

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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Jan. 26.

<sup>1</sup> See for example Houstoun's "Vision and Colour Vision", p. 89 (Longmans Green and Co., London, 1932).

<sup>2</sup> Hecht, S., and Williams, R.E., *J. Gen. Physiol.*, **5**, 1 (1922).

<sup>3</sup> Abney, W. de W., and Watson, W., *Phil. Trans.*, **A**, **218**, 91 (1916).

<sup>4</sup> König, A., *Sitz. Berlin Akad.*, **2**, 577 (1894).

<sup>5</sup> Lythgoe, R. J., private communication.

<sup>6</sup> Bayliss, L. E., Lythgoe, R. J., and Tansley, K., *Proc. Roy. Soc.*, **B**, **120**, 95 (1936).

<sup>7</sup> See, for example, Dartnall, H. J. A., Goodeve, C. F., and Lythgoe, R. J., *Proc. Roy. Soc.*, **A**, **156**, 158 (1936); Goodeve, C. F., *Proc. Roy. Soc.*, **A**, **155**, 664 (1936).

### 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<sup>1</sup>, and more particularly the work on very pure nickel by Grew<sup>2</sup>, 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<sup>3</sup> 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<sup>4</sup>.

It may be noted that Stoner<sup>5</sup> 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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Feb. 5.

<sup>1</sup> Ahrens, *Ann. Phys.*, (5), **21**, 169 (1934).

<sup>2</sup> Grew, *Proc. Roy. Soc.*, **A**, **145**, 509 (1934).

<sup>3</sup> Svensson, *Ann. Phys.*, (5), **22**, 97 (1935).

<sup>4</sup> Mott, *Proc. Roy. Soc.*, **A**, **153**, 699 (1936); **A**, **156**, 368 (1936).

<sup>5</sup> Stoner, *Phil. Trans.*, **A**, **235**, 165 (1936).

### Constitution of the Keratin Molecule

FROM a study of the elastic properties of wool fibres in solutions of varying hydrogen ion concentration, Speakman<sup>1</sup> 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 pH of the medium. Such is the salt linkage theory, for which support was later found in the titration curves of wool<sup>2</sup> and feather keratins<sup>3</sup>, as well as in deductions concerning the influence of the salt linkages on the reactivity of the disulphide bond in strained animal fibres<sup>4</sup>. Unfortunately, however, the amounts of aspartic and glutamic acids isolated from wool and goose feather by Abderhalden<sup>5</sup> 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<sup>6</sup> and Jones and Moeller's<sup>7</sup> 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