negative genera have been shown to have a higher lipid content and a much fuller range of amino-acids in the protein fraction than have those of the Gram-positives[4]. Their cytochemical behaviour more closely resembles that of intact wool proteins, whereas the Gram-positive cell envelopes resemble degraded wool proteins in this respect[5].

From these observations the following conclusions can be drawn; they are not completely proved, but must be regarded as intrinsically much more probable than the contemporary hypothesis (which most bacteriologists probably do not take very seriously) of antigenic variation by progressive loss of surface layers like the leaves of an onion. The well-known $S \rightarrow R$ variation in the pneumococcus is, of course, concerned with the loss of the capsule and is not referred to.

(*a*) The nucleoprotein material of the growing points is an important somatic antigen.

(*b*) The 'loss' of certain somatic antigens in Rough variants of Bacteriaceæ is due rather to the alteration in position of this material from a surface to an internal site than to its actual disappearance.

(*c*) The loss of further somatic antigens in Rough variants, and the low antigenicity of Gram-positive genera, are due to the chemically simpler structure of the cell envelopes in bacteria of septate morphology.

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[1] Pijper, A., *J. Path. Bact.*, **47**, 1 (1938).
[2] Bisset, K. A., *J. Gen. Microbiol.*, **5**, 155 (1951).
[3] Bisset, K. A., "The Cytology and Life-History of Bacteria" (Edinburgh, Livingstone, 1950); "Bacteria" (Edinburgh, Livingstone, 1952).
[4] Salton, M. R. J., and Horne, R. W., *Biochim. Biophys. Acta*, **7**, 177 (1951). Salton, M. R. J., *Biochim. Biophys. Acta*, **9**, 334 (1952).
[5] Fischer, R., and Larose, P., *Canad. J. Med. Sci.*, **30**, 86 (1952).

Sporulating Anaerobes on English Flax

Allen[1] reported that the majority of spore-bearing anaerobes isolated in pure culture from anaerobic and aerobic flax-rets in England, and which appeared usually to be the active agents in retting, possessed the characteristics of *Clostridium tertium*. Dowson[2] found that *Bacillus polymyxa*, a facultative sporulating organism, was capable of causing a soft rot of potato. This organism is capable of attacking pectin and therefore has potential retting abilities. *B. amylobacter* Bredemann, which is a synonym of *Cl. butyricum* and wrongly includes more than one true specific group[3], is mentioned in the literature as a retting organism[4]. So far as I am aware, no other strict anaerobe, facultative anaerobe or micro-aerophilic organism has been reported in England as a possible retting agent.

In other leading flax-retting countries, however, *Cl. pectinovorum*, a plectridial anaerobe, and *Cl. felsineum*, an orange-pigmented anaerobe, are considered to be the major retting agents, the latter being superior to the former. *Cl. tertium* has not been cited, except by Lanigan[5], who observed that a micro-aerophilic species related to *Cl. tertium* but differing from the latter in that it liquefied gelatin was most commonly found on Australian flax. *B. polymyxa*, if found, is considered of minor importance. Hellinger[3] found *Cl. aurantibutyricum*, an orange-pigmented butyric acid-producing organism, and *Cl. pectinovorum* var. *pseudoplectriforme*, to be commonly distributed in Israel flax rets. *Cl. aurantibutyricum* proved to be a highly efficient retting organism comparable to *Cl. felsineum*.

I have recently been investigating the microbial flora, more especially the sporulating anaerobes, on samples of English flax from Norfolk, Suffolk and Wiltshire. Straw samples were placed under simulated retting conditions, that is, immersed in water at 32° C., and sporulating anaerobes were isolated in pure culture using maize mashes, yeast–glucose–chalk media and potato/yeast–glucose agar slants in test-tubes under anaerobic conditions. A micro-aerophilic plectridial organism classified as *Cl. pectinovorum* (cf. Weizmann and Hellinger[6]), and *Cl. butyricum* were invariably present and numerous in all samples. An orange-pigmented anaerobe was found; but it formed a small part only of the flora of some of the flax. It was identified as *Cl. aurantibutyricum*, and not *Cl. felsineum*. *B. polymyxa* was obtained, but it was present in extremely small numbers.

The English isolates of *Cl. pectinovorum* were compared with a typical strain of the organism obtained from Prof. Kluyver of Delft, and a strain of *Cl. tertium* (541) obtained from the National Collection of Type Cultures. Studies carried out with these organisms tend to show that *Cl. tertium* is identical with *Cl. pectinovorum*. The strains examined were micro-aerophilic and also liquefied gelatin, the former a feature characteristic for *Cl. tertium*, the latter a distinguishing feature of *Cl. pectinovorum*.

The flax-retting abilities of the organisms isolated were tested on sterilized flax straws according to the method of Hellinger[3]. The new isolates of *Cl. aurantibutyricum* were remarkably active. Retting progressed moderately well after 48–54 hr. and the fibre bundles were completely liberated from the stem matrix after 66 hr. None of the strains of *Cl. pectinovorum*, including also the Dutch strain and *Cl. tertium* (strain 541), showed any sign of retting in 6–11 days at 32° C. Continuous aeration was tried, but also gave negative results. The *Cl. butyricum* isolates were also ineffective, whereas *B. polymyxa* caused a certain amount of loosening of the fibre bundles.

It is perhaps possible that *Cl. tertium* (strain 541) and the Dutch strain of *Cl. pectinovorum* had lost their original retting ability on long-continued artificial cultivation.

Full details of this work will be given elsewhere. It was done while on leave from the Weizmann Institute of Science, Rehovoth, Israel. Grateful acknowledgments are due to Mr. Gillham, Directorate of English Flax Production of the Ministry of Materials, and Major Searle, director of H.M. Norfolk Flax Establishment, King's Lynn, for their ready co-operation in giving me laboratory facilities and assistance.

Esther Hellinger

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[1] Allen, L. A., *Nature*, **157**, 829 (1946).
[2] Dowson, W. J., *Nature*, **152**, 331 (1943).
[3] Hellinger, E., *Bull. Res. Counc. Israel*, **2** (1952).
[4] Galloway, L. D., and Burgess, R., "Applied Mycology and Bacteriology", 127 (Leonard Hill, London, 2nd edit., 1940). The Flax Development Committee, Sixth Interim Report, 1945, p. 76.
[5] Lanigan, G. W., *Nature*, **165**, 516 (1950).
[6] Weizmann, Ch., and Hellinger, E., *J. Bact.*, **40**, 665 (1940).