

the record completed and this manuscript first prepared, during the year 1884, twelve months before the publication of similar observations by Mr. Aitken, by him presented to the Royal Society of Edinburgh on the 21st of December, 1885.

These observations were planned and executed by Winthrop E. Stone, B. S., Mass. Agr. Col., 1882, and Frank E. Emery, B. S., Maine State Col., 1883, as part of their duties in the experiment work of Houghton Farm. The report was originally prepared by Mr. Stone. It is transcribed from the records for present use by the writer.

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## PARASITIC FUNGI AS AFFECTING PLANT DISTRIBUTION.

W. J. BEAL.

**D**OUBTLESS almost every observing person is familiar with the fact that when a large area is cleared of vegetation of a miscellaneous character, and the ground is then covered with plants of one kind, this large area, after a time, is much more liable to be damaged by injurious insects than it was before the change was made. The increased supply of suitable food encourages certain one or more kinds of insect enemies.

Again, many insects seem to be more likely to attack isolated plants when they grow in open places, than when closely crowded among those of a miscellaneous character. As examples, I need only cite a few :

Isolated bushes of currants and gooseberries among other shrubbery or trees are seldom found by the insects which cause much trouble, while the large area in the garden is much troubled.

Trees of black cherry in the open field or along the fence are often much damaged by the tent caterpillar, while isolated trees in the mixed forest are seldom found so infested.

A similar statement may be made with reference to insects which infest locust trees, the potato, cabbage, wheat, Indian corn, the meadow grasses, and the clovers.

A similar state of things seems to prevail in reference to parasitic fungi. Those which infest cultivated grapes sweep down with great severity in many sections where vineyards are large or numerous, while a few vines in isolated neighborhoods may often escape uninjured. So it is with rust, smut and hurt on wheat, smut on Indian corn, lettuce mold, rust on onions, burnt on blackberries and raspberries, black knot on cherries and plums.

Ten or twelve years ago, in a small arboretum of 200 species at the Agricultural College of Michigan, some species were represented by several rows entirely across the field, while the majority of species were

represented by a few plants, or in some cases by single specimens. Parasitic insects and fungi were generally more troublesome on the whole rows than on isolated specimens.

In Central Michigan, *Capsella Bursa-pastoris* is a very common weed which usually thrives in the cool portions of the growing season. In part of an old garden it had become very abundant and was healthy for many years. Some years ago, *Cystopus candidus* was only rarely seen, but for a few years past it has increased at a rapid rate. In the spring of 1885, *Cystopus* was so abundant that it was hard to find a plant of *Capsella* which was not badly infested. Most of the plants failed to produce seed. During the past spring (1886) very few plants could be found, and these were generally much disturbed by *Cystopus*. It is very probable that the few plants which were found came from seed grown some years before, and had remained dormant in the soil.

In a portion of a young arboretum, some 30 rods distant and across a lawn beyond tall trees, recently appeared plants of *Capsella* in great abundance. In 1885 some *Cystopus* was seen, but most of the *Capsella* was healthy. This spring (1886) there was much *Capsella* and it was terribly distorted and infested with *Cystopus*. Healthy plants of *Capsella* were rare, and these were mostly isolated plants among other weeds about the margins of the main lot. No experiments were made in scattering the *Cystopus*.

*Capsella* has been studied more or less in several other neighborhoods.

Until within three years, it was very rarely that *Puccinia podophylli*, Schu. could be found on *Podophyllum* at Michigan Agricultural College. In 1885 I found a few patches somewhat infested. This year (1886) it is very much more abundant and most seriously affected the health of the mandrakes. Most patches, and especially isolated plants, are still healthy.

The *Cystopus* on common purslane and the one on *Amaranthus* has been watched. In some places where the land had been long in cultivation it has sometimes seemed as though these fungi would drive out the weeds they live on, but for some unexpected reason they seem to survive above my expectations. I think plants which spring from old seeds help to bridge over emergencies. No doubt, even in these cases, *Cystopus* is doing good work.

In some seasons, as during the past one, plants of *Arisæma Dracontium* are much troubled with *Uromyces Coledii*. Some plants are healthy, and this may be partially owing to the fact that many of the specimens are isolated and crowded among other kinds of plants.

A small patch of *Sambucus Canadensis*, on a bank, has been watched for fifteen years. Here, during this time, I have yearly gone for *Acidium Sambuci*, which has gradually been growing more and more abundant, until this year the whole patch was badly infested, all of them having a yellow, sickly color. Perhaps the bushes are starving for better food or choked for room, or the drainage is not right, or, perhaps, they are pining for a change, and the *Acidium* is doing all the better on this account. At any rate, the *Acidium* is thriving and the *Sambucus* is dying.

Near my house, situated on a sandy land, is a small garden where sweet corn has probably been raised every year for over twenty-two

years, certainly for sixteen years. A slight change has been made in the spot by alternating a rod or more on different years.

*Ustilago Maydis* has become very abundant, especially during the last four years. Last year some pains were taken to cut out and burn the smut while it was yet young. This year it is not so abundant, but still very troublesome, causing much damage to the corn.

In the botanic garden begun in 1877, the plats have been arranged according to the natural orders. The land has been changed and enriched occasionally, and the plants have been well cared for. Kindred plants are often affected by the same fungus.

Within three years some genera have begun to weaken, especially *Aster* and *Solidago*. *Æcidium compositarum* has become very abundant, and it now looks as though we should lose many of the plants, and be obliged to change the location.

Last summer, Dr. C. E. Bessey and Professor J. C. Arthur were much interested in a few sickly specimens of *Asclepias cornuti* seen here and there about waste places on the college grounds. These diseased plants have been slowly on the increase for several years, and this year they are very common about the neighborhood.

This year, for the first time noticed, a similar, if not the same trouble, has overtaken *Asclepias tuberosa* and *A. incarnata*. When only slightly affected, a few leaves of the top, including the tips of the stems, appear smaller than usual, and have a yellow, sickly color. In some cases the whole plant is affected in this way, and in its worst form, a large number of small, sickly stems, with small, pale leaves, come from the root. This forced growth of sickly twigs reminds one of the slender, wiry twigs on peach trees badly troubled with the yellows.

May we not hope to introduce the disease into healthy plants, in neighborhoods where the milkweed is very troublesome, and thus call to our aid some parasitic fungus?

In these parasitic fungi we see an important factor which helps control the geographical distribution of plants. And may there not be something here to help explain why certain foreign species for a time are often so vigorous in a new country? May it not help explain why isolated specimens are scattered here and there instead of found in large masses? They may have formerly existed in large masses, but all may have died out except the few isolated plants now to be found.

Isolation is favorable to thrift, while large masses are opposed to long continued escape from the ravages of insects or parasitic fungi.