between 0·05 and 0·1 per cent. The tolerance of *A. funestus* to DDT, therefore, exceeds somewhat the figures given for *A. gambiae* by Busvine[2] and Davidson[3]. The species appears, however, to be considerably less tolerant to gamma-BHC and dieldrin than *A. gambiae*,

Apart from experimental error, the cause of the heterogeneity of the response to dieldrin might be either the presence of allied species indistinguishable in the adult stage from *A. funestus* (*A. rivulorum* or *A. leesoni*), or the presence of strains of *A. funestus sensu stricto* of different tolerance-levels. The allied species have not been recorded in the larval stage from the area, while the proximity of the dieldrin-sprayed zone of the Pilot Project, in which *A. funestus* has not been eradicated, means that the possibility of the presence locally of selected strains differing in tolerance to this toxicant cannot be entirely discounted.

V. Ramakrishna
(World Health Organization)

R. Elliott
(Malaria Service)

c/o Malaria Service,
Federal Department of Medical Services,
Yaba, Lagos.
Nigeria.

[1] Elliott, R., and Ramakrishna, V., *Nature*, **177**, 532 (1956).
[2] Busvine, J. R., *Nature*, **177**, 534 (1956).
[3] Davidson, G., *Nature*, **178**, 705 (1956).
[4] Busvine, J. R., World Health Org., Tech. Series, Report No. 80 (1954).
[5] Litchfield, J. T., and Wilcoxon, F., *J. Pharm. and Exp. Ther.*, **96**, 99 (1949).

Brown Stain formed on Wet Cellulose

The phenomenon of the 'brown stain' formation on wet cellulosic materials was reported[1] in 1934 and has since been studied by Turner[2] and his colleagues at Manchester, and by Appel[3] and others in the United States, but does not even yet seem widely known. As the effect may be encountered in paper chromatography and with the Weisz[4] 'ring-oven', it may save trouble to workers in those techniques if attention is directed to it. The effect can readily be seen by putting a strip of filter paper as a wick in distilled water. In a few hours a brown stain is found at the top of the wick, or of its wet portion. The immediate neighbourhood of the stain has a brilliant white fluorescence under ultra-violet light and is strongly dyed by methylene blue (0·1 per cent in water).

The mechanism of the effect is twofold, being in part the formation of a degradation product of cellulose by oxidation at the wet–dry boundary[2,3] and in part, as has recently been found in this Inspectorate, the capillary concentration of the same or a similar product already in the paper. It is found that the amount of this material present is proportional to the age of the paper, and that its formation is accelerated by increasing temperature, the rate doubling for each 10 deg. C. rise.

When distilled water is run through filter paper on the ring-oven, a brown ring is formed which could easily mask, or be mistaken for, a precipitate of a metal compound. Under ultra-violet light, however, the ring fluoresces strongly, and it is strongly dyed by methylene blue. The effect can be largely eliminated by washing the filter paper before use.

The reason that this very common effect with wet paper or cotton has not been remarked upon more often may well be that the stain looks like a rust stain and is often met with in circumstances in which the material is liable to wetting with water which may contain iron. Thus a cotton curtain which had been in contact with a steam pipe had developed deep yellow stains, which looked exactly like rust stains, but which were found to fluoresce strongly under ultra-violet light, to be dyed by methylene blue and, in fact, to contain negligible iron.

Details of the preliminary results briefly mentioned here, as well as of the behaviour of some non-aqueous liquids and non-cellulosic materials, are being published elsewhere.

H. R. Ambler
C. F. Finney

Chemical Inspectorate,
Ministry of Supply,
Station Approach Buildings,
Kidbrooke,
London, S.E.3.
March 6.

[1] Bone, W. H., *J. Soc. Dyers and Colourists*, **50**, 307 (1934).
[2] Turner, H. A., *Proc. Paper Makers Assoc.*, **19**, 182 (1938). Bone, W. H., and Turner, H. A., *J. Soc. Dyers and Colourists*, **66**, 315 (1950). Madaras, C. W., and Turner, H. A., *ibid.*, **69**, 371 (1953).
[3] Bogaty, H., Campbell, K. S., and Appel, W. D., *Textile Res. J.*, **22**, 75 (1952). Schaffer, R., Appel, W. D., and Forziati, F. H., *J. Res. Nat. Bur. Stand.*, **54**, 103 (1955).
[4] Weisz, H., *Mikrochim. Acta*, 140 (1954).

Mutation to Virulence in *Cladosporium fulvum*

The origin of physiological races of fungi causing plant diseases has been attributed to sexual and parasexual recombination, adaptation and mutation. Where pathogenicity depends on the action of several genes, recombination results in new physiological races. Where pathogenicity on a given host depends on a single gene, changes in host specificity can only arise by point changes within the gene as distinct from recombination.

Attempts have been made to induce host-range mutants in plant pathogenic bacteria and fungi but the changes brought about have mostly been unspecific increases or decreases of vigour[1]. More recently, induced changes in relation to specific host genes for resistance have been studied in *Cladosporium fulvum* on tomato[2] and *Melampsora lini* on flax[3]. Experiments with a variety of induced auxotrophic mutants of *C. fulvum* have failed to reveal either heterocaryosis or somatic recombination. Since the sexual stage is also unknown it seems likely that physiological races have arisen in Nature by mutation.

In this communication we are concerned with race 0 and race 2, and the mutational step, race 0 → race 2. Race 0 is avirulent, but race 2 is virulent on the tomato variety Vetomold, homozygous for resistance gene Cf_2. Conidia of race 0 were treated with a mutagen and inoculated to Vetomold, so that virulent mutants might be recovered from any lesions that occurred. In order that contaminants could be recognized and discarded, a strain of race 0 carrying a marker induced by X-rays was used[4]. Its host-range was wild type but it produced red pigment instead of purple.