petiole callus, and that the embryos found in these tubes developed only from the pro-embryos already present in the inoculum.

Preliminary results, using the phloem-derived callus, indicate that other sources of reduced nitrogen (glutamine, aspartate, a mixture of 14 amino-acids, coconut milk) will not substitute for ammonium.

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Capillary Movement in Fungal Hyphae

SOME years ago I observed¹ capillary movement in the hyphae of *Mucor mucedo*; the phenomenon was not photographed at the time and subsequent attempts to repeat the observation were unsuccessful. Recently, however, the observation has been repeated, in fungi cultivated on dishes of sugar-agar. Capillary movement was observed after the addition of a drop of guinea-pig blood to the culture medium, but it is uncertain whether the relation between the observation and the addition of blood was causal or merely fortuitous.

Serial photomicrographs have been prepared, demonstrating the phenomenon, and Fig. 1 shows part of such a series. The movement of the hyphal contents was slow but continuous; displacement in the large hypha shown in the photograph was from left to right and the rate of flow was variable. Transport from 'A' to 'A'', as shown in Fig. 1, took from 0.25 to 10 min. Movement within the smaller hyphae was towards the larger one.

The stream carried with it the protoplasts² and smaller particles, and movement was continuous over a period, usually of hours, but in one case for several days. The oval or lozenge-shaped segments seen in the photographs

are broken up or deformed from time to time, especially as they enter the large hypha from a tributary, somewhat in the way that erythrocytes may be deformed in capillary transport in animals³.

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Inhibition of the Perfect Stage of *Venturia inaequalis* (Cooke) Wint., by Urea

EPIDEMICS of apple scab (*Venturia inaequalis*) originate from ascospores discharged from perithecia present on over-wintered leaves on the ground. Hutton¹ has shown that post-harvest pre-leaf-fall applications of organo-mercurial compounds greatly improved the level of disease control in that they suppressed perithecial formation and hence reduced the amount of ascospore inoculum in the following spring.

Recently there has been growing interest in the use of post-harvest pre-leaf-fall urea sprays as a means of supplying nitrogen to fruit trees². As *in vitro* investigations had suggested that excess nitrogen could suppress perithecial formation³, we studied the effects of urea on the development of *Venturia inaequalis* in overwintering leaves.

In October 1963 scab-infected apple plants (clone M.III) were sprayed in the field with either 5 per cent or 2 per cent urea solutions. 48 h later samples of 200 leaves from each treatment, and a control sample from trees sprayed with water, were placed in 14 × 14 mesh nylon envelopes and allowed to overwinter in an exposed situation on the ground. Analysis of leaves immediately after collection showed the percentage dry weight of nitrogen to have increased from 1.81 to 2.06 with 2 per cent urea and to 2.49 with 5 per cent urea. In November further leaf samples were taken from non-treated M.III plants and from the scion variety 'Granny Smith', dipped in 5 per cent urea or in water (control) and then similarly overwintered. All urea solutions contained 0.01 per cent of the wetting agent 'Agral LN' which has been shown to be biologically inactive in the context of the present work.

During the next 4 months, observations were made on the state of the leaves and, at intervals, random samples of 10 dipped and 10 non-treated M.III leaves were tested for microbial activity. Two 1-cm. disks were cut from each leaf and the bulk samples of 20 disks macerated in 10 ml. of sterile distilled water in a Measuring and Scientific Equipment microhomogenizer for 4 min. After allowing large pieces of leaf debris to settle, 1 ml. of the supernatant liquid was withdrawn and suitable dilutions plated into nutrient agar containing 5 per cent sucrose. Bacterial colonies were counted after 3 days at 25° C.

The 5 per cent urea had a noticeable effect on the decomposition of the leaves. Five weeks after treatment the laminae of many of the sprayed leaves had partially or completely disappeared, leaving a veinal skeleton. The dipped leaves remained intact until the following spring, but were observed to be a darker brown than the corresponding controls. This colour change was associated with striking differences in microbial activity. In mid-December when the first estimate was made there were approximately 170 times as many bacteria per unit area on the treated compared with the non-treated leaves (Fig. 1). By early January the difference had fallen to times 48; thereafter it diminished progressively but residual effects of the urea treatment were still apparent in the spring.

In early March, all leaves were brought indoors to prevent the release of mature ascospores by rain, and their

Fig. 1. Capillary movement in hyphae of *Mucor mucedo*