Exp. No.	Composition of the grass		pH after 14 days	
	Dry matter (per cent)	Crude protein in dry matter (per cent)	Without crushing	After crushing
1	14·6	28·1	6·7	5·0
2	14·6	21·9	5·2	4·8
3	17·9	17·3	5·0	3·6
4	19·3	22·7	4·6	3·9
5	17·3	19·8	5·4	3·9

noticed; for example, in experiment No. 5 the *p*H still reached a value of 4·3 if the grass was passed only once through the mill.

We do not think it is likely that the inactivation of enzymes is responsible for the beneficial effect of crushing, as suggested by Gneist (*l.c.*). It is generally known that the stems of grass have a higher carbohydrate content than the leaves and a lower protein content, so it might well be that the distribution of the contents of the stems through the silage explains to a certain extent the effect of crushing.

From our results a relation between dry matter content and *p*H can be noticed, especially after crushing. The same was found earlier by Brouwer[4]. This might be explained by assuming that there is a relation between the dry-matter content and the carbohydrate content of grass.

J. C. DE MAN

Experiment Station for Potato Processing,
Groningen.
July 31.

[1] Gneist, K., *Forschungsdienst*, **17**, 416 (1944).
[2] Crasemann, E., and Heinzl, O., *J. Brit. Grassl. Soc.*, **4**, 263 (1949).
[3] Watson, S. J., "Grassland and Grassland Products" (London, 1951).
[4] Brouwer, E., *Versl. Land. Onderz.*, **43**, 55 (1937).

Spurious Mitotic Spindles and Fusion Tubes in Bacteria

A SERIES of papers has recently been read by E. D. DeLamater, of the University of Pennsylvania, and his associates, notably at the Sixteenth Cold Spring Harbor Symposium in June 1951, which I was privileged to attend.

By use of a technique which includes acid hydrolysis, staining with thionin, and dehydrating in freezing alcohol, DeLamater claims to be able to demonstrate classical mitotic spindles in bacteria. In my opinion, these appearances are grossly misinterpreted, and he is falling into the error, unfortunately common in the interpretation of cytological structures in bacteria, of mistaking for nuclear material the thickened, secretory areas underlying the cell walls, cross-walls and growing points. These

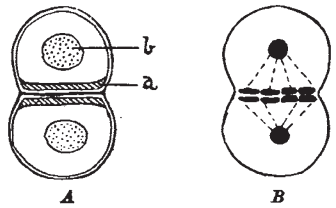

Fig. 1,*A*. Diagram of nuclei and cell envelopes of a large coccus. The cross-wall is secreted by septa from the cell membrane (*a*), which stain well because of their high nucleic acid content. The nuclei (*b*) occupy the centres of the cells. The cell wall and cross-wall do not stain well with 'nuclear' dyes. *B*. DeLamater's interpretation. The cross-wall is not observed; the nuclei are regarded as "centrosomes", the septa as "chromosomes"; the "spindle" is subjective

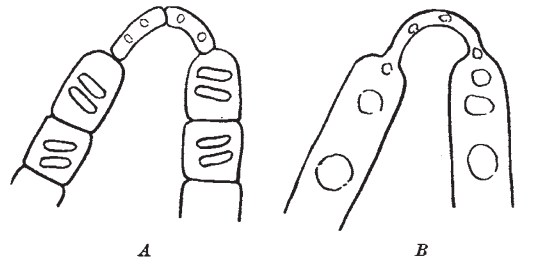

Fig. 2. *A*, Shrunken bacilli joining members of a chain, in *Bacillus*. *B*, DeLamater's interpretation. The cross-walls are not seen and the small bacilli regarded as fusion tubes, their nuclei as migrating nuclear material from their larger neighbours

structures, which are derived from the cell membrane, have a high nucleic acid content[1,2]. Despite DeLamater's contention that his staining technique is specific for nuclear structures, it is my experience that it stains these membranous structures as well as, or rather better than, it does the nuclei. Comparison of preparations fixed by DeLamater's freezing technique, and of others unfixed and mounted in water, shows considerable shrinkage and distortion in the former.

This error is particularly obvious in DeLamater's interpretation of the cytological structures in a large coccus. Cocci of this type are almost invariably divided into two cells by a cross-wall[3], which does not stain well by 'nuclear' dyes. This wall is secreted by a thick septum (*a* in Fig. 1,*A*), which stains well because of its nucleic acid content. The nuclear bodies (*b* in Fig. 1,*A*) lie in the centres of the cells. DeLamater describes the shrunken nuclei as "centrosomes", and the septum material as "chromosomes". The "spindle-fibres" are entirely subjective (Fig. 1,*B*).

These interpretations are made possible only by DeLamater's acknowledged unawareness of the multicellularity of these bacteria[1,4,5], which he describes as multinucleate cells.

Errors arising in this manner have been so common in the past that it was considered worth while to include a warning paragraph in the section dealing with the technique and cytochemistry in my recent monograph upon bacterial cytology[4], but apparently without avail.

The further claim by DeLamater and his associates to describe "fusion tubes" joining individual bacilli of *B. megatherium* is, in my opinion, equally baseless (Fig. 2). These bacilli occur in chains, and it is frequently seen that small, shrunken bacilli retain their position, joined at each end to their neighbours. This is especially frequent under adverse conditions, and it is notable that DeLamater observes these appearances only when the organism is cultured upon blood-agar, which is a most unusual medium for a saprophytic *Bacillus*. Again, the error of considering these structures to be tubes, continuous with the interior of the cells with which they are in contact, arises from unfamiliarity with the behaviour of the bacterial cell wall.

K. A. BISSET

Department of Bacteriology,
University of Birmingham.

[1] Bisset, K. A., *J. Gen. Microbiol.*, **2**, 83 (1948).
[2] Bisset, K. A., *J. Gen. Microbiol.*, **5**, 155 (1951).
[3] Bisset, K. A., *J. Gen. Microbiol.*, **2**, 126 (1948).
[4] Bisset, K. A., "The Cytology and Life-History of Bacteria" (Livingstone, Edinburgh, 1950).
[5] Robinow, C. F., addendum to "The Bacterial Cell", by Dubos, R. J. (Harvard University Press, 1945).