type of spore is represented. In other cases, up to four of the types have been noted in the same sample.

Investigations are proceeding to determine whether these spores will induce mycorrhizal infection on various hosts grown in sterilized soil and to determine how many species are represented. However, it is now apparent that spores of *Endogone* are abundant in certain cultivated soils. These can be detected by direct microscopic examination of soil fractions obtained by wet sieving and decanting and are not revealed by methods normally utilized in soil mycology.

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[1] Gerdemann, J. W., *Mycologia*, **47**, 619 (1955).
[2] Gerdemann, J. W., *Mycologia*, **53**, 254 (1961).
[3] Mosse, B., *Ann. Bot.*, **20**, 349 (1956).

MICROBIOLOGY

Inhibition of Endotrophic Sporulation by Antibiotics

ENDOTROPHIC sporulation occurs when an organism forms spores in a medium lacking substances necessary for growth. It was of interest to determine whether a group of growth-inhibitory substances also inhibited sporulation.

A strain of *Bacillus cereus* var. *mycoides* was isolated from soil. The organism was grown for 18 hr. in shaken flasks at 32° C. in a peptone–yeast extract–glucose medium. The cells were washed twice in distilled water and suspended at a concentration of 9×10^8 cells/ml. in 0·1 *M* potassium phosphate buffer (*p*H 7·4) containing 1 mgm./ml. glucose. Antibiotics were added in a graded series of concentrations to 10 ml. aliquots of cell suspensions and these were then placed in 125-ml. flasks and incubated with shaking at 32° C. overnight. Sporulation was determined by microscopic examination of smears stained with a malachite green spore stain. In the controls, greater than 90 per cent of the cells sporulated. Where inhibition of sporulation occurred, the minimum concentration of antibiotic that completely inhibited sporulation was then determined.

All the antibiotics used were able to inhibit growth of the organism at concentrations below 50 μgm./ml. The effect of the antibiotics on sporulation is shown in Table 1. It can be seen that only three antibiotics inhibited sporulation at growth-inhibitory concentrations. It is interesting that these three antibiotics, tetracycline, chloramphenicol and erythromycin, are the only ones in the table that are known to act by inhibiting protein synthesis[1].

Table 1

Antibiotic	Minimum concentration to completely inhibit sporulation
Tetracycline	10 μgm./ml.
Chloramphenicol	10 μgm./ml.
Erythromycin	25 μgm./ml.
Penicillin *G*	1,000 μgm./ml.
Novobiocin	> 1,000 μgm./ml.
Neomycin	> 1,000 μgm./ml.
Streptomycin	> 1,000 μgm./ml.
Polymyxin *B*	> 1,000 μgm./ml.

Concentrations of antibiotic used: 1,000, 500, 250, 100, 50, 25, 10. 5, 2·5 and 1 μgm./ml.

It should be emphasized that the sporulation process is occurring in the absence of growth. Several of the other antibiotics listed in the table are known to be active primarily against growing cells, that is, penicillin[2], novobiocin[3], and streptomycin[4]. The present results then seem to confirm that endotrophic sporulation does occur in the absence of growth. In addition, these results suggest the value of testing other growth inhibitors for their effects on sporulation, both as an aid in the understanding of the sporulation process, and to help shed more light on the mode of action of antibiotics.

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[1] Brock, T. D., *Bact. Revs.*, **25**, 32 (1961).
[2] Cooper, P. D., *Bact. Revs.*, **20**, 28 (1956).
[3] Brock, T. D., *Science*, **136**, 316 (1962).
[4] Anand, N., and Davis, B. D., *Nature*, **185**, 22 (1960).

Withdrawal of the Concept of the Occurrence of Classical Mitosis in Bacteria

I WISH to retract the concept previously presented by me[1], and to which I have been committed, that classical mitosis occurs in bacteria. This interpretation of cytological material was developed on the basis of routine microscopy on stained preparations. The configurations observed were interpreted using instrumentation of inadequate resolution to solve the problem of the mechanism of division of this group of organisms. It seems likely that this interpretation of structures by white-light microscopy does in fact depend on the presence of not only nuclear material which can assume a multiplicity of forms, but also on the presence of membranous bodies in the cytoplasm which accept stain and at low resolution could be misinterpreted as centrioles. The application of the electron microscope in the hands of many others[2,3], as well as more recently by us[4,5], has demonstrated that a classical form of mitotic division in these organisms cannot occur. Details of the ultrastructure of bacteria are now becoming resolved, and what is presently known precludes the possibility of a classical mitotic mechanism.

It seems appropriate, therefore, on the basis of work of others as well as of ourselves, to acknowledge the error in interpretation which was made, and in so doing perhaps remove some of the confusion in the literature contingent on such an interpretation. By acknowledging the error of interpretation, however, I do not mean to imply that I consider that the interpretations of some of my critics concerning the structure of the bacterial nucleus are necessarily correct in the present state of our knowledge. There is much yet to be done by means of high-resolution instruments to resolve the ultrastructure of the bacterial cell. The work of Kleinschmidt *et al.*[6] is perhaps the most revealing so far, and correlates well with the genetic studies of Wollman and Jacob[7].

It should also be emphasized that much of the work done still remains valid. The staining and dehydration procedures[8] developed during these investigations are accepted and used by many as routine[9]. More recent efforts at isolation of bacterial nuclei by chemical dissection, as well as the