Globulin also produces changes in twenty-four hours, but to a less marked degree than egg-albumin. Food passes into the tentacle between the lateral walls of the cells, and secretory products pass through the apical walls, thus producing an appearance of striae in the food which is in contact with the tentacles.

Fibrin is digested slowly, and changes similar to but generally less pronounced than with egg-albumin are seen.

Milk is absorbed rapidly and completely. The morphological changes are less marked than with any of the above-mentioned foods. The cell-plasm remains basophil throughout.

Nuclein produces almost no effect; the tentacles do not bend in, and do not secrete more copiously than before. No cytological changes are produced except very slight vacuolation of the cell-plasm. All the colour reactions are the same as those of controls.

Nucleic acid produced rapid bending in of the tentacles, and extremely copious secretion. The leaves reopen in one to three days, and although the quantity of nucleic acid given is not perceptibly diminished, there are great histological changes, consisting in an almost complete disappearance of the cytoplasm (which remains basophil throughout), and of the nucleoplasm. The basophil chromatin-segments remain unaltered.

Calcium phosphate produces appearances very similar to those after feeding with egg-albumin, but the cytoplasm remains basophil.

Control leaves, after the application of all the above substances, reopened in a perfectly healthy condition, as determined by their naked-eye appearances while living, and their microscopic structure after fixing by different methods.

LILY H. HUIE.

A POTATO-DISEASE.—I have for some time past had occasion to recognize here and there, in various parts of England, a potato-disease which is not due to *Phytophthora*, and which has often been ascribed to bacteria. During the past two years my attention has been especially directed to testing its bacterial origin, and I am convinced that it is not due to bacteria, but to a true hyphomycetous fungus.

Without going so far as to say there is no bacterial disease of the potato, I wish to express the conviction that the alleged cases of such

lately published are not convincing, and that a tendency exists to draw conclusions from imperfect evidence.

I shall show that the way into the tuber is prepared for bacteria by fungus-hyphae, and the open passages of destroyed vascular bundles afford them ample space. The disease I have studied has appeared in a more or less epidemic form at least twice in my experience: it was very common two years ago, and this year has been abundant in various parts of England. In a subsequent publication I shall show that it is common and widespread, and even known in some countries, though not adequately recognized.

Symptoms.—The shoots turn yellow and die prematurely during the summer, and before the tubers are anything like full. The disease starts from below and not from the leaves. The roots are few and poor, and soon rot away. The tubers are few, do not mature, and often rot in the ground. The leaves turn yellow and wither on the stems, with the symptoms of *premature wilting*, and often remain long hanging on the yellowing, glassy-looking, but still living stems.

In very mild cases these symptoms are not obvious, and supervene slowly, and the case may be complicated by the coexistence of *Phytophthora*. In very severe cases, on the other hand, especially in wet situations, the stems and roots may be all rotten by the end of July, and casual observation may ascribe the damage to *Phytophthora* entirely. In ordinary cases, again, it is easy to suppose the damage due to some insect attack, or to drought.

In advanced stages of the disease the stems either dry up to brown sticks, or putrefy on the wet ground; very often bacteria have gained access to the tissues at a comparatively early stage.

Microscopic Appearances.—Sections across the lower parts of the attacked stems show one, two, or more of the vascular bundles yellowish-brown—visible even without a lens—and the principal vessels of these contain branched, septate hyphae. In several cases I have traced these hyphae through every internode of the stem, into the petioles of the still hanging leaves, into the young lateral shoots, throughout the roots and subterranean rhizomes, and *up to and even just into the tubers*. In two cases I have done this in one and the same potato-plant, and so have no longer any hesitation in ascribing the disease to this fungus, the morphological features of which will be described in a subsequent paper. In advanced cases the brown vessels are stopped with a yellowish gum-like substance. Tyloses are common in the vessels of

the root. Those tubers which are not attacked while still very young, but which have already begun to fill with starch, may offer considerable resistance to the invasion of the fungus; but eventually the vascular strands diverging from the point of attachment to the rhizome exhibit the tell-tale foxy-red or yellowish-brown colour, and in many cases the ripened tubers are to all appearance sound, except for *microscopic reddish spots just at the points of entry of these bundles*.

During the winter the stored potatoes, with the fungus thus just lurking in them at the morphological base (the so-called heel) of the tuber, may undergo little change to all appearance *if gathered and stored dry*.

But if wet, various kinds of rot may supervene, owing to the *subsequent invasion* of various micrococci, bacteria, fungi, &c., following the lines of weakness opened up by the fungus in question, and living as saprophytes on the stored reserves.

In some cases even apparently dry tubers may undergo a curious rot—dry-rot—owing to the ravages of a particular bacterium or mould, perhaps more than one, which finds sufficient moisture for its purposes.

The principal point is that the fungus I have especially studied leads the way for these purely saprophytic anaërobic and aërobic forms into the tuber: once in the mature tuber, its progress is necessarily slow until the reserves move in the spring.

During the past winter I gave to Miss Dawson, who is working at such subjects in my laboratory, some of the tubers saved from plants attacked with this disease, to investigate the various fungal forms lurking in the diseased tubers. Her investigations are not yet completed, but enough has been accomplished to convince us that after the fungus in question has opened up the way into the tuber, all sorts of bacteria and fungi can make their way down the destroyed vascular strands, and reappear in spring, when the tubers are replanted.

But this is not all. The evidence shows that the fungus in question, once in the tuber, leads a dormant life during the early part of the winter, but gradually invades the new sprouts as they slowly appear in the early spring, and that *the parasite is actually replanted* by the farmer or gardener, when restocking the ground, *in his new 'sets'*.

If we reflect that the tuber is really a bud, there is nothing especially strange in this phenomenon; the fungus enters the base of the bud in autumn, and takes some months to traverse its dormant tissues during

the winter and spring. A spotted tuber may give rise to some healthy and some diseased sprouts, according to the tracks of the fungus.

A curious phenomenon was observed in some potato-plants very badly attacked by this disease this summer. In some of the badly diseased young shoots, quantities of beautifully developed *cubical proteid crystals* (crystalloids) were observed in the parenchyma of the pith and cortex. It is due to Mr. W. G. P. Ellis to point out that he was the first to see these in some sections he was kindly cutting for me of this batch of specimens. On going further into the matter I find such crystalloids have been seen by Heinricher in the shoots of a diseased potato¹, but he did not give any account of the disease itself.

I find these crystals are not uncommon in the still green bases of the petioles of the withered leaves hanging on the diseased shoots, though they do not always occur.

I ascribe their formation to the accumulation of proteids in the leaves, while still living and active, from which the passages of transference at the nodes of the stem have been cut off by the fungus; just as the eventual withering of the leaves is due to the blocking of their water-conduits when all the vessels are stopped up.

At the same time, the attempts I have made to induce the formation of these crystalloids artificially have failed so far.

Neither ringing, nor ringing combined with destruction or the pith with a hot skewer—to destroy the internal phloëm—has given satisfactory results as yet, though the leaves of healthy plants withstand this drastic procedure much better than might be supposed.

Here again I must reserve further particulars for the fuller paper.

In conclusion, it is evident that the efforts of the potato-grower must be directed to the selection of sound sets, and to the careful preparation of his ground. I hope to show later that it is a fatal procedure, even with sound sprouts, to allow the young shoots to lie in contact with raw manures, as it is *viâ* wounds and small rotting spots at and near the collar that new infections occur. The same arguments apply to wet soils and situations, and the disease is particularly apt to increase when wet and cold weather supervenes on the early growths.

H. MARSHALL WARD, Cambridge.

¹ Ber. d. deutsch. bot. Ges., 1891.

Ward, H. Marshall. 1898. "A potato-disease." *Annals of botany* 12, 561–564.
<https://doi.org/10.1093/oxfordjournals.aob.a088712>.

View This Item Online: <https://www.biodiversitylibrary.org/item/233102>

DOI: <https://doi.org/10.1093/oxfordjournals.aob.a088712>

Permalink: <https://www.biodiversitylibrary.org/partpdf/318524>

Holding Institution

Smithsonian Libraries

Sponsored by

Biodiversity Heritage Library

Copyright & Reuse

Copyright Status: Not in copyright. The BHL knows of no copyright restrictions on this item.

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at <https://www.biodiversitylibrary.org>.