If in place of the absorption curve as shown, one uses the curve from which has been subtracted the absorption of the bleached solution (as is usually done), the difference in the blue is much reduced. Such a 'correction' is, however, meaningless, as visual purple bleaches to a yellow substance, and the resultant curve depends largely on the yield and stability of this substance. The yellow products of visual purple may themselves be partly responsible for the low luminosity in the blue. The curve obtained by Dr. Lythgoe may include absorption due to a small amount of residual impurities, but is much more trustworthy than the 'corrected' curves.

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Sharpness of the Magnetic Curie Point

EXPERIMENTS carried out in recent years on nickel and iron have led to the view that the spontaneous magnetization does not disappear suddenly at the Curie point, but that there is a definite 'tail' to the magnetization-temperature curve. The specific heat measurements of Ahrens[1], and more particularly the work on very pure nickel by Grew[2], establish beyond doubt that the energy (E) associated with the ferromagnetic state does not vanish suddenly at the Curie point, although there is probably a sharp discontinuity in the $(d^2E/dT^2, T)$ curve at this temperature. The measurement of the energy, either through the specific heat or the magneto-caloric effect, appears to us to be the only sound method of estimating the degree of spontaneous magnetization.

Recently, Svensson[3] has measured the resistance of nickel near its Curie temperature and finds a discontinuity in the temperature coefficient taking place within a temperature range so small as 0·1° C. One of us (H. H. P.) has recently repeated and verified this result, and has also shown that from the Curie point (357° C.) up to a temperature of 1,000° C., the resistance-temperature curve is concave to the temperature axis with a very marked curvature for some 30° or more above the Curie point. We wish here to suggest a means of reconciling the results of the experiments on the change of magnetic energy with those on the change of resistance.

The magnetic state is determined by the degree of order among the electron spins, the disappearance of the ferromagnetism being associated with the break-up of the Weiss domains. Now the magnetic energy must depend on the interactions between spins at close range or, in other words, on short-distance order. On the other hand, since the mean free path of an electron in nickel at its Curie point is of the order of 20 times the interatomic distance, the resistance will depend on long-range order. If at a definite temperature (Curie point), order suddenly ceases to extend over domains of more than about 8,000 atoms, a kink in the resistance-temperature curve will be obtained; but owing to the presence of smaller ordered domains the magnetic energy will not have vanished completely.

The effect of the subsequent break-up of these smaller domains is to produce the 'tail' of the magnetization-temperature curve, and a marked curvature in the resistance-temperature curve in the region immediately above the Curie point.

The continued concavity of the resistance curve towards the temperature axis up to 1,000° C. is due to quite another cause; it occurs also for paramagnetic metals, and has already been explained by one of us[4].

It may be noted that Stoner[5] has used a similar idea of small ordered domains persisting above the Curie temperature to explain certain apparent anomalies in the magneto-caloric effect.

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Constitution of the Keratin Molecule

FROM a study of the elastic properties of wool fibres in solutions of varying hydrogen ion concentration, Speakman[1] has argued that the long peptide chains of wool are bridged by salt linkages formed from the acid side chains of aspartic and glutamic acids, and the basic side chains of arginine, lysine and histidine. In addition, chemical equivalence between the *free* acid and basic side chains was deduced from the form of the curve relating the ease of fibre extension to the *p*H of the medium. Such is the salt linkage theory, for which support was later found in the titration curves of wool[2] and feather keratins[3], as well as in deductions concerning the influence of the salt linkages on the reactivity of the disulphide bond in strained animal fibres[4]. Unfortunately, however, the amounts of aspartic and glutamic acids isolated from wool and goose feather by Abderhalden[5] are insufficient to account for the basic side chains as well as amide nitrogen. The difficulties of protein analysis are so great that the salt linkage theory is not called into question by Abderhalden's results, but it was felt desirable to augment the supporting evidence already available by direct proof based on new determinations of the dicarboxylic acids in wool and seagull quill, which may be regarded as typical keratins.

Using modifications of Foreman's[6] and Jones and Moeller's[7] procedures, which will be described elsewhere, the following data, corrected for nitrogen loss at different stages of the investigation, were obtained for Cotswold wool.

Acid	Amount isolated expressed as: per cent on weight of wool	mgm.N/gm. of wool
Glutamic acid	15·27	14·54
Aspartic acid	7·27	7·65
	Total N =	22·19

When uncorrected for loss of nitrogen, the total dicarboxylic acid nitrogen was 20·75 mgm./gm., so

that correction, being small, is justified. The amide nitrogen content of the wool was found to be 13·7 mgm./gm., leaving dicarboxylic acid equivalent to 8·49 mgm./gm. available for combination with the basic side chains. Taking Vickery and Block's[8] determinations of the basic amino acids in wool, the excess dicarboxylic acid required for combination according to the salt linkage theory is 8·55 mgm.N/gm. Vickery and Block's results are probably low, but even if the maximum combining capacity of wool for hydrochloric acid is taken as a measure of the basic amino acid content, the amount of dicarboxylic acid needed for combination is only 11·2 mgm.N/gm. In other words, we have succeeded in isolating 22·19 out of the maximum possible requirement of 13·7 + 11·2 = 24·9 mgm./gm. of dicarboxylic acid nitrogen.

The methods employed in the preceding investigation were evolved during a preliminary attempt to determine the dicarboxylic acid content of seagull quill. According to the salt linkage theory, the quill should contain 20·6 mgm./gm. of dicarboxylic acid nitrogen, comprising 14·9 mgm./gm. for amide nitrogen and 5·7 mgm/gm. for basic side chains as deduced from the acid combining capacity. In the case of goose feather, however, Abderhalden[5] succeeded in isolating only 2·3 per cent of glutamic acid and 1·1 per cent of aspartic acid, together equivalent to 3·4 mgm.N/gm. When corrected for nitrogen loss as before, the quantities isolated in the present investigation were as follows:

Acid	Amount isolated expressed as: per cent on weight of feather	mgm.N/gm. of feather
Glutamic acid	9·72	9·26
Aspartic acid	6·57	6·92
Not identified	—	0·96
		17·14

The amounts of aspartic and glutamic acids are an improvement on Abderhalden's values, and the agreement between the nitrogen content of the isolated dicarboxylic acids and the requirement of the salt linkage theory is sufficient to establish its validity for feather, as well as for wool, if due account is taken of the preliminary character of the feather investigation.

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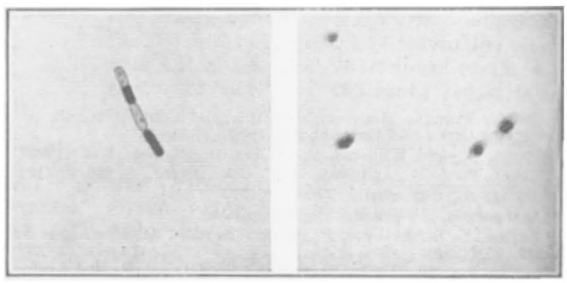
Chromatin Arrangements in Spore-forming Bacilli

WE have recently made a cytological study of several species of spore-forming bacilli, using the vital staining method of Nakanishi as modified by Stoughton[1]. This has resulted in two observations which help to explain (1) the confusion of ideas as to the changes in cell structure accompanying spore-formation, and (2) the role of the spore in the cycle of development of the bacillus.

(1) In young cultures (purified by plating, followed by single cell isolation), prior to the appearance of spores, many cells show a sharp lateral division into two sections depending upon a difference in affinity for the stain (for example, neutral red chloride). One section (usually rather less than half the cell) is deeply stained, the other section very lightly and in many cases apparently not at all. This appearance (shown by the top cell in the photomicrograph reproduced as Fig. 1, *a*) has been found to be typical in the case of six spore-formers—two isolated from silage, one from soil, one found as a contaminant in a medium and two stock cultures (*B. subtilis* and *B. megatherium*)—otherwise easily distinguishable on physiological grounds.



a *b*

Fig. 1.

Observations on cultures of a slightly more advanced age indicate that the cell containing the two sections undergoes fission in the usual way, giving rise to one cell capable of staining deeply and one which has little or no affinity for stain (as shown by the two lower cells in Fig. 1). Further observations in the case of three of the above cultures have led us to the conclusion that the two kinds of cells thus produced differ in their subsequent cytological development, resulting in each case in a cell containing an endospore but with a different structure extraneous to the spore. These alternative methods of forming endospores shown by the same species of organism may possibly explain to some extent the divergence in descriptions of the process of spore-formation by different authors.

(2) As is well known, the fully formed bacterial spore, examined by ordinary methods, appears as a refractile body resistant to the entry of stains, and it has been generally assumed that it is in fact homogeneous and represents a resistant resting stage in the life of the bacillus. So far as we are aware, there is no record of experimental evidence to refute this view, and the only suggestion found in the literature is one by Mellon (quoted by Hadley[2]) that the bacterial spore may be a 'cover' for nuclear reorganizations.

In the case of two of the above species of spore-formers, both isolated from silage, structures visible by vital staining methods have been followed at frequent intervals until the cultures were several weeks old. This has disclosed the fact that endospores, though certainly refractile for some time after formation and subsequent release from the enclosing cells, may later take up the stain and reveal a deeply staining granular structure. This shows rearrangement into several definite forms over a considerable period of time. In some spores showing an internal structure the stain is absorbed quickly, in others the structure appears more slowly after leaving the spores in contact with