was thought possibly to represent our form though no record of its larval characters or habits were accessible. Mr. Marlatt has how-

ever kindly compared our specimens whith three specimens of physalivorella in the National Museum and states "these are very distinct from your specimen." "The latter agrees quite well with G. quercifoliella but may be a distinct species."

From this it seems most probable that this insect is undescribed but we prefer to leave the technical description to some specialist in this group of delicate and interesting moths.

TREATMENT.

Apparently the most effective remedy for this species would be the destruction of the larvae or pupae during autumn. The infested berries could be gathered up and deeply buried, fed to hogs or otherwise disposed of. The fungus and parasite already mentioned may prove sufficient to keep them in check.

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## *The Cosmos Weevil.*

### (*Baris confinis Lec.*)

This weevil, Fig. 8, was found Sept. 1st 1895 to work very extensively in the root-stocks and the base of the larger branches of *Cosmos bipinnata* causing the ultimate destruction of the plant. The presence of the insect is first manifested by

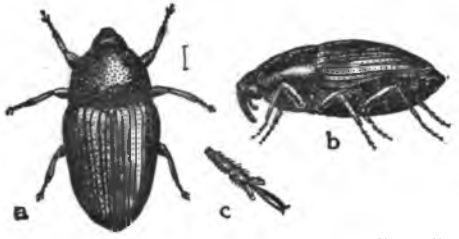


Fig. 8. *Baris confinis.* (Drawn by Miss King.)

the breaking off of the larger branches. By examining the base of these branches, and especially the root stock, it will be found that numerous white larvae and pupae about one eighth inch long are present and working in the woody tissue of the plant. They make small tunnels packing the borings around them much as does the Potato Stalk weevil. They pupate in these tunnels and emerge as a small black beetle.

The adult when first formed is white and takes on the black color gradually beginning on the head and thorax and then extending backward to the scuttellum and base of elytra and then gradually over the whole body.

The adults are quite active but drop to the ground as soon as disturbed and remain very quiet for some time.

Specimens of the adults kept on plants under observation in the laboratory worked in the young tender tissues, either eating into the terminal portions or into the stems at the axils of the leaves, almost burying themselves and finally causing the small leaf or branch to break down as do the larger branches. They were not confined entirely to the parts just mentioned but would eat into the little leaflets as they were expanding thus preventing their complete opening.

One individual was found boring into the end of a broken stem making its way into the pith and almost disappearing in a short time. It remained in that position for some time. Thinking that it might be a female and that the eggs were being deposited, the cavity was examined at the end of four or five days, but no eggs were found. This adult was placed on a growing plant and soon began feeding in the young tissues as stated above. On one small plant in the laboratory the young leaves were so badly eaten into that the plant died in a short time.

One specimen was taken while collecting in the woods August 31. So the species undoubtedly infests other plants besides the one recorded above.

Nothing can be stated concerning oviposition and the early larval stages. As stated above, numerous fully grown larvae an pupae were found in the root-stock and base of the larger branches Sept. 1st. A few fully colored adults were found a few days later. One root-stock was isolated during the second week it September and adults kept gradually issuing till about the middle of October. From this one root-stock as many as 12 to 15 specimens issued besides the numer-

ous larvae and pupae that were removed for the purpose of examination.

Since no eggs were deposited by the specimens kept under observation and adults were still very active after the plants had all been killed by frost, it is quite safe to say that they hibernate and deposit eggs the next spring, there probably being but one brood each year.

A nearly related species, determined at the Division of Entomology, U. S. Department Agriculture, as *Baris dolosa* Casey, was bred in small numbers from the same stems. It was thought to be the same and differences in appearance due to imperfect maturing, but there is a decided difference in form of thorax and it seems probable that both species breed in the same plant and with practically the same life history.

DESCRIPTIONS.

Larva: Fig. 9, a. The fully grown larva is about 5-32 in. long and 1-16 in. diameter, and a yellowish white color; head light-brown, mandibles reddish-brown; legs represented by mammiform protuberances similar to those in *Bruchus 4-maculatus* Fabr, only that they are not so conspicuous and do not show the small projecting tubercles. The body tapers somewhat toward posterior end, the last segment usually showing four bristles.

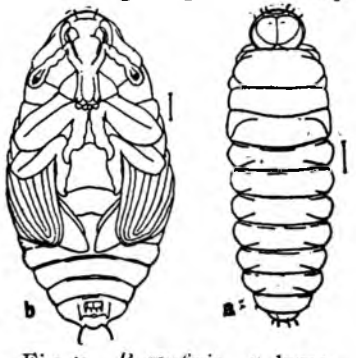


Fig. 9. *B. confinis.* *a*, larva. *b*, pupa.

Pupa: Fig. 9, b. About the same length as larva but comparatively wider. Head (from beneath) fits closely to the body, eyes not especially prominent; antennae wide in proportion to their length, normally not projecting beyond the sides of the thorax, club conspicuous, usually somewhat denser in appearance. Snout reaches base of first pair of legs and shows small roundish portions at

tip corresponding to the mouth-parts. First and second pair of legs clumsy in appearance; joints of the tarsi indicated, the last one distinctly curved; third pair of legs hidden, only a slight portion being visible along the inner margin of the hind wing-pads. Four abdominal segments visible for their entire width. The last segment usually has two apical bristles and a group of small spiny processes.

Adult: Fig. 8. (a, dorsal view; b, side view; c, tarsus.) Widest at base of elytra and tapers strongly toward either end; shining black, glabrous; numerous medium sized punctures on the thorax and between the striae of the elytra. Snout about 1-24 in. long, curved, usually extending directly downward, but sometimes drawn backward or slightly projected forward. Thorax narrows perceptably toward the head. Tarsi strongly pubescent beneath, claws strongly curved, diverging. Elytra emarginate at tip making the tip of abdomen more distinctly visible from above.

REMEDIES.

Collecting and burning the old root stocks and stems in early autumn will be the most effective treatment, that can be suggested from present knowledge of the species.

## An Insect Occuring in Water Tanks and Reservoirs.

(*Chironomus sp.*)

Early in July I received some specimens of a slender red larva from Boone with the following letter:

PROF. OSBORN. Dear Sir.—Enclosed I send a sample of the worm that appeared in our city water about a week ago, in countless numbers, would like to know what they are and where they would be likely to come from. The water we use comes from a 3000 foot well, but about two weeks ago our pumps failed and we were supplied with water from a forty-five foot vein owned by the C. &. N. W. Ry. Co., and pumped to our reservoir through a hose. Yours truly,

E. E. CHANDLER,

Chairman Water Committee, Boone, Iowa.

The larvae were evidently Chironomus and in replying to the letter it was so stated and that in themselves they could be considered harmless though of course the presence of masses of such ugly looking creatures would be objectionable and if dying in the water they might become a source of

pollution. Also that the larvae must have gained access to the water from the eggs of the adult mosquito like insect being deposited in the reservoir or the mains by which it was filled. They could not be derived from a deep well. It was suggested that provision be made to exclude the insects from the water to prevent deposition of eggs.

The larvae (Fig. 10.) *a* and *b*, which are an inch or a litte more in length and of a light red color with green reflections on the sides near the head, construct a tube at the bottom of the water in which they live and in this remain protected and from it extend themselves to obtain food. The food is for the most part apparently minute aquatic organisms, algae etc. Their presence might be considered a means of clearing water of such matter did they not at times become so numerous as to prove an element of danger.

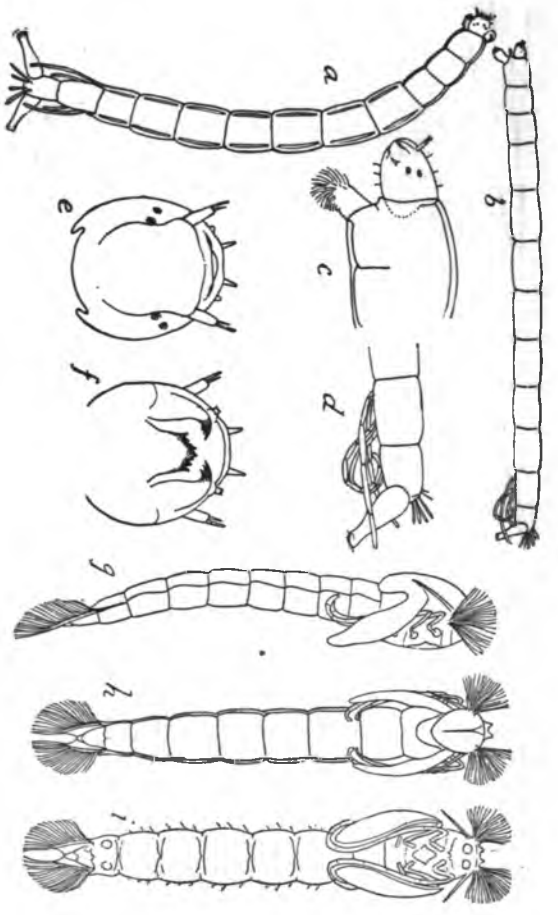

Fig. 10. (*Chironomus sp*) *a*, larva, dorsal view. *b*, side view. *c*, head and first segments of body. *d*, terminal segments of body showing appendages. *e*, upper surface of head. *f*, lower surface of head. *g*, side. *h*, dorsal. *i*, ventral view of pupa. (Original, drawn by Miss King.)

Later in conversation with Mr. G. W. Brown a civil engineer of Boone it was learned that the water was pumped into a large cement lined reservoir which contained the larvae in immense numbers and was without question the point where the eggs were laid, it being exposed to easy access by insects. It appeared also hat the larvae were drained into the mains at times when the reservoir was low, doubtless due to the forming of strong currents over the bottom. Specimens have also been received from Des Moines.

When mature they change to a delicate pupa (Fig. 10 *f*, *h*, *i*,) and then rise to the surface of the water and soon the adult insect escapes from a slit along the back of the pupa case.

The adult is a delicate mosquito-like insect (Fig. 11.) belonging to the genus *Chironomus* but it cannot be referred to any of the described species and the present state of the classification of this genus is such as not to warrant us in giving it a scientific name or description.

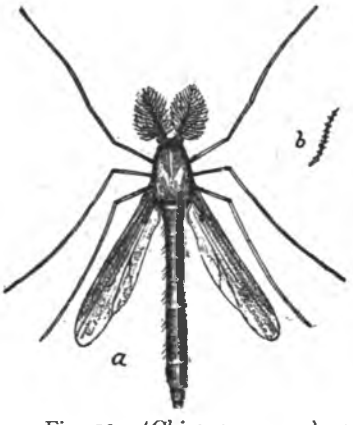


Fig. 11. (*Chironomus sp.*) *a* adult male. *d*, antenna of female (Original.)

The insect is of interest at this time because of the great number of water tanks and reservoirs established, not only in cities and towns, but on many farms and the probability of its frequent occurrence where these are open to visits of the adults.

Exclusion of the adults where practicable may be accomplished by the use of ordinary mosquito netting or wire gauze. Where this is impracticable the providing of an inlet to distributing pipes that will draw water from a few inches above the bottom of the reservoir (which might further be protected by a fine screen.) will it is believed avoid the distribution of the worms in the mains.

NOTE. The figures in this paper have been drawn from nature by Miss Charlotte M. King, under the direction of Herbert Osborn.