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## NOTES ON THE OCCURRENCE AND DISTRIBUTION OF UREDINEÆ.

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VERY little attention has been given to the distribution of parasitic fungi, except so far as to note their occurrence on host-plants of more or less close relationship, and that they are usually somewhat more abundant in wet seasons and places than in those that are dry. But close observation reveals more facts than these, and some that are peculiarly interesting.

Strictly speaking, the parasitic fungi are affected by but two of the elements of environment concerned in the distribution of phanerogams. These are *temperature* and *moisture*, while flowering plants are also affected by differences in kind of *soil* and amount of *light*.

However, there is a kind of distribution of parasitic fungi, scarcely to be called geographical, although such distribution has probably been caused by changes in the anatomy and physiology of the host, which changes were themselves caused by variations in soil and climate. I refer to cases of certain hosts which support certain fungi in one locality and not in another. Of course, it may be said that in one or more of these localities there has yet been no chance for infection, but in numerous cases this is, to say the least, rather improbable, and sometimes the hosts are distributed so as to completely connect these localities, and yet without general distribution of the fungi. Moreover, some of these hosts are annuals, or occasionally biennials, so that it cannot be said that the fungi are prevented from spreading by the circumstance of their being reproduced yearly from perennial mycelium and not by infection by germinating spores.

Again, while a group of species (a genus, for instance) in one locality may all be attacked by a certain fungus, in another locality, where these hosts are all represented, only a part of the group may be affected by the same fungus.

Certain fungi have also peculiarities of occurrence in point of time. After being reproduced annually for several years, they may suddenly disappear for an indefinite period, or reappear after certain intervals of time.

In illustration of these general statements, it may be of interest to give here some observations that I have made on the distribution of Uredineæ in Kansas, covering a period of about six years.

In the first place, it seems to be true that *Aecidia* require more moisture than the other stages, and *telentospores* the least. In Kansas, east of the 96th meridian, the species of *Aecidia* number about fifty, and *telentospores* (of all genera) sixty-five; while west of the same meridian the proportion is about twenty-three of the former to fifty of the latter. The *telentospores* of western Kansas, it is seen, are more than twice the *Aecidia*. The difference in rainfall of the two portions is well known. But all Uredineæ are probably more abundant in wet seasons than in dry seasons, and

also more abundant in warm seasons than in cool seasons. This season has been much earlier than the preceding one, and has been marked by a number of unusually hot days, alternating with heavy rains. Moreover, the rains have continued to date, and were quite frequent just at harvest time. The result has been a season unusually favorable for rusts. The following species have been collected in large quantities this season: *Aecidium peckii*, De Toni, on *Oenothera biennis*; *Aecidium euphorbiæ*, Gmel.; *Aecidium violæ*, Schum., on *Viola falmota*, L., var. *cucullata*, Gr., and cultivated pansies; *Aecidium zanthoxyli*, Pk.; *Aecidium cephalanthi*, Pk.; *Puccinia graminis*, Pers. II.; *Uropyxis petalostemonis* (Farl.), De Toni; *Roestelia pirata*, Thaxt., on *Pirus coronaria*; *Uredo cæoma-nitens*, Schwein., on *Rubus villosus* (cult.) and *Rubus canadensis*. Immense numbers of spermogonia were found with *Aecidium peckii*, De Toni, and with the *Uropyxis*, *Roestelia*, and *Uredo cæoma-nitens*, Schw., above mentioned. *Puccinia graminis*, Pers., has been quite destructive to grains, especially oats, over the greater part of the State, but particularly in the eastern portion. It is a very interesting fact that, while this species was quite rare last year, it is the predominating rust of grains this year, and has caused extensive damage. Last year *Puccinia coronata*, Corela, was very abundant on oats, but this year, in repeated examinations, I have been unable to find a single specimen. Even *P. rubigo-vera* (D. C.), Wint., the ever-present grain-rust, is very scarce this season.

The greatest damage from rust prior to this season that I recall was in 1877, when there was a severe rust scourge over northern Kansas. Many fields of wheat were entirely destroyed, and never harvested. Sulphur-like clouds of spores filled the air and irritated the nostrils of the workmen. I had no knowledge of botany then, but a vivid remembrance of the general appearance of the rust, coupled with my present knowledge of the differences between the species, inclines me to believe that it was *Puccinia graminis*, Pers., that did the damage. I have always doubted the usual statements that *P. rubigo-vera* is the rust that usually does the damage in this country, and this season the facts in Kansas strongly confirm my opinion. Of course, the last-named rust is the more common from year to year, but seldom attacks the stem to any great extent, and, in my own experience, any amount of it on the leaves usually does little damage, but when the stem becomes covered with red powder and finally weakens and falls, and the grain shrivels, and the straw becomes very light, then you may guess that *Puccinia graminis* is in the field. However, there may be facts from other portions of the country, even this season, that furnish contrary evidence, for aught I know.

The above facts call up further instances of variations in the occurrence of species. The following species, originally known in Kansas, have not, to my knowledge, been reported for several years: *Aecidium abundans*, Pk.; *Aecidium cassiæ*, E. and K.; *Aecidium sambuci*, Schw.; *Puccinia similacis*, Schw.; and *Aecidium macrosporum*, Pk. During the succession of recent dry seasons they have probably become so reduced in numbers that finally there were not enough healthy spores left to reproduce the species on the following year. In like manner *Puccinia solida*, Schw.; *P. seymeriei*, Burrill; *P. saniculae*, Grev.; and *Aecidium punctatum*, Pers., seem to have disappeared. In future wet seasons infection may take place from a distance, and the fungi reappear.

As to migration, *Aecidium tuberculatum*, E. and K., has certainly been coming rapidly eastward, until this season it was found at Manhattan for the first time. *Uredo gaurina*, Pk., seems also to be coming eastward. *Puccinia heterospora*, B. and C., with its host (*Abutilon avicennæ*), *Puccinia zanthii*, Schw., var. *Ambrosiæ*, Burrill, several varieties of *Aecidium compositarum*, Mont., and *Puccinia microsperma*, B. and C., are, without much doubt, working westward. Others might be mentioned, but the possibility of their having been present for years already, and overlooked, forbids that we should place much dependence on such observations.

But a more remarkable phase of distribution is found in the fact that a number of species known on certain host-plants in western Kansas for a number of years are entirely absent in the