LETTERS TO THE EDITORS

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Electrostatic Charges on Spores of Fungi in Air

Particles or droplets suspended in air often carry an electrostatic charge. The size and magnitude of the charge depend on how the charge originates (commonly by picking up positive or negative ions from the air). The phenomenon appears to be fundamentally distinct from the characteristic positive or negative charges acquired by particles in colloidal solution[1]. Buller reported that spores of the common mushroom (*Agaricus campestris*) and the dryad's saddle (*Polyporus squamosus*) already carry either positive or negative charges when they are shed into the air by the fungus[2]. Ingold has recently suggested that in fungi with long, narrow, vertical hymenial tubes, such as *Ganoderma applanatum*, electrostatic forces may serve to keep a basidiospore in the middle of the tube while it is slowly falling under gravity to the exterior[3].

After a dozen tests made during 1954 and 1955 on naturally occurring specimens growing on trees, I can confirm the existence of such charges on the basidiospores of *Ganoderma applanatum*. Further, in this species most spores carry a positive charge.

Tests were made by allowing spores to fall in an air-gap between two metal plates charged from a battery. The apparatus (Fig. 1) consisted of a brass box in the form of a cube with approximately 2·5 cm. sides, and with a slit 0·5 cm. wide in the lid, placed immediately under an actively sporulating fruit body. The vertical charged metal plates, separated by an air-gap 1 cm. wide, were mounted on 'Perspex' blocks to insulate them from the walls of the box (which was earthed). The circuit was suggested to me in discussion by Mr. H. L. Nixon, of Rothamsted Experimental Station, and consisted of deaf-aid dry batteries giving in series about 400 volts, connected to the vertical plates through 680-kΩ resistors for safety. The poles of the battery were kept at +200 and −200 volts with respect to earth by earthing each end of the battery through 1·0-MΩ resistors.

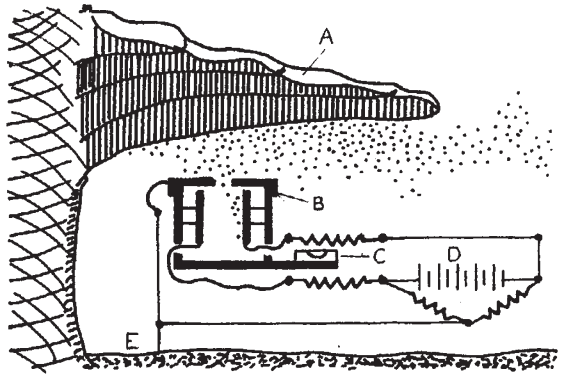

Fig. 1. Diagram (not to scale). *A*, Fruit body of *Ganoderma applanatum* (shown in vertical section) growing on tree trunk and liberating spores into air from vertical tubes; *B*, brass box with slit in lid, connected to earth and holding vertical insulated plates charged to +200 and −200 V.; *C*, bubble level; *D*, battery connected through resistors to plates and to earth; *E*, earth line to ground

In use, the box was levelled with a bubble level and exposed under an active fruit body of *Ganoderma applanatum*. After exposure for an hour, a rusty brown spore deposit was usually visible on the negatively charged plate and on the adjacent part of the base of the box, whereas the positive plate remained clean. In one test in which the box was taken apart and the spores counted under the microscope, 85 per cent of the spores entering the box had been deposited on the negative plate, 14 per cent were on the earthed floor of the box (mostly nearer the negative plate), and 1 per cent were on the positive plate. Essentially similar results with this species have been obtained at three localities in Hertfordshire, at one in the New Forest and at two in Bristol. In one of the Bristol specimens, the spores seemed to be less strongly charged than in other specimens. Some specimens have been tested on two or three occasions and in different years.

Because the majority of basidiospores move towards the negative plate, it is concluded that they carry a positive charge. Preliminary tests indicate that positive charges predominate also on basidiospores of *Agaricus campestris*, *Pholiota squarrosa* and *Flammula carbonaria*. On the other hand, negative charges seem to predominate on basidiospores of *Coprinus micaceus*, *C. hiascens* and *Polyporus squamosus*.

The phenomenon raises a number of problems. What is the origin of the charge? Does it differ consistently in different species? Why, if so nearly uniform in sign, as in *Ganoderma*, is it not completely uniform? Is it causally connected with the still mysterious spore discharge mechanism of basidiomycetes? Does it aid liberation of spores from the fruit body, as suggested by Ingold? Does it affect the pick-up of air-borne spores by rain drops, or their deposition on plant surfaces or in the respiratory tract of vertebrates?

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London, S.W.7. June 10.

[1] Freundlich, H., "Colloid and Capillary Chemistry", 781 (1926).
[2] Buller, A. H. R., "Researches on Fungi", **1**, 192 (1909).
[3] Ingold, C. T., *Endeavour*, **16**, 81 (1957).

Electron Microscopy of Leaf Surfaces

The morphology of leaf surfaces is of considerable interest in the study of the effects of selective herbicides. In the course of investigation into the nature of some leaf surfaces, it was suspected that structure beyond the resolution of the light microscope was present. The electron microscope was therefore employed in an attempt to determine the nature of this structure. The examination of the surface of a leaf required the use of a replica technique, preferably not involving the treatment of the specimen with organic solvents, since many leaf surfaces are covered with a waxy layer which might be affected. A single-stage method involving evaporated material was therefore indicated, and though at first it seemed likely that any such method would meet with considerable difficulties, an extremely interesting technique was easily developed.

The method employs evaporated carbon[1], and is carried out as follows. A portion of the leaf to be examined is fixed to a glass slide with 'Sellotape', and the assembly placed in an evaporating plant. There

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