Examples:

(1) Bright day—temp. = 20° C. Sycamore shoot.
In window—air still.

Time required = 39 min.
Water transpired = 50 × ·00895 = 0·447 c.c.
Area of leaf = 155 sq. cm.

1 sq. metre of leaf transpires 44 c.c. per hour.

(2) Bright diffuse daylight—temp. = 21° C.
Out of doors.

Time required = 16 min.
Water transpired = 0·447 c.c.
Area of leaf = 286 sq. cm.

1 sq. metre of leaf transpires 59 c.c. per hour.

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THE BROMES AND THEIR RUST-FUNGUS (*Puccinia dispersa*).—I have for some time been occupied with an investigation which has involved a comparative examination of the 'seeds' and seedlings of all the species and varieties of the genus *Bromus* that I could obtain, and a study of the conditions of infection of these grasses by the Uredo-form of *Puccinia dispersa*, the Rust-fungus so common on certain species of them.

The details of the results will, I hope, appear in due course, but some points of interest may be summarized now.

The uredo-spores germinate at all temperatures between about 10–12° C. and 25–27·5° C., which may be considered the minimum and maximum cardinal points; the optimum is about 18–20° C., and many failures in infection were found to be due to the fact that the leaves of the grass may be at temperatures above the maximum. Uredo-spores in water frozen for ten minutes into solid ice germinated on thawing, but freezing for two hours seems to kill them.

Infection experiments show that spores originating on a given species—e.g. *B. mollis*—easily infect that species, but not necessarily another species, even if closely allied, and indeed may not infect all varieties of that species. Thus spores from *B. sterilis* easily infect *B. sterilis* and the closely allied *B. madritensis*, but not *B. mollis* or its allies *B. secalinus*, *B. arvensis*, &c., and not even the more closely allied *B. maximus.* Broadly speaking, the uredo-spores, growing on a species belonging to the *Serrafalcus* group, infect other members of that group—in varying degree, however, and not necessarily all—but fail to induce the development of pustules on species belonging to another group—e.g. *Stenobromus* or *Festucoides.*

There is evidence, however, going to show that an occasional adaptation to another species may occur in cases where infection does not usually succeed. In such cases, the Uredo having once established itself on another species, its uredo-spore progeny will thenceforth readily infect that species.

The rule seems to be that the uredo-spores infect most easily the species and variety on which they have been developed, less easily varieties or species more remote, and fail altogether to gain a hold on more distant ones.

This does not appear to be a matter depending merely on the structure of the leaves of the host plant, or on any recognizable excretion from them; at any rate the microscope shows none such, and experiments with *B. mollis* and *B. sterilis* demonstrated that the germ-tubes grow readily in filtered extracts, boiled or unboiled, of the leaves. The matter evidently depends on the influence of the previous nutrition of the Fungus, as well as on the reactions of the species attacked, and presents problems of great complexity.

It is possible to grow pure cultures of the grass as well as of the Fungus for weeks and even months in closed and in aerated tubes. 'Seeds,' sterilized by various reagents, have been germinated in large tubes, on cotton-wool supplied with pure nutritive materials, and excellent plants thus raised out of contact with any but filtered air. Such pure cultures have been infected with uredo-spores, and the progeny utilized for similar re-infections, thus ensuring pure cultures of both host and parasite.

'Seeds,' from infected plants, thus treated do not give rise to infected plants; and unless spores are sown on the leaves of the latter no pustules are developed. Moreover, pustules only arise in these cases on the spots where the spores were sown, and within the usual incubation period. These facts seem to militate against any theory of internal seminal sources of disease. It is hoped that by longer series of such pure cultures more definite information on several obscure points will be obtained.

At present the evidence points to the following conclusions. The acts of infection and incubation occupy about ten days, and many exigencies may prevent the germination of the spores, the entry of the germ-tubes into the stomata or the successful growth of the mycelium in the tissues.

Experiments go to show that the lack of certain minerals—e.g. potassium or phosphates—cause a starvation of the Fungus; partial etiolation of the host, or any other hindrance to free nutrition, assimilation, transpiration, &c., also act detrimentally to the well-being of the mycelium.

Every degree of virulence of attack seems to be shown by the spores in their germ-tubes, either on different varieties or species of host, or on the same host in different conditions.

It appears that in certain cases the germ-tubes may kill the tissues, and cause them to turn black and shrivel up as if corroded. In such cases the parasite can make no further progress, and infection fails. In other cases a mycelium is developed, but lies dormant and produces no spores; we may compare the Fungus in this case to a plant in poor soil, or suffering from drought, &c.

Seedlings with 'spears' only a millimetre or two high can be infected by applying spores to the 'dew-drops' issuing from the water-stomata at the apex of the first leaf.

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