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A NEW DISEASE OF SWEET CORN.

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\*Connected with Second Judicial Department Branch Station.

†Connected with Fertilizer Control.

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## A NEW DISEASE OF SWEET CORN.

F. H. HALL.

A disease of sweet corn, new to science, has **Prevalence.** been causing loss to the growers of this crop on Long Island, the early varieties being most injured. The effects of this disease have been noticed for several years, but in 1897 it was particularly destructive. Some fields were almost completely ruined by it, others suffered from 20 to 40 per cent of injury and few were entirely exempt.

In its principal symptom the disease is so like **Symptoms.** the ordinary "rolling" of corn caused by dry weather that many have ascribed the injury to that cause (See Plate I). The affected plants wilt and the leaves wither and die as though the ground were too hot or too dry; but that the effect is due to something beside dry weather is proven by the fact that the plants die in wet weather as they do in drought.

There is no abnormal coloration of leaves, stem or roots; no constant sign of insect injury or of the presence of harmful fungi; and no rotting until after the plant is dead; nothing but drooping, drying up and death of leaves and stem.

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\*This is a brief review of Bulletin No. 130 of this Station on A Bacterial Disease of Sweet Corn, by F. C. Stewart. Any one specially interested in the detailed account of the investigations will be furnished, on application, with a copy of the complete Bulletin.

**Progress  
of the  
disease.**

The injury may take place at any stage of the plant's growth but is most noticeable at the time of flowering. The small plants are usually the first to succumb to the disease, probably not because their small size makes them more susceptible, but because they have been affected for some time, and the disease has checked their growth before it has revealed itself by other outward signs.

Fields seriously affected appear very uneven: plants with a single leaf just beginning to droop and those killed by the disease may be intermingled with perfectly healthy plants, even in the same hill, and the affected hills be scattered irregularly over the fields. The wilting does not seem to spread from a center nor to be communicated from plant to plant. It may run its course in four days from its first appearance or the plant may withstand the attack for a month. Sometimes, indeed, the stalks recover completely, and, again, they may appear to recover but succumb to a second attack.

**Cause.**

Upon cutting healthy stems and affected ones, especially if the latter be large and badly diseased, a difference is presented which soon leads to the conclusion that the cause of the injury has been discovered. Scattered through the pith or parenchyma of the stem are threads or fibers, the fibro-vascular bundles, which in healthy specimens are glistening and nearly colorless, and from which the watery juices of the plant exude when the vessels, which form part of these bundles, are ruptured. In the split stems of diseased plants these fibro-vascular bundles appear as yellow streaks in the pith; while upon cutting across the stem drops of a viscid, yellow substance exude from the ends of these cut vessels.

Examination of a drop of this substance through a compound microscope shows that the yellow color is due to the presence in the plant juice of countless millions of bacteria. A thin longitudinal section of a fibro-vascular bundle looks, under the microscope, like a chimney from which smoke is pouring, the "smoke" being the swarms of bacteria floating in the water in which the section is mounted. (See Plate II, Fig. 2).



PLATE I—*Young sweet corn plant affected with bacterial disease.*

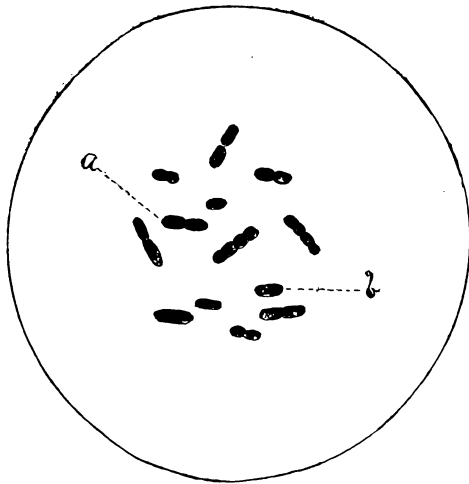


FIG. 1—*Various forms of the sweet corn bacillus grown on potato agar. a and b are typical forms. Magnification, 1875 diameters.*

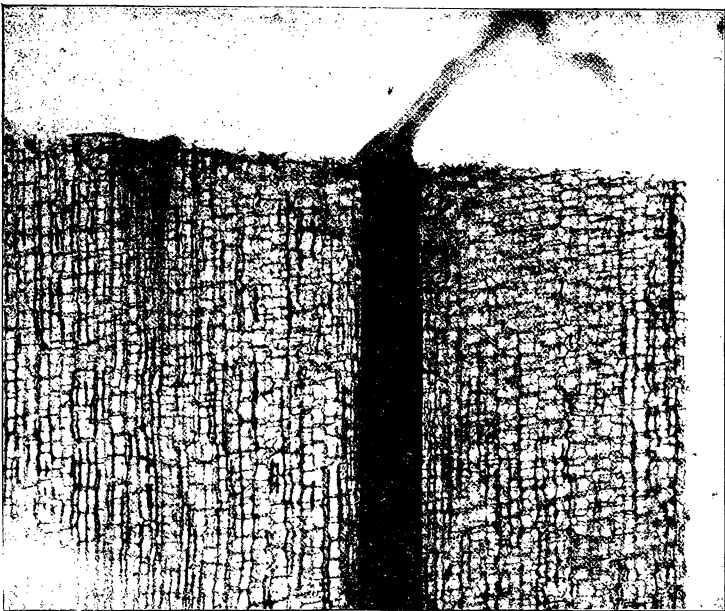


FIG. 2—*Photomicrograph of a longitudinal section of a diseased sweet corn stem mounted in water, showing the bacteria swarming from the end of a fibro-vascular bundle.*

PLATE II.

**Action  
of the  
bacteria.**

Bacteria are plants of low order, consisting of single cells. Those which are found in the fibro-vascular bundles of the sweet corn belong to the kind known as bacilli (sing. bacillus), are short, rounded at the ends, and usually occur in pairs, with a constriction between the members as shown at *a*, Plate II, Fig. 1. A pair of these bacilli is only one ten-thousandth to thirty-three two-hundred-and-fifty-thousandths of an inch in length, but they multiply so rapidly that, notwithstanding their minute size, they soon become sufficiently numerous to clog completely the circulatory vessels of the sweet corn plant, to absorb the nutriment from the juice and to cause the death of the plant from thirst and starvation.

**Study  
of the  
germ.**

Whether this bacillus is a new and undescribed species, or has already been classified and named was not determined, owing to the limited amount of bacteriological literature at hand and the confused state of systematic bacteriology at present, the science being yet in its infancy. The germ was isolated from all others by removing, upon the point of a sterilized needle, a portion of the viscid, yellow juice of the fibro-vascular bundles and starting colonies upon various materials in which bacteria find nourishment, such as agar (a preparation from an edible seaweed), gelatin, potato, bouillon, peptone and solution milk. So small are the organisms that the different species of bacilli are hardly distinguishable by size or shape, but upon these various nutrient materials the colonies of different species grow differently as regards form, color, odor, chemical action, gas production, need of oxygen, temperature required, etc.; and by careful study of these features the scientist is able to discriminate between the different species and to describe them. Observations upon these features of growth of the colonies of this bacillus were made and are available for the systematic bacteriologist's use in assigning it to its proper botanical position.

Sufficient data were obtained to prove that this **Not Burrill's** bacillus is not identical with the organism causing the only previously known bacterial disease of corn, that described by Prof. Burrill, of Illinois, in 1889. Burrill's disease attacks field corn, turns the affected plants yellow and causes moist rot of the ears; the germ producing the disease is not conspicuous in the fibro-vascular bundles and, upon agar, forms colonies grayish in color: while this new disease attacks only sweet corn; it does not discolor the plant nor cause rot; the presence of the bacteria in the fibro-vascular bundles is very noticeable, and the colonies upon agar are yellow.

**Experiments.** Field experiments in inoculating the disease upon sweet corn plants have been unsatisfactory, as the disease is slow in its progress and without outward signs for a considerable time; so it is almost impossible to know that any selected plant is healthy; and the disease is so widely spread that it is uncertain whether or not a particular field or portion of a field is free from the disease.

Under such conditions the inoculated plants and uninoculated ones may both show signs of the disease due to infection previous to the artificial inoculation.

One experiment, however, is worth noting, as it apparently shows the communicability of the disease through soil inoculation. In 1896 a handful of earth taken from soil where the disease had been prevalent the preceding season was placed, at planting time, in each of the first seven hills of a row of Manhattan sweet corn, the remaining six hills of the row being left untreated. On July 20, when the kernels were in the milk, all of the inoculated plants were dead or dying, while none of the untreated plants showed any signs of the disease. Later, however, some of these became affected, but from what source is not known.

Seed of Early Cory sweet corn (raised in Iowa) was sown in pots in sterilized soil and inoculation experiments were started; but some of the check plants became diseased, showing that the disease exists in Iowa and that germs may be carried upon the seed.



Inoculation of field corn and pop corn either through use of soil in which diseased sweet corn plants had grown or by introducing into the stems, through punctures, the bacteria taken directly from diseased plants failed to produce the disease, although the bacteria increased in number and could be found in the vessels at a distance of three nodes above the punctures.

Since the bacteria are wholly within the tissues of the plants, and probably gain entrance through seed or roots, the application of remedies to leaves and stems is useless. There is a possibility that soil treatment with fungicides may check the disease ; but lime and sulphur, applied with the seed, proved of no benefit, although these substances have been successful in prevention of club-foot of cabbage and onion smut. The lime might have given more favorable results if applied to the soil several months before planting, as has been proven necessary for the prevention of club-foot.

As the disease germs are carried upon the grains, the ears of diseased plants should not be used for seed. There is quite a difference in the susceptibility of different varieties to the disease, the early varieties appearing most subject to attack. Advantage can be taken of this fact and resistant varieties chosen.

If necessary to plant grain to which suspicion attaches, or if a susceptible variety is chosen, it may be of advantage to soak the seed in some germicide, as corrosive sublimate, 1 ounce to 8 gallons of water. Manure from animals fed upon diseased corn stalks should not be used, nor should a field free from the disease be tilled with tools used in a badly affected field.