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POTATO DISEASES ON LONG ISLAND IN THE SEASON OF 1895.

BY F. C. STEWART.

GENEVA, N. Y.

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NEW YORK AGRICULTURAL EXPERIMENT STATION,
Geneva, N. Y., February 20th, 1896.

HONORABLE FRED. C. SCHRAUB, *Commissioner of Agriculture:*

The following pages, treating of "Potato Diseases on Long Island in the Season of 1895," are submitted for publication under chapter 509 of the laws of 1895.

L. L. VANSLYKE, Acting Director.

SUMMARY.

1. The most serious diseases affecting potatoes on Long Island are the early blight and late blight. These two diseases cause considerable loss which could by prevented by spraying with Bordeaux Mixture. In an experiment at Floral Park five applications increased the yield 62 bushels per acre and three applications, 52 bushels per acre. Had late blight appeared the benefit from spraying would have been still greater.

2. Paris green can be applied with Bordeaux Mixture and is then more effective than when applied alone, either dry or in water. Plants sprayed with Bordeaux Mixture and Paris green were less injured by flea-beetles and Colorado potato-beetles than were plants treated with Paris green only.

3. The expense of spraying is small as compared with the increased value of the crop. With suitable apparatus it need not be more than about $1.00 per acre for each application.

4. Beginning when the plants are from 6 to 8 inches high spray thoroughly at intervals of about two weeks until five or six applications have been made.

5. The internal browning of potatoes was observed on Long Island in 1894. The cause of this trouble is not known. An experiment made at Cutchogue shows that potatoes so affected are considerably injured for

seed purposes although the disease is not transmitted from seed to crop.

6. A new stem-blight of potatoes has been observed on Long Island and in Dutchess county. Some fungus destroys the stem near the surface of the soil. It promises to become troublesome.

7. "Pimply" potatoes are caused by some insect which punctures the skin of the tubers while they are growing. This trouble was common in the eastern portion of Long Island in 1895.

8. Fusarium acuminatum E. & E., a new species of fungus, has been found on potato stems at Canandaigua, N. Y. It is probably parasitic.

I. INTRODUCTION.

On Long Island potato growing is one of the leading industries, and potato diseases consequently assume a proportional importance.

The season of 1895 on Long Island was probably about an average one for potato diseases. Some diseases were more destructive while others were less destructive than usual.

The bacterial disease which causes a watery rot of the young tubers and suddenly wilts the tops by rotting the stem near the surface of the soil, has been rare. Upon good authority I am informed that in some seasons past, this disease has done much damage.

The potato scab, caused by the fungus *Oöspora scabies* which is so troublesome in many parts of the United States, is not at all common on Long Island. Its absence is to be attributed chiefly to the fact that the soil is sandy and devoid of lime, and very little barnyard manure is used. The fertility of the soil is maintained, for the most part, by the use of commercial fertilizers.

The greater part of the damage to potatoes here is caused by the two diseases known as early blight and late blight. Of these two, the *late blight* is much the better known. This disease appears in warm moist weather in mid-summer. It first attacks the foliage. The leaves turn black and die. If the weather continues warm and rainy whole fields may go down in a few days. Later in the season the tubers become affected with a foul-smelling rot. The cause of the disease is a parasitic fungus, *Phytophthora infestans*. The *early blight* is not affected to any extent by weather conditions. It appears every year and continues its depredations throughout the entire life of the plants whether the weather be wet or dry. It attacks the foliage only, producing brown, brittle, circular spots on the leaves. These spots usually have their origin in flea-beetle injuries. The disease works slowly. It never rots the tubers. The cause of the disease is a parasitic fungus, *Macrosporium Solani*.

In 1895 there was considerable loss from late blight in the eastern part of Long Island, but very little in the western part. The

early blight did considerable damage in all parts of the Island.

It is impossible to estimate, even approximately, the amount of damage done annually by these two blights but the results of the spraying experiment reported in a subsequent portion of this bulletin, go to show that the damage is considerable. I am confident that it is much greater than farmers generally realize.

II. SPRAYING POTATOES.

The object of spraying is to prevent the two diseases, early blight and late blight; and it has been proven by numerous experiments that spraying will prevent both of these diseases. Moreover, it has been shown that the yield can be increased enough to considerably more than pay for the expense of spraying. It has been so thoroughly tested by experiment and in practice that we are warranted in making the statement that spraying should be made one of the regular operations in potato culture as much as the application of fertilizer or the cultivation. The question awaiting an answer is not, "Will it pay to spray?" but rather, "What is the most economical method of spraying?"

In order that farmers might see what can be accomplished by spraying potatoes on Long Island the following experiment was made. It was also desired to compare five applications with three.

The experiment was made at Floral Park, N. Y., on a field of potatoes belonging to Mr. F. P. Baylis. Mr. Baylis kindly gave me permission to use four and one-half acres of the field for a spraying experiment. The experimental plot had been planted to potatoes for four consecutive seasons, during which time it had been fertilized practically alike all over. It was divided into three portions which we shall call Plots I, II, and III. The soil was uniform throughout. The three plots were planted on the same day, with the same variety of potato, Michigan Rose, treated with the same quantity of fertilizer, 1825 lbs. per acre, and given the same cultivation.

Plot I.	Plot II.	Plot III.
1½ acres	1½ acres	1½ acres
Sprayed 5 times.	Check. Not sprayed.	Sprayed 3 times.
Yield 270 bu.	Yield 182 bu.	Yield 272 bu.

Plan of Experimental Field.

Spraying was begun June 4, when the plants were from 6 to 8 inches high and repeated at intervals of about two weeks until Plot I had received five applications and Plot III three applications. Plot II was not sprayed. The last application to Plot I was made Aug. 2.

The Bordeaux mixture used was made according to the 1 to 7½ formula, that is, six pounds of copper sulphate to forty-five gallons of water, with sufficient lime to neutralize the copper sulphate. When Paris Green was used it was used at the rate of three-fourths of a pound to forty-five gallons of the mixture. The first application was made with a knapsack sprayer; all the others were made with a horse machine.

The difference in the treatment of the three plots will be made clearer by the following table:

	Plot I.	Plot II.	Plot III.
1st spraying.....	Bordeaux mixture and Paris green.	Paris green in lime water.	Bordeaux mixture and Paris green.
2d spraying.....	Bordeaux mixture and Paris green.	Paris green in lime water.	Bordeaux mixture and Paris green.
3d spraying.....	Bordeaux mixture.	Not sprayed.	Bordeaux mixture.
4th spraying....	Bordeaux mixture.	Not sprayed.	Not sprayed.
5th spraying....	Bordeaux mixture.	Not sprayed.	Not sprayed.

On the unsprayed plot, the early blight was plentiful by June 25, and continued its ravages throughout the season. This plot was less attacked than some other fields in the vicinity and more than others; on the whole it was about an average field for the season as far as early blight is concerned. By August 2 Plot II was badly affected with early blight and there was considerable on Plot III, but Plot I was almost perfect in foliage. On Aug. 15, not a single green leaf could be found on Plots II and III. All of the plants were dead. While on Plot I. about two-thirds of the leaves were still green. The late blight did not appear at all.

Throughout the season it was noticeable that the flea-bettle injuries were much less numerous on the sprayed plots than on the unsprayed plot. That Bordeaux mixture will check flea-beetles, is by no means a new idea. It has been repeatedly observed by Prof. Jones at the Vermont Station and by others.

Our experiment showed very strikingly also that Bordeaux mixture is exceedingly distasteful to Colorado potato-beetles.[1] At the time of the fifth spraying (Aug. 2) Colorado beetles were quite numerous on the unsprayed plot, and on other unsprayed portions of the field, while scarcely a single beetle could be found on Plot I and only a few on Plot III. This could not have been the consequence of using Paris green in the Bordeaux mixture because no Paris green had been used since June 24, and since that date several heavy rains had fallen washing off all traces of the spray applied at that time. In the case of Plot III, twenty-four days had elapsed since it had been sprayed with anything. Only traces of the Bordeaux mixture could be seen and yet the Colorado beetles shunned the plants. Later in the season the same thing was observed on tomato plants. Colorado beetles were unusually abundant and when the potato plants died the beetles migrated in swarms to egg-plants and tomatoes. Unsprayed tomato plants were almost completely stripped, while adjoining plants sprayed with Bordeaux mixture were scarcely touched.

At digging time the tubers on the three plots were sorted and measured with the following results :

	Total.	Merchantable tubers.	Small.
Plot I. Sprayed five times.....	270 bu.	257 bu.	13 bu.
Plot II. Not sprayed.....	182 "	164 "	18 "
Plot III. Sprayed three times	272 "	242 "	30 "

YIELD PER ACRE.

	Total.	Merchantable tubers.	Small.
Plot I	180 bu.	171 bu.	9 bu.
Plot II	121 "	109 "	12 "
Plot III.....	181 "	161 "	20 "

[1] *Doryphora decemlineata*, Say.

Increase in yield due to spraying with Bordeaux mixture five times,—sixty-two bushels of merchantable tubers per acre.

Increase in yield due to spraying with Bordeaux mixture three times,—fifty-two bushels of merchantable tubers per acre.

Difference between three and five sprayings,—ten bushels of merchantable tubers per acre.

As previously stated, no late blight appeared. The increased yield on the spayed plots is due to the fact that the Bordeaux mixture prevented the early blight[2] and gave more perfect protection against flea-beetles[3] and Colorado beetles.

I am convinced that many farmers who spray potatoes do not use enough Bordeaux mixture to get the best results. The object should be to keep the entire foliage at all times covered with the fungicide. A few drops of poison on the upper leaves may do for insects—they will eat of the poison and die; but against fungous diseases each leaf must be protected individually. When horse machines are used there should be at least *two* nozzles, and better yet, *three* nozzles for each row. If using a sprayer which has but a single nozzle to the row it is best to go over the ground twice. Vermorel nozzles are the best for spraying potatoes. The quantity of liquid required for an acre may be computed from the number of nozzles to the row. If one nozzle per row is used, about 30 gallons per acre will be required; two nozzles per row will use about 60 gallons per acre, and so on. When a knapsack sprayer is used the quantity of mixture required will vary from 60 to 100 gallons per acre, according to the size of the plants.

The kind of spraying machinery to be used depends upon the acreage to be sprayed. For small fields of three acres or less a knapsack sprayer is entirely sufficient and more economical than a power machine. However, if it is desired to use the same apparatus for spraying in the orchard it would be advisable to use the barrel pump outfit described on page 77. The knapsack sprayer can also be used for applying fungicides and insecticides to small fruits and vegetables. The knapsack sprayer is rapidly taking its place as a part of the necessary farm machinery. There are several kinds varying in price from $10 to $15. One of the best can be purchased for $12.

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[2] *Macrosporium Solani*, E. & M.

[3] *Crepidodera cucumeris*, Harr.

For larger fields it will be found advantageous to use horse machines. Here again we have quite a variety, some better than others but none perfect. It is advisable to buy only on approval. If the dealer is not willing to have his machine tested it is a good indication that there is something wrong about it. For a discussion on spraying machinery see Bull. No. 74 of this Station.

A cheap and very serviceable outfit for spraying potatoes may be made by mounting a force pump in a barrel which is hauled through the field on a two-wheeled cart. The nozzles are fastened at the rear of the cart in such a position as to wet as much as possible of the foliage. One man can work the pump and do the driving, spraying two rows at a time. With slight changes in the hose, this outfit can be used for spraying in the orchard. Good brass-lined force-pumps for the purpose can be bought for $10.

Full directions for the preparation of Bordeaux mixture can be obtained from Bull. No. 86 of this Station. Copper sulphate should not cost more than 5 cents per pound. In barrels of 350 lbs. it can be purchased for 4½ cents per pound f. o. b. New York. It can be kept indefinitely without losing its strength.

The treatment which has given the best results and which is consequently the one to be recommended is as follows: make the first application when the plants are from 6 to 8 inches high and repeat at intervals of about two weeks until five or six applications have been made. In rainy seasons it is necessary to spray more frequently than in dry seasons. The Bordeaux mixture should be plainly visible on the foliage all the time. Spray *thoroughly*.

Since blight (late blight) appears on Long Island perhaps not oftener than one year in four on the average some have expressed the opinion that it will not pay to spray every year to prevent it. They who hold such opinions overlook the fact that spraying protects the plants not only against *the* blight (late blight) but also against the *early blight* which on Long Island is really the more destructive of the two. It will pay Long Island potato growers to spray even if the late blight should *never* appear.

This leads us to the consideration of the expense of spraying. It is readily seen that the expense must vary with the price of labor and the kind of machinery used. Supposing that a knap-

sack sprayer is used, that a man can spray two acres per day, that the price of labor is $1.35 per day and that 90 gallons of mixture are used per acre, Mr. Hunn[4] places the cost of four sprayings at $6.50 per acre or $1.62 for each spraying. Prof. Galloway, Chief of the Division of Vegetable Physiology and Pathology, U. S. Department of Agriculture, makes a lower estimate. He says,[5] "With suitable apparatus and labor estimated at $1.50 per day, potatoes may be sprayed six times for about $6 per acre. This estimate is based upon experiments extending over several years and includes the cost of chemicals as well as of labor." The difference between these two estimates is due chiefly to a difference in the kind of apparatus used. The treatment with the knapsack sprayer involves a greater expense per acre. However, all agree that the expense is small as compared with the increased value of the crop.

When considering the expense of spraying the fact should be taken into account that usually two, and sometimes more, application of Paris green are required to control the Colorado potato beetles. When Bordeaux mixture is used the Paris green may be applied with the Bordeaux mixture and the only additional expense is the price of the Paris green itself. Paris green applied with Bordeaux mixture is more effective than when applied in any other way because it adheres to the foliage better.

III. INTERNAL BROWNING OF POTATOES.

Early in April, 1895, Mr. C. A. J. McCarthy of Cutchogue, N. Y., sent to the Experiment Station some potatoes affected with a peculiar disease. The tubers were outwardly perfect, but when cut open they showed numerous brown spots scattered irregularly through the white flesh. These spots varied in size and their outlines were very irregular and not definitely marked. As a rule, they were distributed throughout the tuber, but frequently they would be found aggregated at one end, in the center, or nearer one side. Mr. Mc Carthy who made a large number of observa-

[4] Hunn, C. E., Bordeaux Mixture Used to Prevent Potato Blight. Eleventh Ann. Rept., N. Y. Agrl. Exp. Sta., 1893, p. 698.

[5] Galloway, B. T., Some Destructive Potato Diseases: What They Are and How to Prevent Them. U. S. Dept. of Agriculture, Farmers' Bulletin No. 15, p. 7.

tions says that such aggregations are more likely to occur at the seed end than in any other part of the tuber. There is no rot connected with the disease.

The same disease has been reported from Minnesota[6] and Mr. A. F. Woods of Washington, D. C., informs me that it has been reported to the U. S. Department of Agriculture from other states and that it has also been observed in Europe. Prof. Green says that in Ramsey and Hennepin counties, Minnesota, probably one-half of the potatoes brought into market in 1894 were affected with the disease. Out of thirty-one varieties of potatoes grown on the University farm at St. Anthony Park, Minn., in 1894, twenty-eight showed the disease. In eleven of these varieties, fifty per cent. or more of the tubers were affected. On Long Island, Mr. Mc Carthy's experience was different. In 1894, he grew thirteen varieties, but Green Mountain was the only one affected. This variety showed about sixty per cent. of diseased tubers. So far as I can learn the disease appeared only to a slight extent on Long Island in 1894 and not at all in 1895. Prof. Green writes that he has heard of no case of the disease occurring in Minnesota in 1895, although diseased tubers were planted in various parts of the state. In Minnesota the disease is known as "rot" or "brown rot." Prof. Green calls it "Internal Brown Rot of Potatoes." Inasmuch as the disease is in no sense a rot, I prefer to use the name at the head of this article.

The cause is not clear. That it is *not* caused by insects, fungi or bacteria is quite certain for the following reasons :

1st. The brown spots are frequently *entirely surrounded* by healthy tissue and have no communication whatever with any portion of the surface.

2d. Agar-agar cultures made from diseased tissue produced no growth. Attempts to communicate the disease to healthy tubers failed and diseased tissue placed in sterilized moist chamber produced neither bacteria nor fungi.

3d. A careful microscopic examination of the spots shows no disorganization of the tissue, no diminution in the amount of starch, no fungi and no bacteria.

The cause is probably a phisiological one. Certain conditions of growth perhaps bring about chemical changes in the tuber.

[6] Minn. Exp. Sta. Bull. No. 39, p. 212.

There are some reasons for believing that rapid growth favors the disease. One of these reasons is the fact that the small potatoes, or "seconds," are seldom affected. The small potatoes are produced late in the season when growth is slow.

Although the disease materially injures the tubers for cooking purposes, the farmer is not the one who suffers. The tubers appear healthy and he can dispose of them before the disease is detected. Hence complaints usually come from consumers and dealers, rather than from producers. If the diseased tubers are fit for seed they should be put to that use; but here, two questions arise:—

1st. Will the disease reproduce itself in the crop?

2d. Will plants from the diseased tubers be as vigorous and produce as large a crop as plants from healthy tubers?

In order to settle these questions I proposed to Mr. McCarthy to make an experiment. But before Mr. McCarthy received my letter he had already planted or disposed of his whole crop. He had, however, begun an experiment of his own planning which is by his permission reported below. The experiment was planned and carried out wholly by Mr. McCarthy.

Plot of Experimental Field.

	100 feet.	88 feet.	50 feet.
1	*a* Yield 58 lbs.	*b* Yield 61 lbs.	
2	*c* Yield 167 lbs.		
3	*a* Yield 64 lbs.	*b* Yield 67 lbs.	*d* Yield 29 lbs.
4	*c* Yield 161 lbs.		*d* Yield 32 lbs.
5	*a* Yield 66 lbs.	*b* Yield 63 lbs.	
6	*c* Yield 164 lbs.		
7	*a* Yield 69 lbs.	*b* Yield 59 lbs.	
8	*c* Yield 159 lbs.		
9	*a* Yield 82 lbs.	*b* Yield 67 lbs.	
10	*c* Yield 142 lbs.		
11	*a* Yield 77 lbs.	*b* Yield 69 lbs.	
12	*c* Yield 166 lbs.		
13	*a* Yield 61 lbs.	*b* Yield 62 lbs.	
14	*c* Yield 171 lbs.		
15	*a* Yield 69 lbs.	*b* Yield 70 lbs.	
16	*c* Yield 164 lbs.		
17	*a* Yield 67 lbs.	*b* Yield 72 lbs.	
18	*c* Yield 157 lbs.		
19	*a* Yield 73 lbs.	*b* Yield 61 lbs.	
20	*c* Yield 151 lbs.		
21	*a* Yield 81 lbs.	*b* Yield 68 lbs.	
22	*c* Yield 167 lbs.		
23	*a* Yield 72 lbs.	*b* Yield 66 lbs.	
24	*c* Yield 149 lbs.		

Total length of Rows *a* = 1200 ft. Total yield = 839 lbs.
" " " *b* = 1056 ft. " " = 785 "
Comb'd " " *a* and *b* = 2256 ft. Combined yield = 1624 "
Total " " *c* = 2256 ft. Total yield = 1918 "
" " " *d* = 100 ft. " " = 61 "

Rows *a* yielded at the rate of 169 bu. per acre.
" *b* " " " 180 " "
" *c* " " " 206 " "

Rows a were planted with badly diseased tubers.

Rows b were planted with healthy portions of diseased tubers; that is, the pieces planted showed no brown spots.

Rows c were planted with tubers which showed only a trace of the disease.

Rows d were planted with healthy tubers.

All conditions of soil, cultivation and amount of fertilizer were as nearly as possible the same. The same variety, Green Mountain, was planted throughout. The small yield is due, in part at least, to attacks of blight, *Phytophthora infestans*, which killed the tops prematurely. This, however, does not affect the experiment because none of the tubers rotted and on account of the alternation of rows of badly diseased seed with rows of slightly diseased seed it is not likely that blight injured the one more than the other.

It is to be regretted that the check of perfectly healthy seed was not larger. Being so small it is of no value and will not be considered. The whole experiment is on too small a scale; but since it is so planned that all conditions (save the amount of disease in the seed) are parallel, and the results are so marked and so consistent with themselves, the experiment is worthy of consideration.

First, let us compare rows *a* and *b*. Rows *a* were planted with badly diseased tubers. Rows *b* were planted with healthy parts of diseased tubers. With the exception of rows 7, 9, 19, and 21 the yield of *b* was larger proportionally than *a*. In five cases the eighty-eight feet of *b* yielded more than the one hundred feet of *a*.

Second, let us compare rows *a* and *b* with rows *c*. Rows *c* were planted with tubers showing only traces of the disease. Rows *a* yielded at the rate of one hundred sixty-nine bushels per acre; rows *b* yielded at the rate of one hundred eighty bushels per acre, while rows *c* yield at the rate of two hundred six bushels per acre.

It should be observed that in each couplet of rows the combined length of *a* and *b* is equal to the length of *c*; viz., 188 feet; but only in one case (rows 9 and 10) does the combined yield of *a* and *b* equal the yield of *c*. This is a very significant fact.

CONCLUSIONS.

Final conclusions cannot be drawn from a single experiment. All we can say is that this experiment teaches the following:

First: The disease of potatoes known as "internal brown rot" or "internal browning" is not transmitted from seed to product;

Second: The greater the amount of "interior browning" in the seed tubers the smaller the yield. It is therefore not advisable to plant tubers so affected.

IV. ANOTHER STEM-BLIGHT OF POTATOES.

In July, 1895, I first noticed at Jamesport, N. Y., a peculiar appearance of potato foliage which was new to me. A few days later potato plants similarly affected were sent to me accompanied by the information that the disease was doing considerable damage in the vicinity of Farmingdale, N. Y. Pressure of other work prevented a thorough investigation of the trouble. In the latter part of August a farmer in Dutchess Co., N. Y., reported that the same disease was very destructive in that section. I visited Dutchess Co. September 4 and found that some fields had been wholly ruined by it. It has also been reported from Orange Co., N. Y.

The disease is characterized as follows:

First, there is a cessation of growth. The topmost leaves take on a yellowish, or in some varieties a purple color, and roll inward from the edges and upward, exposing the under surfaces. This condition is followed by wilting and complete drying up of the entire foliage, the process taking from one to three weeks. The tubers appear to be sound, but when cut at the stem end blackened fibres are seen penetrating the flesh to a considerable distance materially injuring it for cooking purposes. No rot develops in the tubers. The stem just beneath the surface of the soil first shows discolored spots and later becomes dry and shriveled.

In Dutchess County it was more prevalent on upland soil than on the moister lowlands. No variety appears to be exempt and the time of planting seems to make no difference. Neither is it

to a great extent dependent upon weather conditions. It was plentiful in Dutchess County in 1894 which was there a very dry season; it was still more plentiful in 1895, a moderately wet season; and it also appeared on Long Island in very wet weather. Sometimes one or two stalks in a hill will be diseascd while the remaining stalks continue healthy and mature their tubers. The yield is diminished and the tubers are poor in quality. Probably they are considerably injured for seed purposes.

There are several wilt diseases of the potato known and it is possible that this is one which has already been reported but I think not. I know of no description of a potato disease in which mention is made of a coloration of the young leaves correlated with a blackening of the fibro-vascular bundles at the stem end of the tubers; and a description of this disease which omits these characters is very incomplete because they are constant and the most striking characters of the disease.

The damage is not done by insects. It seems to be a clear case of strangulation caused by the attacks of some fungus just beneath the surface of the soil. The diseased stems contain an abundance of fungus mycelium but I have not been able to determine what particular fungus is the cause of the trouble. I strongly suspect that the damage is done by *Oöspora rosea*[7] (Preuss), Sacc. & Vogel, which may nearly always be found on the inside of diseased stems after the death of the plants. *Melanospora ornata*[8], Zukal, supposed to be strictly saprophytic, is also frequently found on the inside of dead diseased stems; but I have been unable to find any specimen of the *Vermicularia* which Dr. Halsted[9] found in connection with his stem-blight of potatoes in New Jersey.

The disease will be a difficult one to treat. It cannot be controlled by spraying.

V. "PIMPLY" POTATOES.

A peculiar trouble of potatoes has been brought to my attention by farmers in the eastern part of Long Island. The affected tubers are known as "pimply" potatoes. Several varieties have been affected but the Green Mountain has been more commonly

[7] Determined by Dr. R. Thaxter.
[8] Determined by Dr. R. Thaxter.
[9] Halsted, B. D., New Jersey Agr'l Experiment Station. Report for 1894, p. 354.

affected than any other variety. A farmer near Cutchogue, who raised 180 bushels of "pimply" potatoes of this variety was obliged to sell them at five cents per bushel below the market price because of their condition. Outwardly, the tubers are perfect except for the so-called "pimples" which are low convex elevations usually scurfy at the summit, from 3 to 5 millimeters in diameter, and distributed irregularly over the surface. Ninety-three such pimples were counted on a single medium-sized tuber. Upon removing a thin peel the flesh of the potato appears to be punctured here and there with short, brown, woody slivers which give it an unsightly appearance when cooked. There is but a single "sliver" underneath each "pimple." Ten of the "slivers" which were measured varied in length from 2 to 5 millimeters, the average length being 2.9 millimeters ($\frac{1}{9}$ inch). Microscopic examination shows that the "sliver" consists of a small tube surrounded by cork-cells. The surrounding cells within a radius of from one to two millimeters are markedly deficient in starch, while, curiously enough, the tube itself is filled with loose starch grains.

As to the cause of the "slivers," the most rational theory is that some insect punctured the skin of the tuber while it was growing and the plant in its effort to heal the wound produced cork-cells around the puncture. Almost any slight injury to the skin of a potato tuber will result in the formation of cork-cells. The absence both of insect eggs and of larval castings from the tubers indicates that the punctures were made for feeding purposes rather than for the deposition of eggs.

VI. A NEW FUSARIUM ON POTATO STEMS.

In July of the past season a farmer in the vicinity of Canandaigua, N. Y., sent to the Station some potato stalks which were girdled in various places by a pink fungus which Mr. J. B. Ellis pronounces a new species and names *Fusarium acuminatum*. E. and E. Prof. Beach, the Station Horticulturist, informs me that complaints of a similar character have come to the Station in former years and he feels quite certain that specimens of the same fungus were sent him in 1893. As reported, the disease has usually appeared in the center of the field about mid-summer, spreading rapidly for a few days and then disappearing, so that

when requests for specimens were sent the reply came that no more specimens could be found. Although not proven by inoculation of healthy plants, there is strong evidence that the *Fusarium* is parasitic. It has not been observed on Long Island.

The following technical description of the fungus by Ellis and Everhart is copied from the Proceedings of the Academy of Natural Sciences of Philadelphia for 1895, page 441:

"*Fusarium acuminatum*, E. & E. Sporodichia gregarious, minute, white at first then flesh-colored, attenuate-acuminate at each end, 3-5, exceptionally 6 septate, not constricted, arising from slightly elongated cells of the proligerous layer, in which respect it differs from the usual type of *Fusarium*. Quite distinct from *F. diplosporum*, C. & E., which occurs on the same host."