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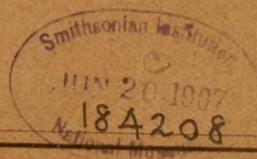
EXPERIMENTAL STATION.

FOURTH ANNUAL REPORT OF THE DIRECTOR,
FOR THE YEAR 1894.

F. H. SNOW,
Director.

CONTAGIOUS DISEASES OF THE CHINCH BUG.
(Illustrated.)

LAWRENCE, KANSAS,
MAY, 1895.



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LETTER OF TRANSMITTAL.

LAWRENCE, KAS., April 5, 1895.

To His Excellency E. N. Morrill, Governor of Kansas:

In accordance with the requirements of the act making appropriations for the maintenance of the Experimental Station at the State University of Kansas for the promotion of experiments for the destruction of chinch bugs by a contagious disease, I forward to you the following report of the results of the experiments for the year 1894, with an itemized statement of the money expended in the experiments.

Yours respectfully,

F. H. SNOW,

Director of the Experimental Station.

ants, experimental apparatus, expressage, telegraphing, postage, traveling expenses of field agents, etc. The said chancellor, Francis H. Snow, is hereby authorized to issue his warrant upon the state auditor, who shall draw his warrant upon the state treasurer, upon itemized accounts, for the amounts specified by this act; and all accounts shall be verified.

Sec. 3. The said chancellor shall also make a full report to the governor, on or before the 1st day of December of each year, of the money expended and of the results of his experiments.

Sec. 4. This act shall take effect and be in force from and after its publication in the statute book.

Approved March 9, 1893.

EXPERIMENTS WITH CHINCH-BUG INFECTION IN 1894.

I. SUMMARY OF RESULTS.

1.—*Extent of Experiments.*

During the year 1894, field experiments for the destruction of chinch bugs by the artificial introduction of contagious disease have been prosecuted upon a larger scale than in any preceding year. No fewer than 8,000 packages of infection were sent out to individual farmers in Kansas, Missouri, and Oklahoma territory. The states of Nebraska, Iowa, Missouri and Illinois having followed the example of Kansas in the establishment of distributing stations, the demand from those states upon the Kansas station was very much smaller than it otherwise would have been, although the demand from the state of Missouri was larger than in any preceding year.

In addition to the distribution of infected material from the central station at the State University, 50 auxiliary distributing stations were established, in as many different counties in Kansas and Missouri, 38 of these stations being located in Kansas and 12 in Missouri. It was anticipated that the establishment of these substations would reduce the demand upon the central station, but this anticipation was not realized, as large numbers of farmers apparently preferred to make certain that the infection was genuine by obtaining it from the laboratory of the central station.

2.—*Is the Chinch Bug Moving North?*

The demand for infection from the laboratory from the southern third of the state of Kansas was far less extensive than in the preceding years. Not a single application for the establishment of a substation was received from the counties of Barber, Harper, Kingman, Sedgwick, Sumner, Butler, Cowley, Elk, Chautauqua, Montgomery, Neosho, Labette, Crawford, and Cherokee.

In the year 1893, individual farmers from the above-named counties sent in applications for infection to the number of 1,303; in the year 1894, less than 15 per cent. of that number, or a total of only 195 applications, were received from the same area. A trip to Labette county the last week in June convinced the writer that the falling off in the number of applications from this district was not from loss of faith in the good effects of the infection, but from the almost entire disappearance of the bugs. Indeed, the

majority of the farmers attributed the small number of chinch bugs to the good effects produced by the infection in the preceding year. That the uninjurious numbers of chinch bugs in the counties named was not due to meteorological causes is indicated by the fact that substantially the same conditions of temperature and rainfall prevailed over the whole of eastern Kansas up to the time of the writer's visit to Labette county.

That the chinch-bug area had moved to the northeast is indicated by the fact that a much greater number of applications for infection was received from the northeastern counties in 1894 than in any preceding year. From the following counties, in 1894, 1,123 applications for infection were received, as compared with 462 applications in the year 1893: Johnson, Douglas, Wyandotte, Leavenworth, Jefferson, Atchison, Doniphan, Brown, Pottawatomie, Nemaha, Marshall, and Washington. There was thus, in the year 1894, a decrease of 85 per cent. in the amount of infection sent to the southern counties, and an increase of 140 per cent. in the amount sent to the northern counties.

3.—*The Establishment of Substations.*

A large portion of the 38 substations located in Kansas were established by the county commissioners of the counties in which they were located. Among this class were stations in Allen, Barton, Dickinson, Lyon, Miami, Mitchell, Osborne, Ottawa, Reno, Rush and Saline counties.

No substation was allowed to be established unless the individual who was to take charge of the station should first have visited the laboratory of the central station for the purpose of obtaining instruction as to the identification of the true parasitic fungus as compared with other fungi readily mistaken for the genuine parasite by an uninstructed observer, and also as to the proper method of propagating the infection at the substation.

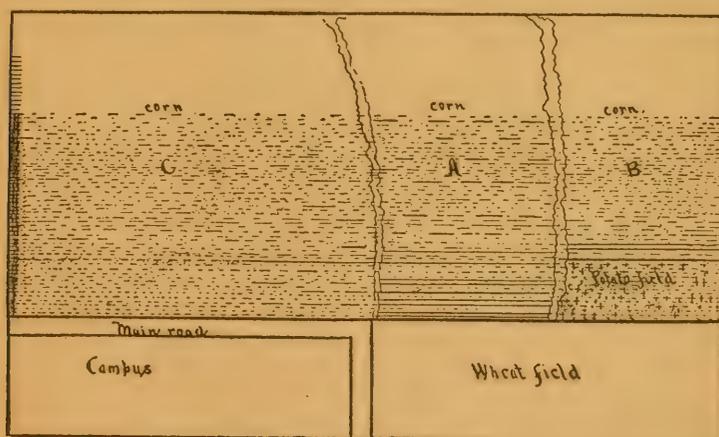
4.—*Results of Experiments.*

It is estimated that each of the 50 substations supplied an average of 300 farmers with infection. This gives a total of more than 15,000 farmers supplied with infection from the substations. If to these be added the number supplied from the central station, it appears that upwards of 20,000 farmers in the chinch-bug area were supplied with infection during the year 1894. Reports have been received at the central station from upwards of 3,000 experimenters. About 55 per cent. of these reports are favorable, and indicate an immense saving of crops consequent upon the use of the infection sent out from the central station. The reports from the substations are variable in their character. Inasmuch as the majority of these substations were not established until late in the season, the dry weather and hot winds of July and August seriously interfered with the success of the infection sent out from such stations. The substations which were established early in the season reported much more favorable results. The substations should be

established at a very early date in the season in order to secure the best results. As a rule, the agents in charge of the substations reported that where the experimenters carefully followed the directions successful results were obtained. It is too often the case that the experimenter departs from the letter of his instructions at almost every point, and charges failure to some defect in the character of the infection. Persistent effort in carrying out the details of the method is as essential to success in field experiments for the destruction of the chinch bug as in any other legitimate agricultural enterprise.

5.—*Field Experiments Conducted by Central Station.*

During the season of 1894, for the first time since the beginning of our experiments, the chinch bugs have attacked fields in the immediate vicinity of our laboratory. This gave us the first opportunity of conducting an experiment which could be under our own personal supervision from beginning to end. Inasmuch as this may be taken as a standard example of the manner in which the *Sporotrichum* works in the field, I will append the following notes.



The field experimented upon was a cornfield 100 rods in length, a portion of which joined the University campus, and the remainder a wheat field, from which the wheat was cut on June 20. When the wheat was cut it was noticed for the first time that chinch bugs were abundant in the wheat. They moved immediately from the wheat field into the adjacent cornfield, belonging to another owner. The bugs were first noticed by him in the corn in large force, in both A and B, blackening the stalks, on Saturday, June 23. The bugs were in about 20 rows in field A, and about 10 rows in field B. A strip of potatoes between corn in field B and the wheat field had hindered the bugs in their progress into B. The contents of one of the laboratory boxes of the 24 by 36 by 6 inches dimension was taken

out, earth and all, and used for the infection of these fields, on the morning of Saturday, June 23. In field A, the infection was put in the axils of the leaves, and at the bases of the stalks of every hill of rows 4 and 5 and 7 and 9; in field B, the same was done for rows 2 and 3.

Search was made before distributing the infection for possible *Sporotrichum* bugs, already spontaneously in the field, but none were found. Previously to June 23 there had been frequent rains, so that the ground was moist at this time. On the night of June 23 heavy rain fell, and again on the afternoon and night of June 24. The afternoon rain was accompanied with heavy hail. The night rain of the 24th was driven by a strong west wind, so that the corn was laid flat in places. The field was visited on the afternoon of the 25th, and the bugs were found in as good condition and as numerous as on the 23d. It was the intention to scatter more infection on the 25th, but a rain storm came, and further infection was deferred. On the morning of June 26, a bucket of soil was taken from the infection box and scattered in each hill of rows 9, 10, and 15, field A. At this time the bugs appeared in good condition, and no signs of the spread of the infection were apparent. The bugs had advanced somewhat into a third field, C, and infection was scattered down row 15 of this field for the few rods the bugs extended, and also in different places in row 15. The morning of June 26 was warm and clear.

On the morning of June 28, a bucket of earth from the infection box was scattered at every alternate hill through row 18 of field A, and at intervals of every two or three hills through rows 1 and 2. Only a few *Sporo.* bugs could as yet be found. The bugs were working in great force. Under clods and fallen stalks and leaves large numbers of the bugs were gathered for moulting. Most of the bugs on the standing corn were black larvæ and pupæ, but there were a few red larvæ and a few old, winged and newly molted, winged individuals. The morning was clear and warm. A slight shower on the night of the 27th. Earth moist in the field.

July 2.—Bugs from the infection boxes sufficient to infect each hill for two rows were scattered in field A where the bugs were thickest out to the fifty-second row, the bugs having extended to that distance. A few white-fungus bugs could be found at nearly every hill. The bugs were apparently not more than half as numerous as when the field was first infected, but they had scattered as far as the fifty-second row, and this may account for the apparent decrease. Bugs were continually hatching and moulting at this time.

July 5.—There was a heavy rain on the morning of the 4th. Bugs covered with *Sporotrichum* can be found in great quantity under fallen corn-stalks and clods. One and one half gross of pill boxes were filled from the field to-day. The victims are chiefly old bugs, but not all.

July 9.—More *Sporo.* bugs were scattered along the advance line of the the chinch bugs. The bugs had made very little headway since the 2d of

July. From two to three gross of infection boxes are filled with *Sporo.* from this field daily. The bugs, both old and young, seem to be but sparingly present in the field. Here and there a very few live bugs may be found in the axils of the leaves and under clods.

July 13.—The *Sporo.* is continually increasing in the field, but there is a larger number of live bugs on the corn in places than could be seen on the 9th.

July 16.—There was a heavy rain on the 15th. There are plenty of *sporo.* bugs for picking, and pickers are still at work, and have not ceased since they began, on the 5th.

July 18.—*Sporo.* is increasing all over the field, but the bugs are numerous in occasional spots throughout the field. These bugs are of all ages, but adults greatly predominate. The dead bugs or mummies gathered by the pickers now include large numbers of little red bugs as well as the pupæ and the adults.

July 22.—A visit to the field shows the live bugs reduced to a satisfactory minimum; probably not more than 1 to 2 per cent. remain of the number which blackened the stalks for from two to three feet above the ground for 20 rows when the infection was first introduced. The entire field promises an abundant crop of corn, and even the outer rows, where the attack was most severe, are well-eared and luxuriant in foliage.

From this field the pickers had already gathered 7,000 boxes, and might have gathered 25,000, of *Sporotrichum*-covered bugs, as a reserve stock for early distribution to the farmers for use in the wheat fields in the spring of 1895. If in every township in the state of Kansas infested with chinch bugs a similar gathering should be made by the township trustees, and distributed to the farmers early in the spring, the chinch bug would soon be reduced to an uninjurious minimum.

6.—The Method of Infection.

The method of infecting chinch bugs with *Sporotrichum globuliferum* in the laboratory and in the field during last year was essentially the same as the method described in our last report, with the exception of a few details. Clean, friable garden soil was used in the boxes to maintain the proper humidity, instead of excelsior, leaves, etc., as formerly. All substances liable to decay were excluded, and the green wheat and corn used were removed as soon as they turned yellow. Even with these precautions, the odor of ammonia, due probably to the decay of the bugs, could be detected in the boxes. *Sporotrichum* does not flourish under such conditions, and whenever the odor of ammonia was detected the boxes were cleaned out and left exposed to dry air for a day or two, and then started anew. The soil was spread over the bottom of the boxes to the depth of about an inch, and kept moist and friable, but never allowed to become muddy.

Dead bugs covered with *Sporotrichum* are found at all depths in the soil

of the boxes, and in stripping the boxes of infected bugs the soil was carefully raked over and picked from after the fungus-covered bugs had been gathered from the surface. In this way the number of fungus-covered bugs which a single infection box was capable of yielding was greatly increased, and at the same time the soil was kept in a loose and friable condition and well aerated throughout, a condition necessary to the best development of the fungus, since a liberal supply of oxygen is essential to it.

In infecting fields under our personal supervision, we found it an excellent plan to remove half of the earth with its contents of *Sporotrichum*-covered bugs from the infection boxes, and to work the soil over thoroughly, in order to distribute the spores through it as evenly as possible, and then to scatter this soil at intervals where the bugs were most numerous in the fields. A new supply of soil and healthy bugs was put into the infection boxes, and on the following day the second half was distributed in the field and the box replenished as before.

By the method just outlined, our infection boxes worked more satisfactorily than in any previous year, and we were able to supply without any delay the largest demand ever made upon us.

7.—Artificial Cultures.

In regard to artificial cultures of *Sporotrichum*, it was found that the fungus would grow on all the nutrient substances tried, but especially well on Irish potato and squash. Turnip, onion, sweet potato, horse and rabbit dung, and decoctions of various substances, taken alone or stiffened with agar agar, were tried successfully, but the vegetables gave a more vigorous growth than the other media. Plate I, figure 1, is from a photograph of a culture of *Sporotrichum* grown on squash; figure 2 shows a growth on Irish potato. Plate II, figures 1 and 9, show *Sporotrichum* grown on the surface of a liquid decoction of squash; figure 2 shows a growth on rabbit dung; figure 3 on horse dung; figure 4 on squash; figures 5 and 8, *Sporotrichum* growing on Irish potato, transferred from a growth found on an insect in a wood near a cultivated field on January 10, 1895; figure 6 shows a culture on turnip, and figure 7 on onion.

Experiments made during the fall of 1894 in infecting chinch bugs with *Sporotrichum* grown on nutrient substances, while not conclusive, indicated that the fungus thus cultivated does not lose its power of killing insects. Experiments were made with *Sporotrichum* grown on Irish potatoes, horse dung, and other substances, and the bugs used were collected in September and October, 1894. In some cases, the first remove of *Sporotrichum* from the growth on the bug was used; in others, the second, third and fourth removes were employed. In several of these experiments where *Sporotrichum* of the fourth remove grown on horse dung was used the bugs exposed to the infection became covered with a growth of the fungus, but only in small numbers, and after a relatively long time. Check experiments, in which

the ordinary method of infecting with diseased bugs was employed, did not show a greater mortality among the bugs introduced than the artificial culture experiments. The experiments could not be repeated on account of the lack of bugs at that season, so the results were not confirmed.

8.—*Experiments in Spraying.*

In March, 1895, chinch bugs were found in considerable numbers in several localities, hibernating under stones, pieces of wood, and the like, in the vicinity of cornfields. They were especially numerous in places where the stones, etc., lay on grass or stubble, so that there was a dry shelter between the stones and the ground. Bugs found in these places were sprayed with water mixed with *Sporotrichum* spores grown on squash; others were sprinkled with dry spores in the same manner. A week later it was found that many bugs in the places infected were dead and covered with *Sporotrichum*, while no trace of fungus-covered bugs could be found in places not infected. This experiment suggests the possibility of infecting bugs before they leave their winter quarters. The method of scattering the spores of the disease in a fine spray of water, which appears to be successful in the above experiment, may prove to be a much more efficient means of spreading the infection than we have yet employed.

The results thus obtained in the field are sustained by the following laboratory experiments:

On March 19, 1895, chinch bugs, found hibernating under the shelter of stones and grass in the vicinity of fields infested by them the previous season were put in flower pots containing moist earth, about 50 bugs in each pot. The bugs in pot 1 were sprayed with distilled water; in pot 2 with distilled water containing the spores from the squash culture shown in plate I; in pot 3, with spores from the squash culture shown in plate I which had been in a 5 per cent. solution of grape sugar for 24 hours and had commenced to sprout; to pot 4 were added a few *Sporotrichum* bugs which had been kept over from the previous year. Although a few white-fungus-covered bugs appeared in the check lot of pot 1, a greater number appeared in pot 2 where *Sporotrichum* spores were sprayed in distilled water, and still a much greater number in pot 3 where the spores had been sprouted in a sugar solution and then sprayed, and both of the artificial cultures of pots 2 and 3 gave better results than were obtained in pot 4, where *Sporotrichum* growing on chinch bugs was used for infection. We do not look upon this single experiment as at all conclusive, and have others in progress at the present writing. If the method of spreading the infection by spraying proves successful in the field, and particularly by the spraying of sprouting spores, it is possible that the infection may prove successful even in dry weather. If the bugs in the field are thoroughly sprayed with the sprouting spores in the evening, it is possible that the fungus, aided by the mois-

ture and nutriment of the sugar solution, may penetrate the body of the bug before the heat of the morning sun can prevent it.

When once established inside the body of a bug, the death of the bug would be pretty certain to result, whatever the conditions of the weather. Plate III, figure 1, and plate IV, figures 1 and 2, show the appearance of the fungus within the bug's body.

Preparations are now being made to carry out field experiments along this line on a large scale.

These preliminary experiments are given here as possibly useful suggestions to other experimenters.

II. REPORTS FROM SUB-STATIONS.

As mentioned before, each agent in charge of a sub-station was required to visit the central station before starting his infection boxes. He was required to report at various intervals the condition of his station, and occasionally was called upon for samples of the infection he was furnishing from his boxes. In this way, a check was kept upon the substation agents which proved of great benefit to the country in which the station was conducted. The following were the stations established during the past season, and the agents thereat:

Adams, G. I.	Emporia.....	Lyon county, Kas.
Adams, S. B.	Huber, Mo.	
Amberg, Jacob.....	Lydia, O. T.	
Avery, W. H.....	El Dorado.....	Butler county, Kas.
Barber Bros.....	La Cygne.....	Linn county, Kas.
Becker, C. L. & Co.....	Ottawa.....	Franklin county, Kas.
Belew, M. E.	Adair, I. T.	
Bixby & McDowell.....	Hardy, Neb.	
Bradbury, L. T.....	Paola.....	Miami county, Kas.
Britenstine, Chas.....	El Dorado.....	Butler county, Kas.
Brooks, F. C.....	La Crosse.....	Rush county, Kas.
Chancellor, H. C.....	Liberal, Mo.	
Cowman, E. E.....	Osborne.....	Osborne county, Kas.
Davis, O. P.....	Warrensburg, Mo.	
Diebart, Frank.....	Eureka.....	Greenwood county, Kas.
Dickinson, F. A.....	Quenemo.....	Osage county, Kas.
Dunwoody, J. L.....	Lamar, Mo.	
Evans, J. M.....	Burlington.....	Coffey county, Kas.
Findley, Robt.....	Sterling.....	Rice county, Kas.
Gilmore, M. E.....	Scottsville.....	Mitchell county, Kas.
Gosch, Geo.....	Pleasant Hill, Mo.	
Hall, John.....	Fulton.....	Bourbon county, Kas.
Hayse, N. S.....	Great Bend.....	Barton county, Kas.
Hickey, E. C.....	Abilene.....	Dickinson county, Kas.

Hopper, A. L.....	Scandia.....	Republic county, Kas.
Hurd, Jos.....	Carbondale.....	Osage county, Kas.
Hutchinson, Kate.....	Onaga.....	Pottawatomie county, Kas.
Jones & Son.....	Colony.....	Anderson county, Kas.
Knaus, Warren.....	McPherson.....	McPherson county, Kas.
Lamb, D. E.....	Peabody.....	Marion county, Kas.
Lawyer, I. B.....	Iola.....	Allen county, Kas.
Logan, W. N.....	Beloit.....	Mitchell county, Kas.
Lutz, Frank.....	Yorktown.....	Lincoln county, Kas.
Lyons, John.....	Olathe.....	Johnson county, Kas.
Myers, J. Q.....	Holton.....	Jackson county, Kas.
Newsom, D. G.....	Butler, Mo.	
Perry, B. F.....	McLouth.....	Jefferson county, Kas.
Ramsey, J. A.....	Garnett.....	Anderson county, Kas.
Sawtell, J. H.....	Salina.....	Saline county, Kas.
Scheffer, T. H.....	Minneapolis.....	Ottawa county, Kas.
Smith, C. O.....	Burlington.....	Coffey county, Kas.
Smith, S. S.....	El Dorado.....	Butler county, Kas.
Stine, J. H.....	Fairland, I. T.	
Taft, S. F.....	Hutchinson.....	Reno county, Kas.
Valentine, D. A.....	Clay Centre.....	Clay county, Kas.
Ward, J. M.....	Cornelia, Mo.	
Watson, F. G.....	Mound City.....	Linn county, Kas.
Willoughby, E.....	Windsor, Mo.	
Woodward, H. O.....	Hesper.....	Douglas county, Kas.
Young, P. C.....	Fredonia.....	Wilson county, Kas.

Of the above list, several stations were discontinued shortly after their establishment. Others were merely distributing points for infection in the original packages as sent out by the central station. From such stations as constituted the regular sub-stations the reports following have been obtained. These reports are published here to show in detail the manner of conducting these stations and the results of the work of each agent.

Station Reports.

C. L. Becker & Co., Ottawa.—Our infection box was started on May 16, at which time the weather was still cold, and it was very difficult to procure live bugs. On account of the cold weather at this time the bugs did not become infected until after two weeks, when the white fungus commenced to develop. This we found was hastened when a little dampened soil was first placed in the box. The infected bugs that had the white fungus on them were distributed among the farmers of this county. The bugs in the fields did not multiply to any extent until about the 9th of June, at which time we had a warm rain, which brought the young bugs out of the ground by the millions. The farmers began harvesting their small grain about the 13th of June, and as soon as the grain had been cut the bugs immediately started for the neighboring cornfields. At this time we had a greater demand for infected bugs than we could supply, and were favored with an additional number of boxes of infected bugs from the Station, at Lawrence. These we also gave out to the farmers, distributing in all about 400 boxes, and requested a report from each person receiving the infection. Although we have notified the farmers through the press that their reports were now desired, we have not been successful in procuring as

many as we had hoped for. The weather was extremely dry during the latter part of the summer, so that it was not the most favorable for the development of the fungus. The reports that we have been able to obtain are conflicting, but the majority either report a partial success or a complete failure. We distributed the infection in several fields of our own, with only poor results, which we attributed to the unfavorable weather.

Bixby & McDowell, Hardy, Neb.—We inoculated bugs at our place of business and gave them to farmers whose crops were being destroyed. From their reports, about 75 per cent. of the bugs received from us infected fields of bugs and almost completely destroyed them. A few failed to infect at all, and others only partially. Weather was dry; no dampness at all. From our observations, we believe the inoculation successful, although not without continued attention to details. We saved possibly 800 acres of corn and 200 of wheat. The bushels we saved we cannot determine, as the season developed an almost complete failure of both crops experimented upon. Allowing 10 bushels of wheat and 15 of corn, it would make 2,000 bushels of wheat and 12,000 of corn saved.

L. T., Bradbury, Paola.—The station here was closed the 14th day of July; up to that date 262 orders have been sent out from the station; out of this number only 89 reported to me in any way. Out of this number 70 were successful in full or in part; 10 were decidedly unsuccessful and the parties would not try it again; nine were doubtful, but expressed a willingness to work with it. It seems a small per cent. to report, but these were all I could get to report; yet every farmer who received the infection here got explicit instructions in regard to reporting. This demonstrates, however, to the farmers of our county, that the disease is a success if used properly. I think it will cause more of them to try it next year. I have found that some farmers, after finding that there was some work connected with the infection, took it home and did not try to use it at all. The weather I believe has as a general thing been favorable for the infection all the spring and summer, being slightly damp all the time except early in the spring. If the value of the infection could be estimated in any way, it would, I think, amount to thousands of dollars in this county alone.

F. C. Brooks, La Crosse.—The infection box worked nicely. All my expectations and hopes were realized, so far as infecting the bugs in the box was concerned. The weather being very dry during the time or season of infection, it is impossible for me to give satisfactory information. Station established July 10, and continued for three months. Quite a number were supplied with infected bugs during that time, but I have not received any authentic reports from anyone supplied as to the success of the efforts put forth. In different parts of the county, especially where bugs were to be found in large quantities, the infection was used successfully—at least this is the idea of many individuals; and further, there is some evidence that in one locality the bugs were destroyed by the same disease, yet no one in the immediate neighborhood had put forth any effort to infect them. We have considerable faith in the destruction of the bug by the infection, but here in the west, where the atmosphere is so dry and conditions are naturally unfavorable to the development of the disease, it will be necessary for us to take advantage of the season, and commence early and try to infect the bugs in the spring, while the wheat plant is growing, and thereby improve the advantage of a damp or wet season, which is considered quite necessary to success. I give this last idea as to beginning in the early spring as the most important.

C. C. Brosius, Hays City.—Your card to J. H. Ward handed to me. Mr. Ward gave the matter up, and the commissioners handed it over to me. I put my boxes up and procured the chinch bugs and started in. Here is the working of it: I put 52 packages of infected bugs among the farmers. They report 21 that worked fine, and the balance, I think, did not get the care they should have had.

H. C. Chancellor, Liberal, Mo.—Our substation was in operation about three months, and in that time perhaps 100 received the infection directly and that many more indirectly from this station. Reports came in very slowly, but, so far as reported, 70 per cent. were successful. I experienced no trouble in infecting bugs, and the state of the weather made no perceptible change in the working of the infection. I noticed a remarkable thing in the field of C. M. York, who resides near this place. Mr. York put out fungus about the time the young bugs began hatching in his wheat, and shortly the old bugs began dying in great numbers. I visited the field about the 10th of June, and found fungus all over the ground, but could find no young bugs dead, nor was I ever able to find any young bugs dead in the field. Mr. York had another field in which he put no infection, and there the old bugs, as well as the young, remained alive until by nature they expired. Take it all in all, I believe the thing is an established success, and we shall give it another trial, if necessary. In a great many of the above reports, I know the parties expected to lose their entire crop, but lost very little. For example: Chas. Boyd came to me and informed me that he expected to lose most of his crop. After putting out infection, he found the bugs still alive, and, as he put it when talking to me, "they were crawling around and acted crazy." They did not seem to be eating corn at all. This was in the early part of July. Mr. Boyd put out no more infection, and paid no attention to his field until in August, when he noticed that the field was still full of bugs, and they were eating corn, but slowly. In conclusion, I desire to say that never before in this country did so many bugs do so little damage. Our crops were comparatively uninjured, and our leading farmers attribute it solely to the use of the infection.

E. E. Cowman, Osborne.—Station was in operation about two months—July and August; number of persons supplied with infection, about 310. Of these, I send you the names of 220 and their reports, if reported, whether successful or unsuccessful. Most of the remaining 90 names were persons I gave the infection to during the latter part of August, for use later in the season if weather became more favorable. Besides these, a number were given infection while I was visiting boxes in the country, and thus did not secure their names. Reports received, 49; successful, 32; unsuccessful, 8; doubtful, 9. Per cent. successful, 65; unsuccessful, 17; doubtful, 18. From the number that sent me their report on the work, I can hardly say that 65 per cent. of all that tried the infection were successful, as I heard of a good many, indirectly, who were not successful, but thought it due to the dry weather, and would not report. From what I could learn from inquiry, etc., I estimated that about 40 per cent. were successful, and most of these took out the infection before the hot winds, July 25 to 29. The weather was extremely backward for the propagation of the disease. We had but one rain, about one-half inch, during the entire time, and with but little dew. In the latter part of July, hot winds struck this part of the country, destroying the crops. This greatly reduced the demand for the infection, and a good many who had taken out the infection neglected to take care of it. My boxes worked well all the time the station was in operation, and, after the first few days, had no trouble in keeping plenty of infection ahead. Very few farmers had trouble with their boxes. I visited 16, and of this number three were not working, being entirely too small, and not kept sufficiently damp-

ened. Very few, if any, who failed with the infection condemn it, but are willing and wish to try it again a more seasonable year. What infection I had left (975 boxes), I left with the commissioners and real-estate men, to be distributed to those who wished to try again in the fall.

O. P. Davis, Warrensburg, Mo.—I assumed charge of a substation June 4, 1894, at Warrensburg, Johnson county, Mo., in response to a call received by myself while at Lawrence. This substation was to be supported by the subscriptions of private individuals. Three or four large infection boxes, similar in every respect to those maintained at the central station, were procured. Two of these, and, during part of the time, a third, were kept running during my administration of affairs. Full and explicit directions were printed, and the distribution of information and infection was begun in three or four days after my arrival. The newspapers kindly published several letters of information which I furnished them. The infection flourished continuously in the boxes during my stay. A liberal supply of dead bugs (from 10 to 20 white-fungus-covered ones) were furnished to each applicant, together with printed and verbal information. I started individual boxes for many. The weather was very dry throughout June, with only an occasional shower. This delayed the successful working in the fields and caused discouragement among the farmers, most of whom professed no faith in the remedy at the outset. This, together with an active hostility on the part of a certain faction, rendered our crusade against the pest very difficult. At the end of my first month, my engagement terminated. I left on hand a quantity of infected bugs, however, ready for subsequent distribution. Comparatively few of those who received the infection gave the matter a fair trial, on account of their skepticism. About 450 farmers were supplied. There were quite a number of successful reports. I, myself, visited fields where the infection was working nicely, and, at the time of my departure, the number of successful reports was increasing. I have not been informed of the subsequent results.

J. M. Evans, Burlington.—As to my report on the chinch-bug business, I will say that I had three boxes made the size and manner you directed, and put the bugs in just as you directed. Fed them on green corn and wheat, and used a sprinkler to keep them damp. Kept the boxes in the basement of the house. Will say that every box put up with infection worked like a charm. I put up and distributed in the county over 700 of the small boxes. Had different reports, but the general report was very successful. I had very good success on the farm where I put the infection out. I think the infection works better with warm, damp weather.

John Hall, Fulton.—Arrived at Fulton on May 7, 1894, and had boxes made and went to field to collect live bugs. Distributed infected bugs in field at time of gathering live, healthy bugs. From this time infected bugs were distributed in the two wheat fields, of which I had the overseeing, but no visible signs of the disease taking effect, could be found up to the 7th day of June. As soon as the station was in working order, the local paper made a statement that the diseased bugs would be given to anyone who wished, provided they would bring live bugs to exchange for them. This brought a few farmers to town with live bugs, and they received diseased bugs in return and went home, told their neighbors of the station's establishment, and during the second week quite a number of men came for bugs. After this, they came in very slowly, and no reports were made at all until the day before leaving Fulton, when it was reported indirectly that there were two farmers north of town who had been successful in their experiments. Bugs were distributed to something over 100 persons, and these were the only reports that were brought in.

Along the latter part of June of the same year I was again in that part of the state, and made some inquiries, and found that there had been a number of successful trials made in the vicinity, one man having saved his oats, another his corn, and so on. In cornfields and adjacent to wheat fields where the infection had been used, after the wheat had been harvested, the bugs began to migrate to the cornfields and did not get further than two or three rows in when they began to collect in balls and die on the ground. Many were covered with the white fungus. So that unsuccessful personally in the fields I was watching and experimenting, the majority seem to have been successful in their experiments.

N. S. Hayse, Great Bend.—I have been trying as hard as I could since I closed the bug station, in August, to get a full statement of what was done from my station. I let 158 applicants have the infection, and I have only about 41 reports to send to you, such as they are. I will send you what I have, and perhaps I can do better another time. So far as the farmers followed the instructions, they were successful; those that thought they knew best of course failed. The weather was so dry and hot that we closed the business the 15th of August.

E. C. Hickey, Abilene.—The work was begun on the afternoon of May 23d, at which time the preparation and satisfactory arrangements of the principal county station, that at Abilene, were made. The spacious basement of the courthouse was at once converted into a genuine chinch-bug station. Here the conditions necessary to the successful and special propagation of the white fungus, *Sporotrichum globuliferum*, were extremely favorable, the only apparent disadvantage being a liability of several kinds of mold spores to alight in the wooden boxes, and there profusely propagate. The boxes used were the same as those made use of by the University Station. Frequent visits of the Abilene agent to the state station were productive in keeping the substation in strictest harmony with the working of the principal one. In Abilene, I found the diseased bugs to have been as efficient in destructive effects as those sent out from Lawrence into the same territory were reported to have been. White fungus was very prolific in the wooden cases, but much more so on the hard-beaten and moistened earthen floor of the basement rooms, where numerous stalks of corn were thrown to afford harboring places for the bugs which had escaped from the infection boxes. These spots especially attracted the attention of the numerous visitors to the station, and also were of considerable advantage, in that by means of them the actual field experimenters could be easily shown what to expect or look for in their work. Many, indeed, insisted upon receiving these bugs which had died in great numbers beneath the masses of green material, there invariably seeking the cool and darkened protection from the sunlight which but slightly streamed in through the basement windows. In a north room I found hundreds of dead, white-mold-enshrouded bugs clinging to the stone walls.

By means of having a station in easy access of the farmer experimenters, I have found that a much greater intelligence in regard to the work is not only possible but also very apparent, much to the gratification of both farmer and station man. Intelligence and care in the use of these parasitic diseases are the preëminent requisites. They induce better results, inspire confidence upon the part of the user, and by all means are a source of pleasure to him who assumes the responsibility connected with the control of a county station. Not only did they who were in actual need come to see and have their wants supplied, but also many who were actuated by mere curiosity came. And of the latter class, not a few received supplies to be used in case of an invasion of bugs upon their crops, or to send to friends whose fields might be invaded. In no case were any refused. Of the incredulous, a goodly num-

ber had their incredulity shaken to the extent that such expressions as "Now, there may be something in it, after all," were of such frequent repetition that they ceased to be unfamiliar.

Very fortunately indeed, had the boxes in the station begun nicely to work when a wheat field adjoining town, and up on the east and but a short distance from the station, afforded an excellent opportunity to see something of the practical outdoor results. In this field, owned by Messrs. Cooper & White, of Abilene, chinch bugs young and old were thriving by the millions. Along the south end is a dense hedgerow, in and about which had collected a great amount of rubbish, and here the bugs were observed to die and turn white in exactly the same manner as those in the station boxes. To the surprise of all interested, the bugs which had so numerously appeared very suddenly began to disappear. From one end of the field to the other occasional dead, mold-covered bugs were found beneath clods and in places of hiding. The one question always asked by those who had seen the field before and after the disappearance of the dead bugs was, "What has become of them?" To be sure, the dead ones seen were only a very small per cent. of those which had been seen alive, but it must be remembered the sick and dying burrow themselves out of sight, while the live bugs are in plain view upon the ground about the wheat stools or upon the corn hills. The presence of the disease in this field was not due to the introduction of any dead bugs by any known party. I can only account for it with the supposition that the spores of the *Sporotrichum* had existed over the previous winter in the rubbish of the hedgerow previously mentioned. Several such cases have come to my notice in the last summer's work. It is to be much hoped that my hypothesis is not a false one, inasmuch as the "seed" once sown may live on from season to season, beginning its destructive operations in the early springtime, which former experience has taught is a favorable time for the procuring of favorable results. I am strengthened in my belief by the fact that the first appearance of dead bugs has invariably been in and near these hedgerows, and also by the fact that the bugs farthest from these places are the last to disappear.

The work was still further carried on by me in person into a cornfield to the east of this wheat field. Here many visitors found their way, and many gathered their own supplies from the dead bugs which were to be found by the hundreds in the old, dead, half-decaying, half-buried stubs of cornstalks from the crop of the previous year. This was a comparatively easy task, since we had simply to pull one of these stalks from the ground from which one end protruded, having not been entirely covered by the plow, and then break the stalk apart. I have found as many as 500 white, mold-enshrouded bugs secreted within one of these hiding places. Also, along an east and west hedge, upon the north side of the field, the ground in spots among bunches of fox-tail grass was as white as though partially covered with snow, from the presence of the dead bugs. From this time, as far as the season would permit, three men were kept busy at times in keeping up the stock of supplies. At this stage of the work the boxes for a time seemed to rest. However, the growth of mold revived again in about a week's time, although during this period the bugs in the cases seemed unusually sluggish but not dying. From time to time new boxes were put into use, while old ones were cleaned beneath the hydrant and then sunned. From the central station boxes of supplies, accompanied by the station instructions, were sent to the county substations located at Herington, Enterprise, Solomon, Chapman, Banner, Dillon, Carleton, Manchester, Hope, Talmage, and Sutphen's Mills. Each box thus sent out received the personal care of the director, and all the bugs given out were diseased and killed in the central station. Everywhere the director received the most hearty coöperation of those in position to assist, and for the good of the cause such assistance was gratuitously

given. The county papers also gave most valuable assistance by getting the matter fully before the people, and by occasionally publishing results. It is very apparent that the people of Dickinson county, regardless of occupation, are ready and eager for anything of a beneficial nature, or to try any test which points toward bettering the condition of the farmer. It was the business of the director of the county station to direct all work, meet with and talk to the farmers, visit their fields where personal supervision was necessary, keep an effective supply of infection on hand to distribute to individual callers, send out to the substation men, and to put up a supply to be retained over winter for early spring use. Of course all reports and observations fall naturally to his care. For five days the number of callers who either wished dead bugs or information reached the average of 75 persons a day. These were, as patiently as time and human nature would permit, shown through the station. For the season, 493 individuals were supplied from Abilene alone, and no name was counted twice. All together, a few more than 2,000 farmers received supplies from either the central station or one of the substations. The bulk of the supplies were given out from June 10 to July 18; however, after the 18th of July the number of calls was perceptibly lessened.

Concerning results, the agent can say that, everything considered, he is of the firm opinion that his summer's work was a success—not entirely so, to be sure, but to a large and profitable extent. The real per cent. of favorable and what would have been favorable results was cut short by the extreme unfavorable conditions of the season, which conditions also caused an almost entire failure of the corn and oat crops. Hundreds of fields of Indian corn yielded on this account no return to their tillers, while even the fodder was so injured before cutting that little nourishment is to be obtained from this source of getting stock feed. During the reign of these unfavorable conditions, beginning early in July and existing until late fall, the ground became so hot and parched that no fungus whatever showed itself, while the bugs sought shelter, disappearing at the same time in all fields, whether infected or uninfected. The effect of the hot winds and extreme drought was to kill myriad thousands of the pests. This is not given wholly upon my own observation, but from the reports of many trustworthy and careful men who are interested in the work. Up to the 10th of July, as far as reports could be gotten, very nearly 80 per cent. of the number reporting pronounced the results favorable. I say very nearly 80 per cent., from the fact that some few were in doubt. As far as I have been able to learn, the majority of those making the test were pleased with their pains and effort expended. Yet the one thing which a county agent must expect, and be prepared for above all things, is the anxiety of the experimenters whose crops are in imminent danger, at which time the disease may not act with the rapidity and destructiveness he may hope for. Such individuals will, to a certainty, implore his assistance, commendably urging him to do what he can for the farmer. Patience, perseverance and assurance are the things in such instances to be summoned and relied upon. Confidence must be inspired, and especially at this critical stage must the station man be strong in his faith of the efficiency of the remedy he advocates, all the while relying upon the more tardy reports for his season of gratification. Beyond a question of a doubt, much of the results of a county station is dependent upon the conduct and ability of him in charge. None but a competent and patient person, and one who has the confidence of the farmers, should be employed in such a capacity; preferably one who has an actual experience in tilling the soil and gathering the crops, who is or has been one among the farmers, practical and observant, of good judgment and patient disposition, should be placed in such positions.

Another work taken up and carried on in connection with the attempted extermination of the chinch bug was that of giving directions for the destruction of

garden and orchard pests. Frequent use was made of Vernon L. Kellogg's "Injurious Insects of Kansas." The potato beetle, an enemy much dreaded during the past season by the farmer—dreaded both because of the injury it does and of the very tedious method of gathering by hand, by no means an easy or effectual means of riddance—received attention. Pyrethrum generously sprinkled in early morn or late at night upon the dew-dampened vines, or dissolved in water and sprayed upon the green foliage and stems, was rapidly effective. The solution used was two ounces of the fresh powder to an ordinary wooden pail full of water.

In concluding, I have this to say: In organizing county stations, all infection should be propagated, inspected and sent out by the director for said station. The people are ready in the time of need for vigorous work, but they want good infection (in generous quantities, to give them confidence), they want careful supervision and clear instructions. The farming communities of Kansas are ready in the realm of scientific education for anything that touches upon the practical side of farming. Many practical farmers have, at various times, expressed to me the opinion that, should every box of infection sent out from the Dickinson county station have failed in the results hoped for, the station could not be considered a dead expense, inasmuch as the people have been thus aroused to what may be done in other lines, and to what they should awaken in the progress of farming. The honorable board of commissioners have also expressed themselves as well pleased. Good supplies have been, with their approval, carefully boxed and stored away for future use, should time and occasion demand another "chinch-bug war" in Dickinson county. The expense of running the station, while I cannot give the exact figures, was about \$400 for a period of three months.

Kate Hutchinson, Onaga.—In answer to yours of the 20th, I would say that I did not succeed very well, because I had not the conveniences to work with and no suitable place to keep the bugs. I gave bugs to several parties, and to make sure that they had infected bugs afterwards gave the same parties bugs supplied by you. Some of them were successful, and some were not; about 75 per cent. successful. My box worked all right, but required constant watching to keep moist enough. I supplied 15 persons, but can only remember two names, and have lost my list. Something over four weeks was the time devoted to it. Mine could hardly be called a substation, because I didn't really have time to devote to it, being much busier than I anticipated when I requested the bugs of you. Mr. C. O. Benton made a thorough success of the bugs, and distributed many among his neighbors. I have saved some bugs, and will experiment next year on my own account. I have been successful two years, and saved a corn crop each time.

W. Knaus, McPherson.—I beg leave to inclose duplicate reports of some 20 farmers who used infected bugs supplied from the laboratory stations at this place. The reports are almost uniformly unsatisfactory, owing to the intense hot and dry weather of July and August.

I. B. Lawyer, Iola.—According to your request, I will try and report some of the chinch-bug experiments. Farmers are so much engaged in their work that it is a hard matter to get them to take time enough to write out a report of their success or failure, as the case may be, and, in fact, so few of them carry out the directions given them, that success can hardly be expected. One man will come in with an old paint bucket that has never been cleaned, and say he is going to infect his bugs in it; another has a glass fruit can; another a cigar box; and so on; and I might mention many other contrivances they have; whilst some follow directions, and most invariably succeed.

D. E. Lamb, Peabody.—In reply to your favor of the 20th, would say that my infection box worked successfully. I followed your directions to the letter, and in 48 hours the box was covered with white-fungus bugs, but it required about 10 days before all the bugs in the box were dead. I had no opportunity to judge of the effects of the weather or the working of the infection, as we had but one kind of weather during the experimental period, viz., extremely hot and dry. At first quite a number thought the infection was working successfully, but finally not over 10 per cent. report favorably. I supplied 51 farmers with the infection, and took special pains to explain how to work their infection boxes and apply to the fields. The station was in operation about eight weeks.

Robert Findley, Sterling.—We spent much time and work experimenting and getting the farmers to take hold of the chinch-bug infection, this last summer. I did not keep the names of all parties to whom I gave the bugs, and I did not get a report from them all, but I am convinced that those who gave it a thorough test were benefited by it. Some seasons the bugs do much damage to our broom-corn crop, and we would like very much to have all the farmers take hold of it. This is the largest market for dwarf broom corn in the United States, and we are very anxious to sustain our reputation for furnishing the best qualities of brush. We had much very dry weather, which discouraged some with the bugs; but we want to take up the work earlier next year, and hope to do more good with it.

W. N. Logan, Beloit.—I hereby present my report of the work of the Mitchell county distributing station, for the three months commencing June 1 and ending September 1, 1894. During the three months, about 500 boxes of diseased bugs were distributed, six talks on chinch-bug diseases were given in different parts of the county, and about 20 field tests were made. During the month of June, when the weather was most favorable, nearly 90 per cent. of the results reported were favorable. Commencing with the 3d of July, no rain fell for more than 60 days, and by the 20th of July almost all field work had ceased. Our experiments would seem to confirm the belief that the infection will not do the work during the dry, hot weather. We also had very little success with the small red bugs, even in favorable weather, because they would not leave the stalk upon which they were and so distribute the disease.

Frank A. Lutz, Yorktown.—The district through which I distributed infection included principally the northwest and southeast parts of Lincoln and Mitchell counties. The fore part of the season was damp, very favorable to the spreading of the disease, and, as my report shows, the disease spread effectually. July 3 was the last rainy day of the summer, in fact no rain fell after this date, and in consequence the farther we proceed from this date the greater are the number of failures reported. Mr. Geo. W. Metzger, of this place, who has for three seasons been successful in spreading the disease in his fields, reports that, in an isolated field in which during the year 1893 the infection was planted and spread, the same lived there during the winter; and early in June, 1894, the bugs were noticed to sicken and die. In the year 1893, Mr. Metzger had his field planted in corn, and in the fall listed the same in wheat. Mr. A. A. Songer, Victor, Kas. (Mitchell county), reports likewise a phenomenon of this kind.

Iowa Agricultural College, Ames, Iowa.—Infected bugs were sent to 164 different persons, and reports have been received from 58. Of the 58 reporting, 32 considered that the infection was a success, and 24 a failure, while 1 was too doubtful to report either way, and 1 reported no use made of the material. Of the 32 reporting success, however, only 5 reported observation of a fungus growth on the bugs,

or gave proof that the bugs actually died as the result of their infection, while a number reported bugs dying in other fields where infection was not used; a number more simply based the report on the fact that bugs were less numerous or had disappeared, and several who sent in what they supposed to be bugs that had died of the disease sent for the most part only the molted skins of bugs which had been mistaken for dead bugs. With these facts in view, it would be unsafe to claim that more than 10 per cent. of the attempts were really successful. Considering the extreme dry weather that prevailed for the period of trial, great success could not be expected. If all would report results, the conclusions would be of greater value.

J. H. Sawtell, Salina.—I shall say for those who secured bugs from me, that but very few will have any report to make at all, for many, after getting them, were so discouraged by the excessively dry and hot weather that they neglected doing anything at all with them. However, there are a few who will have a favorable report to make.

T. H. Scheffer, Minneapolis.—The destruction of chinch bugs in Ottawa county the past season by the artificial dissemination of the *white muscardine* disease was attended with one great difficulty—the total lack of anything like recognized favorable meteorological conditions after the first three weeks after the station was started. After July 10, the condition of the weather was dead against the development of the disease, as well as against the growing of crops, while the same condition was extremely favorable to the rapid multiplication of the bugs. Excessive heat and a prolonged drought in the months of July and August killed the corn and forage crops, so that one cannot safely say what the final results would have been in cases where the earlier experiments had promised success. The station was established on June 11, and the first diseased bugs were given out about a week later. By this time all the wheat had ripened, so that only one experiment (detailed below) was made in this crop. At the time the station was established, the bugs had not appeared in numbers sufficient to attract attention of farmers, many claiming to have seen none at all, and predicting comparative immunity for the season. It was with difficulty that bugs enough to start the infecting cases could be found, the first lot, in fact, being obtained from Dickinson county. A little later, the hordes of young bugs marching from the fields of ripened wheat evidenced the presence of the enemy in full force, and caused a run on the station for infection. A little over 500 packages were given out during the season, 352 farmers being supplied. Distributing points were established at nine of the smaller towns in the county, each of which was visited by myself, and arrangements were made with some local merchant to receive and distribute the packages of diseased bugs, and make reports at intervals.

After two months the station was closed, the drought having left no green crops in which to experiment. A little later, printed blanks for reports were sent out to all who had received infection. Only 40 of these were returned, the other farmers being either too careless or too despondent to attend to the matter. In fact, it is not likely that many of them would have had anything worth reporting, for those reports received covered the earlier part of the season.

The following is a summary of these reports: Crop in which experiment was made was, in every case, corn or forage; weather, as reported by experimenter, was in every case, dry and hot; number of cases in which experiment was attended with greater or less success, 19; number of cases in which experiment was a failure, 16; number of cases in which result was doubtful, 3; no trial, 2. Total, 40. With two exceptions, the infection had, in every case, been procured at the station between June 20 and July 10. The conditions of the weather were very favorable for the

growing crops up to July 4, when the last rain of any consequence fell. The period from June 20 to June 26 was comparatively wet, this county being visited with good showers on the 20th, 21st, 23d, 24th, 25th, and 26th.

The results of my own experiments, of which I undertook three, were in two cases highly satisfactory; in the other case doubtful. The first experiment was made in a field of ripening wheat located in a creek bend, and of about eight acres in extent. The following notes from my field book are pertinent:

June 12.—Visited the wheat field; greener patches of wheat black with young bugs up as far as the heads of the stalks; few old bugs to be seen.

June 16.—Put infection in wheat field along north side, where harvesters had left strip standing; rest of grain in shock; morning damp, a sprinkle of rain during the night having thoroughly laid the dust; field wet down by heavy shower later in the day.

June 18.—Most of the bugs had ceased feeding; running about aimlessly and bunching under clods in handfuls; bunches observed at least 15 rods from infection.

June 20.—Light shower in the afternoon; put out more infection in other parts of the wheat field; some bugs still feeding on green patches of stubble and grass; none observed to feed on north side of field. They could be found massed together among the decaying leaves in the buffalo grass, which formed a mat on the slope at the edge next to the creek; plenty of cast-off skins among them. Placed more infection along the slope, which ran around all sides of the field except the west.

June 21.—Light shower; cool all day.

June 22.—Examined the wheat shocks, which were damp at base, and found fungus-covered bugs plentifully sprinkled about under some of them; also found a few at roots of stubble. Number of live bugs throughout the field apparently un-diminished; stubble, grass along edges and shocks full of them—gathered a clean quart of them from the sheaves in five minutes. All bugs freshly molted or engaged in molting.

June 23.—Good shower of rain. Found white bugs in grass and under shocks and clods in all parts of the field. Live bugs moving about in great numbers.

June 25.—Violent rain storm during the night.

June 27.—Visited wheat field. Scarcely a living bug to be seen in or about the field. Matted grass full of fungus bugs; ground under shocks white with them. Went all over field, and found white bugs everywhere. No live bugs were seen in the field on subsequent visits, so I am disposed to regard the destruction in this case as amounting to practical extermination.

The other two experiments were conducted in fields of corn. Space will not permit me to give full details. In the one case, the field in question had been in wheat, which had partially winterkilled. It was listed to corn late in the season, and long after the spring flight of hibernating bugs usually takes place, so that the young corn was attacked all over the field as it came up by the newly hatched brood. Scarcely a stalk ever reached the top of the furrow. Although the field was several times infected, I never succeeded in finding any fungus-covered bugs, the presence of which is the only positive proof that the disease is in operation.

The third experiment was made in a field of corn almost high enough to tassel. The bugs were coming in on one side from a field of wheat that had just been cut. The first diseased bugs were distributed June 30, on the hills of the fourth row from the wheat. On July 3, as the bugs were still advancing, the tenth row was also supplied with infection. On visiting the field again, July 7, I found that the disease was spreading, as evidenced by the presence of bugs, covered with the characteristic external growth of *Sporotrichum*, in sheaths of lower leaves and pits of stalks. Bugs

were molting in rolled leaves, under broken-down stalks, and between stalk and blades. On July 9, I estimated that the bugs were reduced to about one-fourth their former number. Many of the pits of the stalks and the cracks radiating from them (the ground had now become hard and baked) were lined with fungus bugs. With the help of two boys, three small baking-powder cans full of them were collected. *Sporotrichum* could be found as far in from the edge of the field as any bugs had straggled. Bugs in an adjoining field on the north were plentiful and healthy. The weather had now become so dry that the disease apparently spread no further. Only one very light shower had fallen during the whole progress of the experiment. It was essentially a dry-weather experiment. It may be worth while to mention that the heaviest midsummer flight of the first matured brood of bugs was observed on July 21. Some bugs were seen on the wing, however, as early as July 8.

J. A. Simpson, Mankato.—The county commissioners of Jewell county established a station at Mankato the second week in June, and employed the undersigned as director. We started our boxes immediately, and also commenced a thorough system of advertising. Within two days the infection boxes were quite liberally sprinkled with the white-fungus-covered bugs. Some of these bugs were given out on the second day after starting the boxes. In running the station, we adhered closely to the rules, and tried to impress the importance of so doing on all those who took bugs from the station. During the two months that we had charge of the station, 520 applications for infected bugs were filled. Although many of these were never heard from in a direct report, yet we have reason to believe that a very satisfactory per cent. were entirely successful. Out of the first 50 direct reports, only two were adverse ones, and the failure in each of these was due to negligence in following out instructions. Later in the season, the dry weather seriously hindered the progress of the work. One applicant, of an investigating nature, brought in a dozen or more ladybugs to be experimented with, and, to our surprise, every bug died within three days, completely covered with the white fungus. This experiment was tried several times after this, and always proved successful. One of the most gratifying things in running a station is making friends for the white fungus. It was our pleasure to see many incredulous ones become firm believers. Among those whom we met who had no faith whatever in the disease was Capt. Ed. Kearn, of the southwestern part of the county. Mr. Kearn is a graduate of the state agricultural college, and is still a student. He is one of the most practical farmers in Jewell county, and is a progressive man in every way; but, strange to say, he had never taken any interest in the chinch-bug disease. We met him at the hotel one day and, after talking awhile, he went with us to the station. We showed him our boxes, made some explanations, and gave him some literature on the subject. The next time he was in town he called and took out some infected bugs. His boxes were soon working, and he became a firm believer in the efficiency of *Sporotrichum globuliferum*. It is safe to say that, as a result of the establishment of the station at Mankato, the farmers of Jewell county are much better acquainted with the manner of running the boxes and doing field work, and that the general interest has been greatly increased.

Charles Smith, Russell.—The weather has been very dry and hot since June 20, at which time I got the first infected bugs. I have no trouble to get the infection to work in the infection boxes, but it has not worked satisfactorily in the field since the middle of July. I have been unable to get written reports from all but Mr. Robbins.

Ed. Willoughby, Windsor, Mo.—We started about 20 boxes, and were successful in all of them but the first. We furnished about 200 farmers with the infection, but

only met with success in a few cases in the field. We attribute the failure in the fields to the very dry weather we had at the time we were sending out the bugs. Should bugs be thick here next year, we will try it again, as we do not see why the infection will not work as well in the field as in the boxes, should the weather be favorable.

P. C. Young, Fredonia.—My patrons in the bug line did not report to me, thereby making it very difficult to comply with your very reasonable request. My boxes were in use for about two months, and, as far as my inexperienced observation went, were doing quite well; however, on sending some of my infection to Lawrence for your inspection, it was pronounced bad, and some 100 boxes of your infection were sent me with the advice to use those instead of those produced in my boxes. This was complied with from that on.

III. REPORTS FROM INDIVIDUAL EXPERIMENTERS.

Reports have been received from over 3,000 farmers who made use of the infection during the past season. The following are a few reports, taken at random, which show the general opinion regarding the success of the infection in 1894:

F. M. Akridge, Vandalia, Mo.—Unsuccessful. In regard to the bugs, I tried them according to directions, but never saw any difference only that they increased faster. I got a neighbor or two to send and tell you the result, and sent the bugs with them that you required, and they got bugs, or dust, and we put them in a tight can, then turned them loose, and kept catching and putting bugs in for a week or so and turning them loose, but they still increased all the time till frost. Now the grapes, corn shocks and the roots of the stalks are full of them. If there is anything in your remedy we failed to see it, although we were hopeful, yet maybe we failed to give the proper care or the medicine lost its strength before we got it. So I have n't lost confidence in the diseased bugs, if it is strong enough after it gets here; so you can send me some more in the spring, so I can put it in the field early, before the eggs hatch.

A. G. Anderson, Nilwood, Macoupin county, Illinois.—Successful. It was getting late when I received the bugs, on Tuesday of the week, and placed them in a box according to directions; kept them well moistened, and left them until Saturday morning, when the one-half pint of bugs were mostly dead. I had five acres of late corn with wheat on both sides; the bugs had eaten it clean about 20 rows on the west and north, adjoining the wheat. I placed the infected bugs in several places where the hills were thick with live bugs; in a few days there were very few live bugs, and the balance of the corn was injured but little. We cut and fed out the two sides most injured, and cut and shocked the balance, and sowed the field in wheat. Have not moved any of the shocks yet, but know the fodder is all right. On another field, where I did not put any of the infected bugs, they went all over seven acres of early corn and nearly ruined it. At least half of it fell down before we cut it, and the fodder is very poor feed. I am satisfied, with two years' experience, that the infection can be made a success, if given proper attention.

J. E. Bales, Braymer, Mo.—According to promise, I will try to tell you how the infected bugs worked for me. I think they saved my crop. One of our neighbors got bugs from me, and had good success. The weather was very dry and hot. We

did not find any fungus bugs, but we found dead bugs by the millions, in piles. I would say for everybody to try the infection next summer, if they have bugs, for they will do the work if faithfully attended to, but it takes work. I know I had more bugs in the start than any of my neighbors, and less in the end, and less damage done.

L. M. Ballard, Wichita, Kas.—Successful. I followed your directions. I got about one quart of bugs and put them with the ones you sent me. I let them remain 48 hours, then distributed them all around my field on three sides. The bugs were simply awful on my corn; it looked as though it could not stand four days. I could not see any dead bugs when I distributed my bunch of infected bugs, and I was out of heart and thought they were no good, as I could see no dead bugs. The ground was dry and cracked open. I got to looking into the cracks and found some dead bugs. It rained that night and the next day I found lots of dead bugs. From that time on they died by the millions. I got rid of them and only lost about three acres of corn. They seemed to die the most in the sandy ground, but there were very few on the top of the ground; they burrowed into the ground.

G. Burton, Yates, Randolph county, Missouri.—The bugs proved to be successful in their work. There were some white-fungus-covered bugs found in the infection box, also some dead ones, too. Some white-fungus-covered bugs were also found in the field. The weather was warm and dry when I used the bugs, but the infection took effect and completed the work of destruction on the bugs. In four days after I placed the bugs in the field, the dead bugs could be gathered up by the handful around the hills of corn.

Geo. Coltharp, Leonardville, Kas.—Must say that I was unsuccessful. Followed directions closely. The weather was hot and dry; had no trouble in getting bugs infected. It worked splendidly in the infection box, but after I had distributed them in my cornfield I could find no dead bugs to speak of. I distributed dead and infected bugs for several days and could see no results. The bugs took my corn clean as they went. They ate up eight acres of corn for me after all my trouble. I therefore concluded the infection will not work in dry weather.

James Cross, McLouth, Kas.—Unsuccessful. I am very sorry to say your infection proved to be a failure with me. I was at your experimental station myself and received full instructions; I came right home and had the carpenter make me a box for the purpose, and went right to work and gathered the bugs as instructed, and the most of them would die in two or three days, and I kept plenty of dead bugs on hand all the time, and for as much as three or four weeks before the bugs began to come out of the wheat, I scattered the infection all around over the field of wheat, and then when the wheat was cut they struck the corn adjoining it on two sides, and I was right there to meet them with the infection, and plenty of it, too, and put a teaspoonful of the infected bugs in every hill in one row clear across the field, and repeated this as long as the bugs remained in the corn. The weather was moderately damp, and the bugs were thick. I could catch a quart off of one hill of corn, and I gave Carl Miller the infection you sent him by me. You have his name there, and he worked very faithfully with it too and received no benefit. I received about \$400 damages by them and my time lost fooling with it, and never killed a bug only what I killed in the box, so far as I could see.

A. J. Field, Austin, Mo.—Successful. After receiving the bugs you sent me, I caught I suppose about two tablespoonfuls, and put with them. As I had to pick them up off the ground one at a time from about the roots of the wheat, it was a very tedious undertaking. I put them in a box with the diseased bugs; kept them

in box about five days, and scattered them out through the wheat. Weather was very warm and dry. In about four or five days put out another lot, and kept it up until the wheat was cut. Could not see that I had killed any, though; thought at the time that it was a failure. After cutting the wheat, the bugs went into the corn in great numbers. As I could then catch them easier, I tried it again, with complete success, as I could find them piled up most every place. In the meantime we had two or three rains. I find that the disease spreads much more rapidly when the earth is damp and moist. I am satisfied they saved me from \$200 to \$300 worth of corn. I think it one of the greatest discoveries of the age. Some of my neighbors that used diseased bugs were also successful in saving their crops, while others that did not use them lost a great deal of corn. I am satisfied that if all the farmers would take hold of it and scatter infected bugs through their fields, they could exterminate them.

W. A. Gallaher, Baden Baden, Bond county, Ill.—Successful. I followed your instructions after receiving the infected bugs. I found that in from two to three days I could propagate the disease on the healthy bugs, in a box that I provided for the experiment. I then distributed the dead and diseased bugs in the roots of the corn. I find that the best time to place the diseased bugs on the corn is just after a shower. Again, I find that I cannot spread the infection during very dry weather. We had an unusually dry summer here, and the result of my experiment was not altogether gratifying. I gave infected bugs to my neighbors for experimental purposes, and they secured about the same result that I did. I think the best time to distribute infected bugs is in the growing wheat just before harvest; in that way we get at the first crop of bugs. I find that the fungus disease is peculiar to the chinch bug, and often this disease springs up spontaneously when conditions are favorable to the development of the disease, as wet weather. I worked under instructions of our state entomologist, S. A. Forbes, with good results, notwithstanding the drought of last summer. I will try again next summer, and will commence my experiments in the wheat fields, as I have a quantity of dead bugs that I will carry over for that purpose. I think if all farmers of the infested chinch bug localities would labor together with the white-fungus disease, with favorable weather, would almost expel the bugs—the greatest enemy that the farmer has to contend with.

R. L. Gilbert, Sarcovie, Kas.—Successful. On the 27th of June, 1894, I carried a bottle of healthy chinch bugs to the University, was shown by the attendant the process of propagating the diseased bugs, and received two boxes to take home. I made up a box that night, and on the 30th another, and put in the balance of my infected bugs. I examined the boxes every day, and soon began to find diseased and dead bugs. On the 2d of July put out my first lot of infected bugs; we had quite a little rain the night before. On the 5th put out more, and again on the 9th. On the 12th took out more, and soon found streaks of dead bugs all along the rows where I had put out the first and second time. On the 14th I took out more, and found dead bugs all around. That time I could hardly find enough live, healthy bugs to take home to put in my infected boxes; the whole field seemed to be very sickly. I am satisfied that if I had not done something I would have had no corn in that field of any account, as the corn was black with bugs 50 or 60 rows from the edge of the wheat field where they first entered. After putting out the infected bugs they did not seem to go much further, and I had to stop trying to get live ones, they were so hard to find. The field made very good corn for the season, even where it seemed they had killed it. A neighbor had corn north about 60 rods on the other side of the wheat field. The diseased bugs must have traveled that way, as there was any amount of dead bugs in his field, and he had fair corn. I tried some in-

fecting bugs in another field of corn, but after the dry weather set in I could see no material difference. I think it needs some rainy time to work to perfection. I am satisfied if the directions sent out are properly followed success will follow.

Jonathan Gore, Vinita, I. T.—Successful. Will say that I am fully convinced that the introduction of the bugs in my cornfield saved 50 acres of corn. The bugs had made a fearful invasion and had destroyed 15 acres of my corn before the bugs arrived. I took great pains and scattered the bugs myself. In a few days, to my utter astonishment, the bugs left the field, and I had plenty of corn and some to sell to my less fortunate neighbors. I regard the introduction of infected chinch bugs in our country as a very great blessing to the farmers.

A. Green, La Cygne, Kas.—Successful. My experience with your chinch-bug infection is, that it is the best thing that ever came to Kansas. When I commenced with your infection, we had millions of healthy, ravenous bugs, on 25 acres of wheat and 15 acres of oats. We commenced to spread out with the infection; we could not see that it was doing much, but they did not appear to eat and work like they did. We saved our wheat and oats in fine shape, and before we cut it we found millions of dead bugs piled under dead cornstalks, so we quit attending to them till they got into a piece of corn, which they injured some, but that was our fault. We cannot speak of it too highly. We furnished the neighbors for miles around with dead bugs.

B. R. Henderson, Eskridge, Kas.—Successful. I can truly say again that the experiment was entirely satisfactory; was well pleased with the result. The weather during the trial was generally favorable, being more or less damp. I experimented on wheat, oats, and corn, and believe the result was good on each. I found quite a number of the white-fungus bugs in all of the different crops. I let some of my neighbors have bugs, and some of them had satisfactory results while others failed; but I believe the failures were on account of the neglect on the part of the experimenter. I firmly believe you are doing good work in this line, and if the farmers generally would take more interest in this matter it would be of untold benefit to the farming community.

Isaac V. Holmes, Beloit, Wis.—Doubtful. I would report in regard to the inoculated bugs received, that we infected from them, and they were distributed to several of our neighbors who were troubled with the bugs. I also personally tried them on our field of corn. The trouble here was, first, we did not get the infected bugs early enough; secondly, when they were tried, it had become very dry and hot, and there was no rain, there only being three showers in three months. There was no trouble in infecting the bugs in the boxes, but when distributed in the fields the effect was very slight. I attribute the failure to not commencing early enough in the season, when the ground was moist, and to our trying to use them when the drought had become severe and there was no moisture to develop the fungus in the field.

Thomas Jamieson, Hoge, Leavenworth, Kas.—Doubtful. The directions were followed minutely. Just after putting the bugs in the field a very heavy rain fell; immediately the bugs nearly all disappeared. There were no dead bugs to be found. I could not tell whether their disappearance was caused by the infected bugs or by the rainfall. I have frequently noticed that after a heavy rain the bugs scatter out through the field, but this time they almost all disappeared, which would lead one to believe that the infection had some effect on them. As I cannot satisfactorily fill out the within card, I must leave you to draw your own conclusions from the above.

P. L. Jenson, Denmark, Kas.—Successful. I received a box of chinch bugs from you about the 4th day of July, 1894, and I did according to directions. I will say that after about a week the chinch bugs were all dead, and it saved all my corn-stalks, and I let two of my neighbors have some infected bugs, and they proved satisfactory also. I also discovered that where I had used infected bugs last year, in those fields there were no bugs this year. I am sure that if everybody would use infected bugs, in a few years we would have no chinch bugs.

Edwin Lindstrom, Smolan, Kas.—Unsuccessful. My experiment is a failure. I got a dose of infected bugs and treated the bugs according to directions for about two weeks, but without success. I sent for some more and tried again to get the disease to spread in the boxes, and after one week's trial I found 8 or 10 of the bugs I had gathered dead and fungus covered. I thought of giving it up, but thought I would try another week, and after that week was ended I had a few more dead and fungus covered bugs. I tried another week, and then in all I had about 30 or 35 bugs dead and fungus covered. My neighbors thought I had starved those to death until they looked into the boxes and saw that they had increased so that they were about four times as many as I had gathered. I gathered about 500 or 600. I thought to let them in the field again, but my neighbors asked me for mercy's sake to not do so, but to kill those I had got hold of, and so I did. I'll hereby say, that it is no humbug, but it works too slow.

P. G. Lowe, Leavenworth, Kas.—Successful. My experiments were not so satisfactory as the year before. The inclosed slips explain two fields. The rye was completely destroyed, after which the corn was considerably injured. In the rye I used the infected bugs kept over from the year before. Believing that all the bugs on my farm were in the rye (where I had them in corn the year before), I exhausted all of them there, and thought I had them under control until they suddenly became numerous in the corn. The millet and cornfield is half a mile from the rye and corn. Without seeming to come from any place, the bugs were found scattered all through the millet, compelling me to cut it two weeks too soon in order to save it. I left a strip a rod wide next to the corn, hoping to check them a little and give the corn a chance, but they soon reached the corn and did some damage. When I found them in the millet, I sent to you for infected bugs, and I worked faithfully according to directions, having a good box. I found great quantities of dead bugs, and checked the vigor of those not found dead. In my pasture adjoining both corn-fields, where there was plenty of foxtail, I soon saw signs of bugs. They are very fond of foxtail, and I expected to see them emerge from the cornfield and move into the pasture, but they did not. Where I had millet I sowed wheat, and it did well, with no signs of chinch bugs in it. I think this indicates that the bugs did not leave the cornfield, unless they flew out, and that they mostly died. Notwithstanding the unfavorable season (too dry), and notwithstanding I commenced too late where the millet was, and did not do very good work where the rye was, I had 35 bushels of corn to the acre. So that, you see, my impressions are to the effect that I was too negligent in one field and too late in the other, but that the destructive element was in the infected bugs and did a great deal of work, and if applied sooner and more faithfully, might have saved all my corn.

C. T. Manchester, Bellaire, Kas.—Successful. Before sending to you for infected bugs I procured some from neighbors' fields and scattered them in my corn. It was some time before they took any apparent effect; then they began to die by the thousands and did no further damage. They first appeared in the center of my 90-acre field and had taken about one acre before I discovered them. They were very numerous, and before the infection had time to take effect they had scattered over

about 40 acres, but the infection stopped them, and in about a week there was none left to speak of; and, although it was dry and corn was considered a failure, I raised 400 bushels, but without the infection I do not think I would have had even good fodder.

E. A. Markey, Warrensburg, Mo.—My first trial was with some infected bugs sent from the station by you, and was a failure. The second attempt was from infected bugs received from your assistant. In putting them on the field of corn, I only had time to scatter on one row of corn. I went over the field seven days afterwards, and found the infection on 15 rows of corn. I then gathered more bugs, in all about one quart, and infected them, and scattered them on the same piece of ground. During this period a shower of rain fell, and the sun came out warm. The results were very surprising, as the infection had not only spread over that field, but to a field one-fourth of a mile north; also to the wheat field lying between the two. The weather then turned hot, and, as the ground got very dry, I could not succeed in infecting bugs any further in the fields. I believe that where one can have the time to spend on this, and in the right kind of weather, success will crown his efforts.

E. Marquis, Mulberry, Kas.—Successful. The weather was very hot and dry for about eight days after I began scattering out the diseased bugs. I could see no effect from them at all, and was getting discouraged; thought it was no good; then rain came, and, to my astonishment, the disease seemed to take them like magic. They were dying by the thousand, with the white fungus on their backs. The result proved to be an outright success.

A. E. Martin, Assaria, Kas.—Doubtful. As to the result of my experiment with chinch-bug infection, I cannot say whether it was successful or not, but will tell all I can about it. When I first sent to you for infected bugs, last July, the chinch bugs here were coming out of the wheat fields in countless numbers, and first attacked a field of sorghum, where they killed about an acre in a very few days, but later they did not seem to work as fast. I took the bugs you sent me and put them in a box according to directions. When the time was up I took the bugs and scattered them through the fields. There were quite a number of white-fungus-covered bugs on the bottom when I did so. Some days later I went to examine the fields, and, upon overturning lumps of earth, I found what appeared to be large bunches of dead and dying bugs, but not any white-fungus-covered ones; yet I thought that it was due to the infection. Later in the day I went over to two of my neighbors and found that the bugs were bunched and almost disappeared out of their fields, also, although they had used no infection. Later on I sent you some of those apparently dead bugs, but which upon your examination proved to be only dried skins, as you told me in your reply. I kept the infection box going for two or three weeks, but after the first time I was able to find very few fungus-covered bugs on the bottom. The weather at the time was extremely dry and hot, which I suppose was not favorable, but the chinch bugs did very little damage after I started to use the infection; but as this was equally true of fields where no infection was used, I cannot say what caused them to cease doing injury.

S. E. Miller, Roxburg, Kas.—Successful. I think it was a success. Think I saved a field of sorghum and a part of a cornfield. Had a field of rye, and, as it was ready to harvest, I scattered bugs thick along No. 1 line. Had not bugs enough to go through between the corn and rye, so gathered more bugs, and when they were ready to scatter, went to No. 1 line and found bugs in the sorghum from 10 to 40 feet. Thought at first the crop was gone, but on closer examination I saw that there was something the matter with the bugs; they were not on the stalks, but were running

around on the ground; in short, the ground was red. Then I went on to the cornfield to see if they were like the others, and found them all right. The corn was black all through No. 2 part, but No. 3 had no bugs, so I went to fighting on the double dotted line and saved No. 3, but No. 2 part they took slick and clean and not a stalk remained. I had a neighbor go on No. 1 line and he said it was a humbug; that it was the sorghum that had killed them. The next day I was riding by a sorghum field three miles from mine and the bugs were taking it. They were in it about 100 yards. I got over into the field and found them lively and well. Sorghum had n't even made them sick. Then I went to work on my corn in dead earnest. Got dead bugs and live bugs from No. 1 line and carried them over to my fighting line, and as a result I saved my sorghum field and the No. 3 part of my cornfield.

James Molby, Wellbote, Kas.—Successful. I failed to keep any dates or memoranda, as I had exhausted my enthusiasm and well nigh my faith working with some bugs given me by a neighbor before receiving those from you. The infection sent by you worked like a charm. I don't think a bug escaped from the field where I placed it. I have a box of dead bugs which I shall test on the first handful of bugs I can capture in the spring.

A. J. McAllister, Heber, Kas.—Successful. On Monday, July 2, gathered about one pint of bugs, put them in a box, as you described in directions, and placed the box in the cellar. On Friday afternoon Mr. Foster called to see what my bugs were doing. We opened the box out in the dooryard; found quite a number of dead bugs, (we were in the open sunshine,) perhaps one-tenth of the amount, and the live ones were scrambling to get out and crawling over each other. We discovered that those that were getting out were dying as fast as exposed to the sun. My eyes are getting dim, but I could see that all were covered with the white fungus. I have a small field (four acres) back of the orchard that was sown to wheat. The wheat was harvested this same morning. There is a draw crossing diagonally this piece of land, and in the draw is a patch of elders, grown up through the wheat. The wheat was tall, rank, and green. So the boy drove the harvester around this little patch, about two rods long and one rod wide. In a short time the bugs were all gathered in this standing grain and elders. I think it a reasonable statement when I say that there were a bushel of bugs in that patch. I took my box of infected bugs right down there, knowing that there was moisture and shade, and in just five days I never saw the like here; they were so piled up that I could have scooped them up with a shovel. They had a disagreeable smell, and their appearance was as if they had been covered over with a thin syrup. Where they lay thin they were covered with white fungus. I had intended calling in my neighbors to witness the destruction, but a heavy rain spoiled that. An idea now struck me: that as soon as the grain is cut, if the field is invaded with bugs, haul some green brush as soon as there is sufficient width cut, and throw a few about 20 rods apart. It is shade the chinch bugs hunt for. First have your infected bugs ready, and those that accumulate there will never leave. Across the road Mr. S. E. Smith had 40 acres of wheat, and opposite that I had 50 acres of corn. The bugs crossed the road and through the hedge in a single day, until the corn was full for three rows in. Scattered bugs all along. They accumulated around the roots and died, right at the time. The drought set in, and we had but little corn; but it was not destroyed by the chinch bugs.

Michael Neuhalfen, Doniphan, Hall county, Nebraska.—Successful. Did not follow the directions closely; did not have the box in a sunny place; just scattered a few infected bugs in one end of the field, and in a week the field was clear. The re-

sult was excellent. The bugs were checked in their destruction of crops. They were partially exterminated in the field. Saved about 250 bushels of oats. Did not save corn, as there would not have been any anyhow.

C. W. Peter, Randolph, Kas.—Successful. I received the infected bugs you sent me and gave them a thorough trial. I had a piece of winter wheat in which the bugs bred, and were there by the millions, and on the south of the wheat I had oats, and on the north, corn. They moved into the corn the full length, 80 rods, and in this corn I put the infected and dead, molded bugs and put them out a number of times. I had two boxes and kept a good supply on hand, and will say it worked to a charm in the boxes, and I think I did a thorough job scattering them. About this time we had a number of good rains and I noticed after a few days quite a good many dead bugs; but on the south of the wheat, in the oats, where I did not put any dead or infected bugs, I found them in piles, dead by the millions. They were found in piles, dead, in my neighbors' fields also. I believe they will take the disease and die, if the ground is wet, or there is sufficient moisture.

S. F. Ralston, Walnut, Kas.—Unsuccessful. In reply, will state that it was not a success in my case, but perhaps it was partly my fault, as I had to be away from home so much of the time that I could not attend to it as should have been done. I had to leave it to my youngest boy, 14 years old. He attended to it as well as he could. But we had such very dry weather just as the wheat was cut, and the bugs were so thick that they just went into the corn in swarms. That field of corn was late planted, and between the bugs and dry weather it will not yield five bushels of corn to the acre. And another thing, the corn was too thick on the ground, averaging, perhaps, three stalks to the hill, which is at best too much for our thin, hard-pan land. All these different causes effected an almost entire failure of the crop.

H. C. Reeder, Wichita, Kas.—Successful. When the infected bugs arrived, I gathered and infected them, and put them on each side of my field, for there was no bugs in my field to infect. Now for an explanation: Last year I got infection from you, and I "paralyzed" every chinch bug in my field, and I believe the infection lived through the winter, and, consequently, no bugs. I also furnished infected bugs to a neighbor who had a fine field of corn. There was wheat on each side of his cornfield, and those wheat fields were full of chinch bugs. When the wheat was cut, the bugs went into the cornfield by the wagon load. I gave him infected bugs, and told him to gather two wooden water buckets full of bugs from the field, and 48 hours after he put out the first lot, and I had him put them out every three days for two weeks. After the first lot went out the bugs stopped work. He only lost about four acres of his corn—two acres on each side—the balance made good corn, except what was cut short by the drought. Some of his corn made 40 bushels to the acre, and was a great success.

Frank Robertson, Lowmont, Kas.—Successful. I sent for some of your infected bugs last June and used them according to directions, and found it to work beyond expectations. After scattering them over the field, it was n't but a few days till they commenced to die in great quantities all over the field.

Wm. Rogers, Lee's Summit, Mo.—Successful. I received infected bugs from Mr. Wm. Hoke, of Lee's Summit. Perhaps you would like to know the result. Well, I had 18 acres of millet adjoining 90 acres of wheat badly infested with bugs; so I considered my millet doomed. I thought I would make an effort to save it. In two days after wheat was cut the bugs had killed the millet five or six rods from the fence. On Tuesday I got the infected bugs, and gathered about a quart of bugs; on Thursday I scattered them among the thickest of the bugs. I thought it was a

hopeless case. On the following Tuesday I was in the field scattering another lot; the bugs had made very little progress since I scattered the infected bugs. They had gathered in heaps, some dead. The live ones would crawl under the dead ones and under corn stalks and some running in all directions; some would turn white. They did very little damage afterwards. I cut a good crop of millet. I found a few spots where some of the old ones had flown ahead of the others and deposited a fresh lot of eggs, in thin spots that I did not notice until I commenced to cut the millet. I was very persistent in scattering the infected bugs. I had no wheat, but I will give you my opinion on fighting them in the wheat fields early in the season. I think the greatest difficulty is to get the diseased bugs in contact with the others. I find the old bugs remain in and around the roots of the wheat. I think care should be taken to put the diseased bugs in the roots of the wheat, as the diseased bugs are not able to crawl very much, and soon die.

J. M. Smith, Baxter Springs, Kas.—Successful. The fact is, the chinch-bug infection you sent me was most satisfactory. The bugs, when I wrote you, were very bad in four pieces of corn on the place I am on. I got the bugs, and we went at them. In a few days they were all gone, and let me tell you when we commenced on them we could gather a quart in five minutes. I then commenced to give the infected bugs to my neighbors, and all tell me the same story; the corn was saved, and as many as 10 or 12 men are ready to testify to this statement.

Stephen Stagg, Tonovay, Kas.—Unsuccessful. I had practically no success with your remedy. I kept the bugs, as instructed, for one week in a box, dampened (so much so that some mold came in the box), but not to excess, and out of hundreds of bugs continually coming in contact with them I only found a very few, say 6 to 12, of fungus bugs. I then turned some out and got a lot more fresh bugs in; kept them in a week, and did the same with them; then I got more fresh, and, after keeping them in the house a few days, I carried the box, bugs and all, right into the cornfield, and, as some could crawl out all the time, I thought that I surely would find plenty of dead bugs on the stalks in close proximity to the box, but was disappointed. I tried all I could think of, even to placing individual bugs in the joints of the leaves, amongst the live bugs, but I saw no results; they gradually gained on my cornfield till they became dispersed generally through it. They came in from oat stubble adjoining, and, I am sorry to say, I did not go along the first six rows of corn when they first started and knock them off into a box and burn them, for I know I could have killed four-fifths of them that way; but I wanted to give your fungus a fair show, so left them, and now I have no faith in the remedy. The weather was fairly favorable, the ground moist all the time, as we had one or two rains about that time—it was the latter part of June, I think. You may not remember, but when I wrote you first, I inclosed you some dead bugs I found in the oat field, and you pronounced them true fungus-dead bugs—that was before receiving any from you. Now, my opinion is, that the fungus may attack old bugs when they are about played out, or after they are dead, but not a good, healthy, lively bug; or how could thousands of them pass and repass over the dead ones in the box, as I have watched them do, and still no results occur. It would be a grand thing for Kansas if it were a sure thing, but it is so doubtful and so much trouble to carry out, that I do not hope for relief from it. The bugs kept breeding right along, and young ones getting thicker all the time I was treating them. I hope you may yet give us some surer relief, though I think there will not be much oats or wheat planted here next season.

L. W. Truesdell, Concordia, Kas.—Successful. We followed directions as nearly as possible, and with great success. We had about 14 acres of corn, with wheat on

the south and oats east and west. Finding the bugs were about to take it as the small grain was about to ripen, we put the bugs (infected) in the edge of the wheat and in the corn, and that was the last of them. East of the oats we had 20 acres of wheat, which we plowed up about the 10th of June and put into corn. When the corn was up ready for the cultivator, we found that it was alive in spots with young chinch bugs; we at once distributed infected bugs, and that was the last we heard of them. The man who cultivated the field said he saw no more of them north of that field; and east of the wheat field a tenant had a piece of late corn and the bugs came in from the wheat stubble on the west. He had, by my advice, sent to you for infected bugs, and was prepared for them. He told me that one infection finished them. We believe the infection has been a decided success on our farm of nearly 400 acres—tried by ourselves and two tenants.

D. J. White, Clements, Kas.—Successful. When I first put them out, early in June, the bugs were very scarce, and the ground dry; therefore, it was almost impossible to do the work properly, and I only put out one batch of infected bugs; but, after the rains in the latter part of June, the bugs began dying in great numbers, the ground being covered in places with fungus-covered bugs. The disease worked so effectively that the bugs did no harm to corn in adjoining fields after my wheat was cut.

Stephen Wilson, Washington, Kas.—Unsuccessful. I received the infected bugs in due time, and I complied with the instructions you sent in regard to starting the infection in boxes, and succeeded admirably. Scattered some at three different times in the cornfield, but the disease had no effect at any time in the field, but I was not at all surprised, as rain, dew or moisture of any kind was apparently a thing of the past. Yes, I verily believe, under favorable conditions, that it would be a success; anyhow, I intend trying again next year. Yet, what good can one man in a community accomplish, when people on all sides of him are indifferent to the matter?

IV. SUMMARY OF RESULTS OF FIELD EXPERIMENTS IN KANSAS, FOR 1894.

County.	82 KANSAS COUNTIES.	Suc- cessful.	Unsuc- cessful.	Doubt- ful.	Total.
Allen	3	1	..	4
Anderson	16	4	6	26
Atchison	15	16	8	39
Barton	2	4	1	7
Bourbon	15	15	10	40
Brown	2	5	3	10
Butler	7	7	7	21
Chase	11	9	11	31
Chautauqua	4	1	2	7
Cherokee	11	5	5	21
Clay	31	26	23	80
Cloud	29	30	11	71
Coffey	7	3	3	13
Cowley	2	2	1	5
Crawford	20	10	11	41
Decatur	1	1	..	2
Dickinson	11	9	2	22

<i>C.nty.</i>	KANSAS COUNTIES—CONTINUED.	<i>Suc- cessful.</i>	<i>Unsuc- cessful.</i>	<i>Doubt- ful.</i>	<i>Total.</i>
Douiphan.....		3	..	1	4
Douglas.....		52	54	39	145
Edwards.....		..	1	2	3
Elk.....		4	2	2	8
Ellis.....		5	6	..	11
Ellsworth.....		11	18	3	27
Ford.....		2	..	..	2
Franklin.....		8	6	7	21
Geary.....		7	4	1	12
Graham.....		1	2	..	3
Greenwood.....		30	15	11	56
Harper.....		1	..	..	1
Harvey.....		8	4	1	13
Hodgeman.....		..	3	1	4
Jackson.....		8	7	5	20
Jefferson.....		43	47	32	122
Jewell.....		6	2	..	8
Johnson.....		28	12	9	49
Kingman.....		2	..	2	4
Kiowa.....		..	1	..	1
Labette.....		1	5	2	8
Leavenworth.....		29	27	19	75
Lincoln.....		14	7	5	26
Linn.....		13	17	11	41
Logan.....		2	2	..	4
Lyon.....		6	2	2	10
Marion.....		19	23	14	56
Marshall.....		25	12	10	47
Miami.....		3	11	3	17
Mitchell.....		20	23	19	62
Montgomery.....		5	3	1	9
Morris.....		10	12	4	26
McPherson.....		4	6	1	11
Nemaha.....		8	15	5	28
Neosho.....		7	3	3	13
Ness.....		..	3	3	6
Norton.....		3	9	6	18
Oaage.....		16	14	3	33
Osborne.....		6	5	2	13
Ottawa.....		5	1	3	9
Pawnee.....		9	7	8	24
Phillips.....		6	9	5	20
Pottawatomie.....		43	22	18	83
Pratt.....		..	1	2	3
Rawlins.....		1	..	..	1
Reno.....		8	1	2	11
Republic.....		7	7	2	16
Rice.....		14	15	10	39
Riley.....		22	14	24	60
Rooks.....		7	6	4	17

<i>County.</i>	KANSAS COUNTIES—CONCLUDED.			<i>Total.</i>
	<i>Suc- cessful.</i>	<i>Unsuc- cessful.</i>	<i>Doubt- ful.</i>	
Rush.....	4	6	1	11
Russell.....	11	3	6	20
Saline.....	16	29	19	64
Sedgwick.....	5	2	3	10
Shawnee.....	29	26	13	68
Sheridan.....	..	1	..	1
Smith.....	10	6	2	18
Stafford.....	5	6	3	14
Sumner.....	1	2	..	3
Trego.....	..	..	1	1
Wabaunsee.....	18	17	19	54
Washington.....	33	24	21	83
Wilson.....	2	1	..	3
Woodson.....	6	4	2	12
Wyandotte.....	11	5	2	18
Totals.....	875	741	403	2 019

V. SUMMARY OF FIELD EXPERIMENTS IN OTHER STATES.

<i>State.</i>	<i>Suc- cessful.</i>	<i>Unsuc- cessful.</i>	<i>Doubt- ful.</i>	<i>Total.</i>
Arkansas.....	3	2	..	5
Illinois.....	15	22	15	52
Indian Territory.....	15	4	4	23
Iowa.....	1	1	3	5
Michigan.....	..	..	1	1
Minnesota.....	1	..	..	1
Mississippi.....	1	..	..	1
Missouri.....	126	126	64	316
Nebraska.....	14	9	10	33
North Carolina.....	1	1	..	2
Ohio.....	1	1	1	3
Oklahoma.....	11	16	11	38
Texas.....	1	1	..	2
Virginia.....	..	..	1	1
Washington.....	1	..	..	1
Wisconsin.....	5	2	1	8
Totals.....	196	185	111	492

VI. EXPENSES OF THE KANSAS UNIVERSITY EXPERIMENTAL STATION FROM FEBRUARY 16, 1894, TO APRIL 6, 1895.

Paid for materials and supplies in laboratory:

J. N. McFarland & Son, 20 infection boxes.....	\$30 00
Duncan & Stevens, iron hooks and eyes.....	1 07
A. D. Weaver, cotton.....	30
Richard Kny & Co., apparatus.....	7 60
Bausch & Lomb Optical Company, apparatus.....	27 75

\$66 72

Paid for office supplies:		
Tracy Learnard, pencils, pens, ink, etc.....	\$8 31	
A. C. McClurg & Co., copy books.....	6 80	
E. S. Tucker, photographs for plate work.....	50	
Geo. Leis Drug Company, 170 gross of tin boxes..	56 80	
Lawrence Journal Company, paper and printing.....	12 00	
G. J. Graves, paper.....	2 60	
		\$87 01
Paid for extra office help:		
G. J. Graves.....	\$30 25	
R. L. Stewart.....	184 83	
Frank Snow.....	5 80	
F. B. McKinnon.....	149 94	
Geo. O. Foster.....	1 10	
		371 92
Paid for traveling expenses:		
W. A. Snow.....	\$32 52	
V. L. Kellogg.....	8 18	
Wm. McMurray.....	15 00	
F. H. Snow.....	25 00	
		80 70
Paid for labor in laboratory:		
O. P. Davis.....	\$64 51	
A. O. Garrett.....	63 02	
L. M. Flint.....	35 40	
F. E. Marcy.....	104 33	
W. H. Menke.....	10 00	
J. E. Baker.....	5 10	
C. W. Baldrige.....	2 25	
M. A. Barber.....	116 62	
		401 23
Paid for freight, drayage, and express.....	\$73 33	
Paid for postage.....	489 56	
Paid E. E. Söderstrom, making resumé of French scientific work,	3 80	
Paid J. H. Henderson, printing.....	4 10	
Paid Teachenor & Bartberger, making three zinc cuts.....	1 60	
		572 39
Total.....		\$1,579 97

EXPERIMENTS WITH CONTAGIOUS DISEASES OF ANIMALS AND INSECTS OF EUROPE.

Mr. Jean Danysz, of the Pasteur Institute, has given a detailed account* of recent experiments for the transmission of contagious diseases among noxious animals and insects. As his methods and conclusions are of immediate interest to American farmers, it is thought best to embody herein a resumé of his report.

When insects and rodents appear in great numbers they succumb to contagious diseases, but unfortunately these epidemics come spontaneously only after the crops have been destroyed. Many experiments tried in recent years have shown that rodents can be artificially infected with great success. Field mice are the most numerous of European and American animals. Of the several species of field mice, *Arvicola agrestis* or *arvalis* and *A. subterraneus* are the most widespread and dangerous to crops. They appear suddenly towards the end of summer in legions, attacking forage plants, cereals, vines, and young trees. Nine great invasions of these field mice have been noted in France from 1822 to 1892. These animals were formerly thought to be migratory, but late researches have shown that all are born near where they are found, sometimes spreading to adjoining fields only. The intensity and rapidity of their invasion is due to incredible fecundity and the preponderance of the females. The progeny of a single pair may number 350 individuals in a year. When the number becomes extremely great in a given locality they lack for food and become an easy prey to disease. Epidemics occur spontaneously, and so nature herself furnishes means for destroying these pests, but not at the right time. To turn these artificial diseases to advantage it is necessary to regulate them, to choose one that is injurious only to rodents and not to farm animals, and to create centers of infection at a time most favorable for preventing invasions.

A microbe found on a field mouse killed by an epidemic in Seine-et-Marne is a bacillus. It develops rapidly in all known artificial nutritive media. It presents very dissimilar features according to the media and the conditions of culture. It has been found to be virulent for all species of moles, domestic mice, wood and garden mice and black rats in France. Its action on big gray rats is less apparent. It is always fatal and extremely contagious. At an autopsy, there is generally found hypertrophy of the spleen,

*Maladies Contagieuses des Animaux Nuisibles leurs Applications en Agriculture, in *Annals de la Science Agronomique*, 1895, page 1.

fatty degeneration of the liver, and general congestion of the intestines and the peritoneum. Cohabitation suffices to communicate the infection. A hypodermic injection of 0.1 cc. of a decoction of cultures of 24 hours' standing generally kills the mice in 12 to 24 hours.

Before putting virus at the disposal of the farmers, experiments were made with rodents in the fields belonging to two agricultural schools. In the first few days of March, 1893, pieces of bread impregnated with the virus were distributed in the infested fields. From the fourth day afterward, dead mice were found in the field and in adjoining fields lying on the surface of the ground. In April, the field was partially plowed, and subterranean passages were brought to light filled with the bodies of mice all more or less eaten. The rapid propagation of the disease is partially due to the fact that the mice eat their dead. In immediately adjacent fields, as in the ones experimented upon, the mice were exterminated. No injurious effects were noted in the farm animals that eat of the dead mice.

After the efficacy of this virus had been shown by actual field experiments, the farmers demanded its application to their own fields. Trials on a large scale in different parts of France were made with complete success. The expense amounted to 3 fr., 15 cents, per hectare.

In a storehouse at Amiens, all the mice (*Mus musculus*) disappeared in 20 days after the distribution of the saturated bread. As in a neighboring storehouse they kept on increasing, their disappearance must have been due to the virus.

In the instructions furnished the farmers, it is recommended that two or three distributions of the saturated bread be made in order to completely eradicate the pest. The mice are most numerous in August and September, and the virus acts best at that time on account of their density.

The first distribution of impregnated bread should begin in August, right after the harvesting of cereals, and continued in September and October in fields of beets, potatoes, etc. This first application generally destroys 90 to 95 per cent. of the mice. The epidemic thus started continues of itself for at least six weeks. One month or six weeks after the first distribution, the impregnated bread should be placed at all the new holes in the field. The total cost of three distributions should not exceed more than 5 francs per hectare (about 50 cents per acre). If the whole farm cannot be treated at once, portions of it can be infected at any time, as the rodents are not migratory.

The virus preserves all of its properties in the laboratory for several months. A maximum virulence is obtained from 5 to 20 days after the preparation of the tube.

For the destruction of the large gray rats (*Mus decumanus*), which cause annually numerous losses to crops in many countries, a stronger virus must be used. The same microbe, rendered more active by a series of inoculations on these rodents of larger size, is found to act as successfully as does the weaker virus in the case of the field mice.

M. Danyz treats at length also of the muscardine on the hedge chafer or June bug (*Melolontha vulgaris*). This fungus disease is called by M. Giard *Isaria densa*, and by Messrs. Prillieux and Delacroix *Botritus tenella*. It is also called the rose-colored muscardine, to distinguish it from other similar fungus diseases. The white grubs or larvæ of the hedge chafer present a rose color when dead from this disease. In dry and sandy soils the bodies of the grubs so killed are hard, brittle, and covered with fine down, excepting on the head and legs. In wet, clayey soils the fungus, besides the white shroud, sends out numerous prolongations sometimes 2 or 2½ inches in length, which hold together pieces of earth, roots, and other grubs. These dead and mummified grubs are found at a depth of 8 to 12 inches. In the beetle the white covering occurs only on the ventral surface of the head, thorax, and sometimes the end of the abdomen. The fungus becomes easily transmissible only when its spores are matured, and it can only be used in this state to spread contagion. Wind, rain and living beings are the agents for spreading the disease, by scattering the spores.

Not much success has yet been had in the artificial dissemination of this disease in the field, but these poor results are due only to insufficiently studied methods of procedure. The destruction of beetles and grubs by natural epidemics of muscardine being a fact, it does not seem impossible to propagate these diseases artificially. From researches made by Dufour, it is proved that spores collected from dead insects are more virulent than those developed from artificial cultures. Laboratory experiments by Delacroix and others have shown good results. Forty to fifty per cent. of the beetles treated succumbed. The experiments so far have been insufficient, and the following points must yet be determined: (1) Composition and preparation of nutritive media that will give the greatest virulence and the greatest number of spores; (2) method of using these spores to contaminate the greatest proportion of the subjects treated; (3) the stage of development of the insects most favorable to infection; (4) the method of procedure to obtain the virus at the lowest price.

M. Danyz also recommends that every farmer or commune set apart a small trial field in which to propagate the muscardine on the white grubs, and to proceed carefully, observing everything bearing on the subject. In the following year adjoining fields should be infected from the trial field, and this should be kept up for three years. He thinks that one of the most important factors toward the ultimate success of the muscardine as a white-grub eradicator is its use by *all* cultivators.

It is probable that in whatever soils it can develop the muscardine lives in the ground in the state of a saprophyte; that it first attacks subjects most disposed to contract the disease, and that, having regenerated its virulence in passing through the bodies of the first white grubs attacked, it becomes, or rebecomes, a parasite. By continuing to infect the June bugs and their larvæ by means of artificial cultures, the virulence of the fungus can

be maintained; and by multiplying centers of epidemic, one will simply aid nature to spread the disease rapidly and to render it more intense.

In addition to the results achieved in America, the work and experiments of the Russian scientists, Metchnikoff and Krassilstchik, have shown that it is possible to find on insects invading fields in great numbers parasitic fungi which destroy them, and that these fungi can be cultivated on artificial nutritive media, and, so to speak, manufactured as an article of commerce.

The numerous trials of the infection of white grubs made in France in the last four years have shown incontestibly that, in the struggle with the underground insects, the processes of Messrs. Krassilstchik and Snow can never give appreciable results. An insect like the chinch bug runs around actively, comes in contact with others, and the spores are quickly disseminated. On the other hand, the white grub, being isolated in the soil and slow of motion, and the muscardine being of comparatively slow growth, the methods applicable to the treatment for the chinch bug cannot be applied here.

Insects living on or above the surface of the ground can be treated with success by the methods adopted by Krassilstchik and Snow, but to destroy by contagious disease insects and larvæ underground it is necessary, in order to provoke the development of fungi, to thoroughly infect the soil. This is difficult, but not impossible, as is shown by the natural epidemics which decimate the white grub.

In general, it may be said that the number of entomophytic fungi is very large, and that eventually there will be found a special parasite for every species of injurious insect, or, indeed, that several species will be infected by the same fungus with equal facility. As to their practical application, a very small number of these fungi have been studied and experimented upon.

APPENDIX.

DIRECTIONS FOR OBTAINING AND APPLYING THE CHINCH-BUG INFECTION.

In order to keep up our supply of infected bugs, we must require that each person sending for infection send us live bugs from the field. These should be put into a tin box (a baking-powder box is excellent for this purpose), *without soil*, and with a supply of green wheat or corn. The box should have a tight-fitting cover, and no holes need to be made. We have found that the bugs reach us in the best condition when sent in this way.

CHARACTER AND LOCATION OF INFECTION BOX.

Make a box of seven-eighths inch material (matched white pine is best), about 24x36x6 inches. Make the cover tight fitting, so that the bugs cannot readily escape. Weather strips tacked about the upper edges of the box, so that the cover presses tightly against them when closed, will be found of service in keeping the bugs in.

It would be well for each farmer to have two boxes, and, after the first box has become well started, he should start the second from infection obtained from the first.

Place the boxes so as to exclude them from the sun and wind—a basement room is a good location.

TO START THE INFECTION IN THE BOXES.

Sprinkle the boxes thoroughly with water inside and out. Place an even layer of garden soil in the boxes, half an inch deep. The soil should be free from leaves or anything liable to decay. Sprinkle the soil until it is moistened through, *but not muddy*. Put a thin layer of green wheat or corn over the soil in the boxes, and distribute over this, at regular intervals, five or six of the white-fungus-covered bugs. Now put into the boxes healthy bugs from the field until they are somewhat crowded, but not packed over one another. Lastly, close and fasten down the cover.

Examine the boxes daily and sprinkle the sides and soil as often as they appear to be getting dry. *Do not, however, make the soil muddy*. As soon as the white-fungus-covered bugs begin to increase in your boxes, you may commence to gather them for the infection of your field, but not before. You should be able to do this in three or four days. Always leave a few fungus-covered bugs in your boxes for continued infection. Replace the green wheat or corn as often as it becomes yellow, and keep the boxes replenished with healthy bugs from the field.

TO INFECT A FIELD WITH THE WHITE-FUNGUS DISEASE.

After you are made certain by the increase of the number of bugs covered with the white fungus that the infection is working in your boxes, you

should gather from the boxes dead bugs and live bugs, white-fungus-covered and non-white-fungus-covered, and scatter them in the field where the bugs are the thickest, in the axils of the leaves and at the bases of the stalks. If the fungus-covered bugs are abundant in the boxes the earth might be taken from half of the boxes together with the bugs and scattered in the field. The earth should be replenished as often as removed. You should always take care, however, that some white-fungus-covered bugs remain in your infection boxes. As fast as the bugs are taken from the infection boxes they should be replaced by fresh bugs from the field. Continue to scatter bugs from the infection box over the field at intervals of two days or less, until it is seen that the bugs are dying rapidly all over the field. In no case should efforts to spread the infection be relaxed, for persistence is always certain to bring about the destruction of the bugs, if the fields have been properly infected and the weather is not too dry.

CONTINUED CARE OF BOXES.

If after a time the boxes should give off a smell of ammonia from the decay of bugs or bits of wheat or corn left in the boxes, the boxes should be cleaned out, earth and all, and, after airing a day, started anew as at the beginning.

Keep the earth in the boxes moist, but never make it muddy.

Sometimes other fungi than the white *Sporotrichum* appear on the bugs in the boxes. The only annoying one likely to appear is a yellowish-brown one known as *Aspergillus*. This fungus does not kill the bugs, but it may take possession of their dead bodies and become detrimental to the growth of the white fungus. If the *Aspergillus* should appear extensively in the boxes, clean them out and burn hay in them to kill the spores, and then start the boxes again as at the beginning.

GENERAL REMARKS.

You should save up a quantity of the white-fungus-covered bugs for an early start next spring. These should be put away in tin boxes where they may be kept dry and above a freezing temperature. The fungus will remain alive in the bodies of the bugs for a year at least. Farmers who took this precaution last summer have reported an early extermination of the bugs in their fields this season. Should the first lot of infected bugs from this Station seem to fail in their purpose, send without delay for a new supply. Careful attention to these directions will insure success, while careless use of the infection will often fail. The requirements are few and simple, but they are absolutely essential to success.

Note carefully the chinch-bug conditions in neighboring fields and urge your neighbors to use the infection. Keep a list of farmers who get infected bugs from your farm.

Do not fail to send me a full report, and in case of any difficulty write at once for advice. Do not be discouraged by the small number of infected bugs received from the Station. Four bugs covered with the white fungus will communicate the infection effectually.

EXPLANATION OF FIGURES.

PLATE I, figure 1, culture of *Sporotrichum* growing on squash; figure 2, culture on Irish potato.

PLATE II, figures 1 and 9, *Sporotrichum* growing on the surface of decoctions of squash; figure 2, culture on rabbit dung; figure 3, on horse dung; figure 4, on squash; figures 5 and 8, Irish potato. In tubes 5 and 8, the transfer was made from a growth of *Sporotrichum* found on an insect among leaves in a wood near a cultivated field, January 10, 1895. Figure 6, culture of *Sporotrichum* on turnip; figure 7, on onion.

PLATE III, figure 1, shows the chinch bug in various stages of its life, magnified. At (a) is the red larval stage. At (b) the black pupal stage ready to shed its skin and appear with wings. At (c), the pupal bug in the act of shedding its skin; the skin bursts open in a line along the back and through this crack the adult bug emerges with some effort. At (e) is shown the empty skin. The crack along the back often closes completely, and the skin is easily mistaken for a dead bug by anyone unacquainted with it; the skins are exceedingly light, however, and may be blown about by the slightest breath. At (d) is shown the adult bug just after emerging from the pupal skin. At this time the bug is light pink in color and is often mistaken for a sick bug because of its light color. The adult soon takes on a dark color and appears as seen at (f).

The above stages are normal to the chinch bug, and none of the appearances described are to be taken as evidences of disease. When the bugs are about to shed their skins they run about uneasily and gather into bunches in sheltered places. This habit affords a good opportunity for the spread of the disease, but it is not itself to be taken as evidence that the disease is working. The only sure evidence to the farmer that the disease is working is the presence in his field, under clods, fallen cover, etc., of dead chinch bugs covered with a growth of the white fungus, such as is seen on the bugs sent out by the experiment station.

PLATE III, figure 2, is a photo-micrograph of a portion of a cross section of a fungus-covered chinch bug. The clusters of spores of the *Sporotrichum* may be seen on the long stalks issuing from the body of the insect. Within, the body of the bug is filled with the intertwined filaments of the fungus.

PLATE IV, figure 1, is a photo-micrograph of a portion of a cross section of a diseased bug. The filaments in the open space in the upper right-hand portion of the figure, which corresponds to the center of the body, like those outside of the insect, are much finer than those in the other parts of the body. Figure 2 shows the larger filaments much more highly magnified.

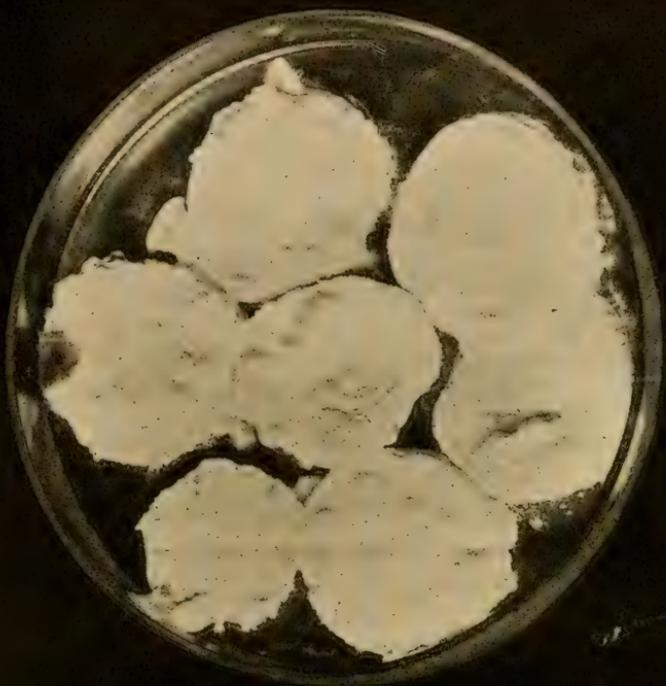
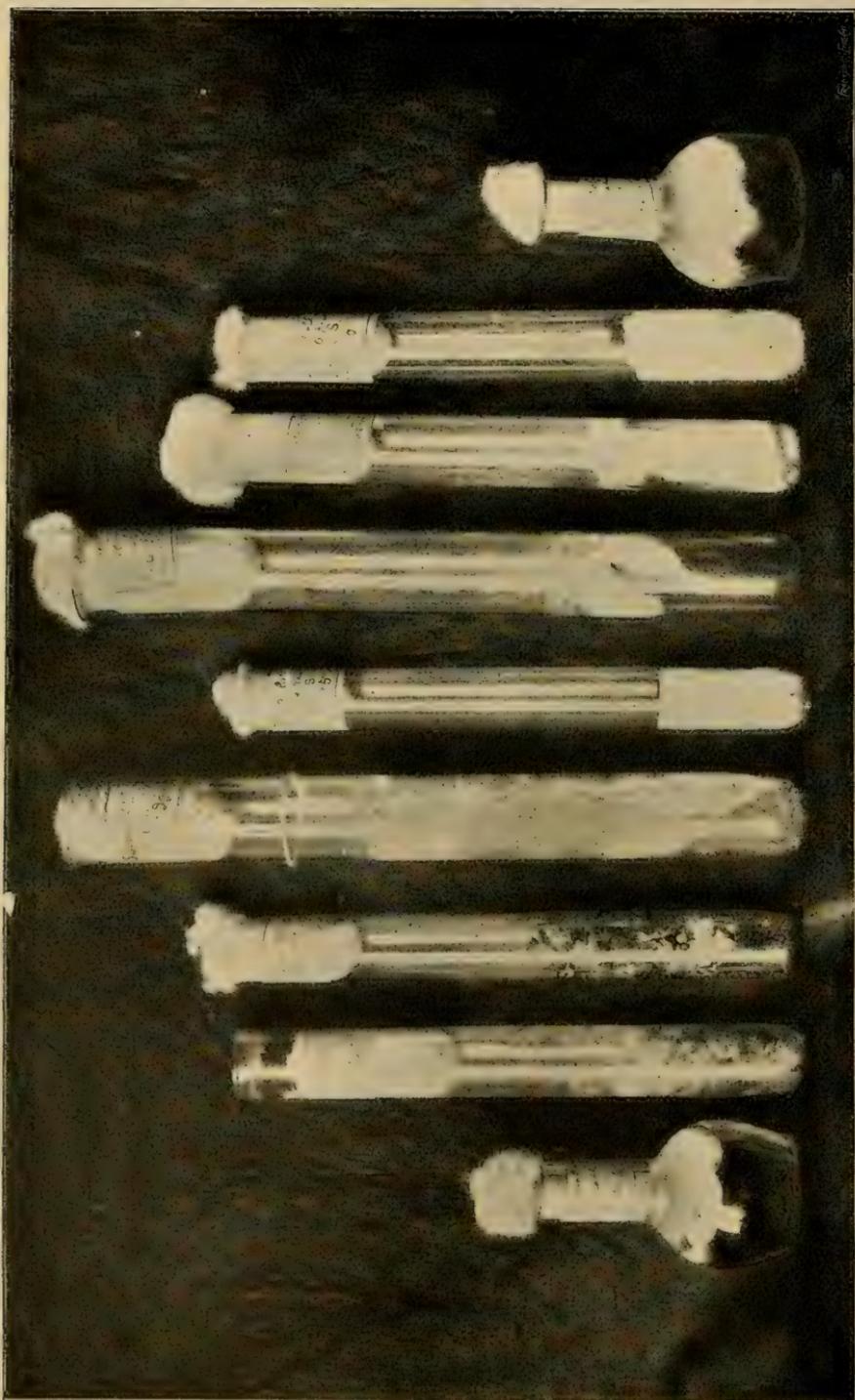


FIG. 2.



FIG. 1.



9.

8.

7.

6.

5.

4.

3.

2.

FIGS. 1.



a *b* *c* *d* *e* *f*



FIG. 2.

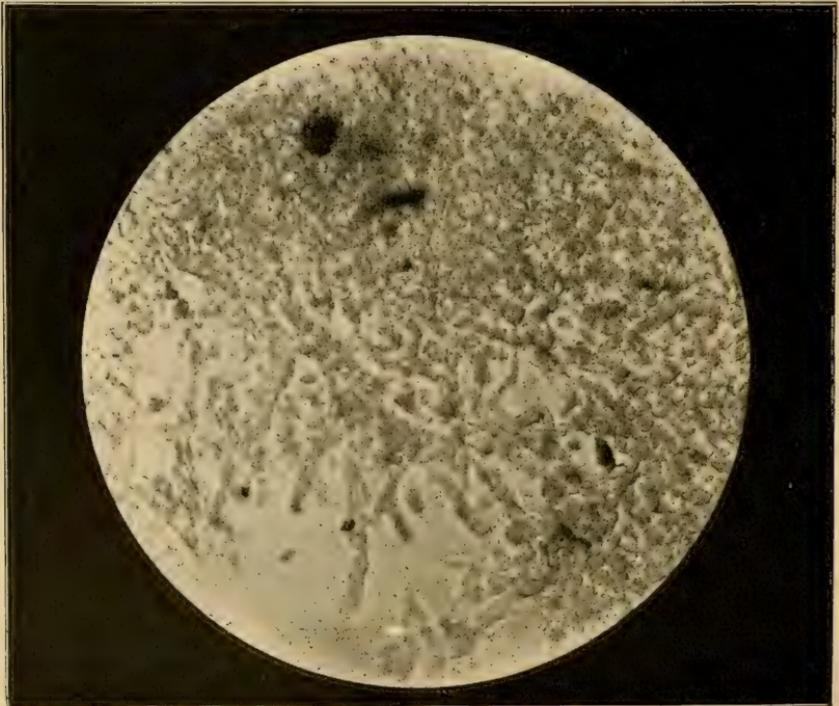
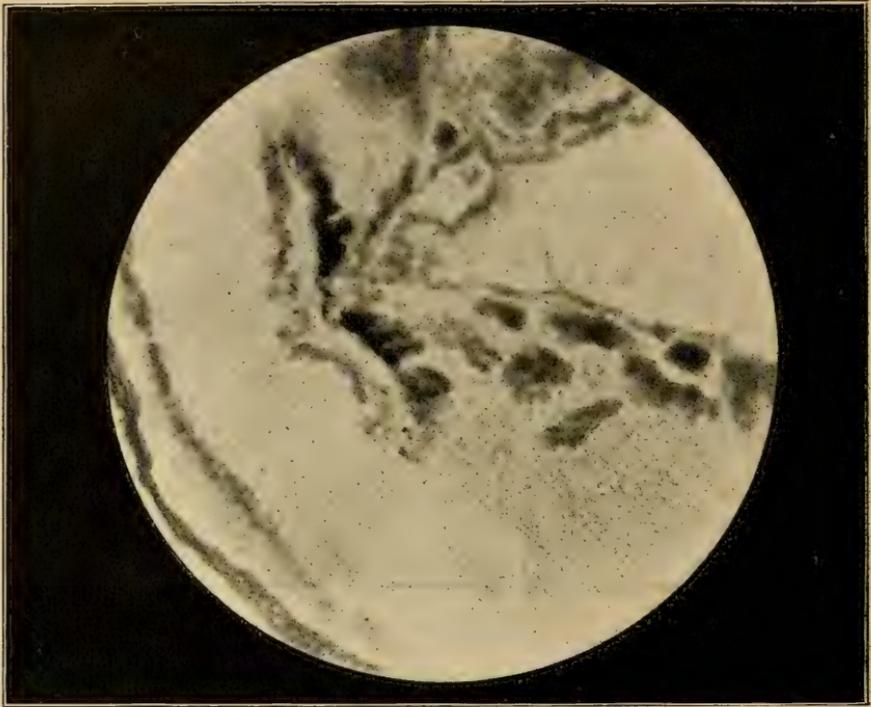
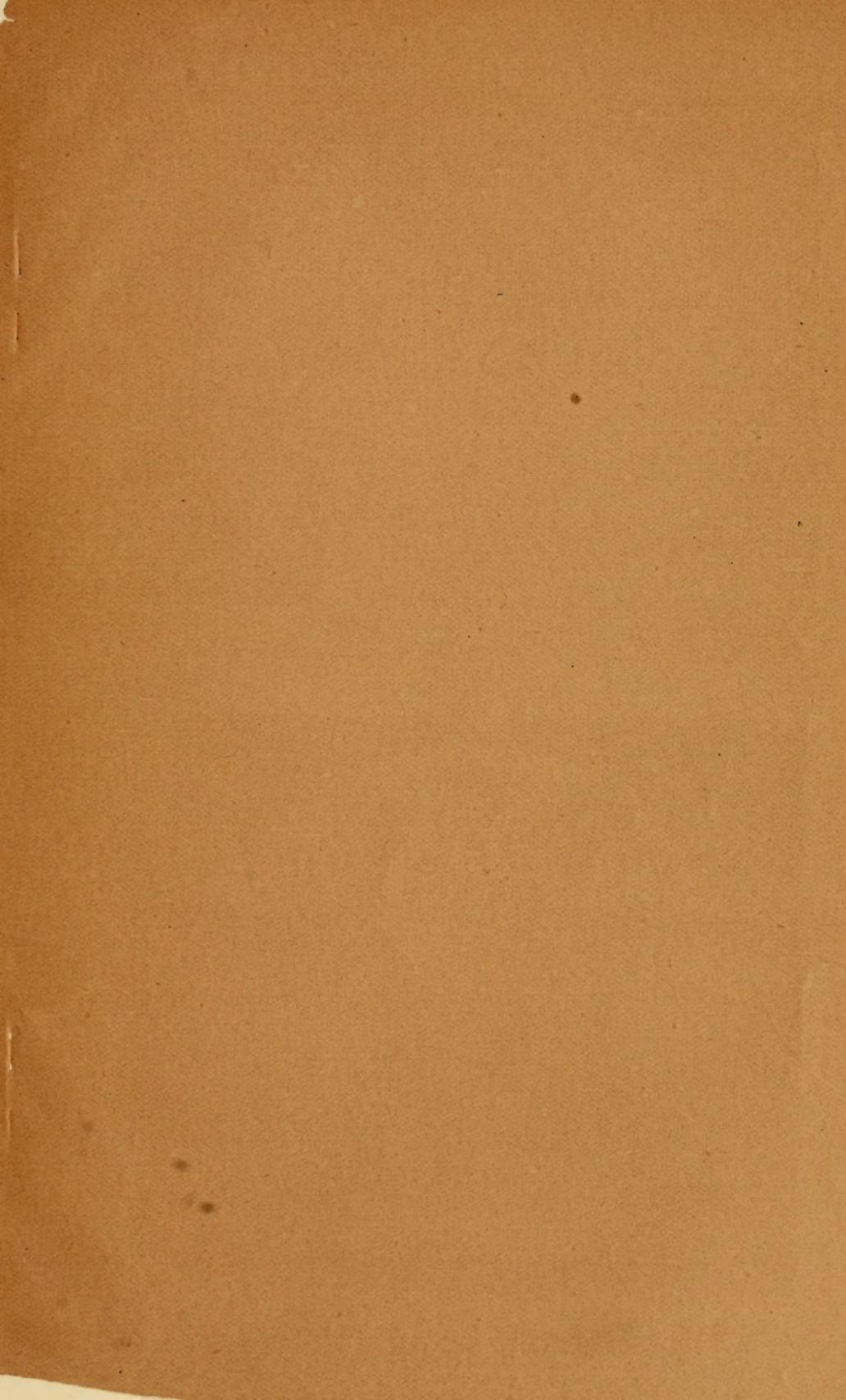


FIG. 2.



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