The work described here has been carried out as part of the general research programme of the National Physical Laboratory, and this note is published by permission of the Director of the Laboratory.

The photomicrograph of Fig. 1 was prepared by Mr. J. L. Heslegrave and the electron micrograph of Fig. 2 by Mr. J. Trotter.

F. W. CUCKOW

Metallurgy Division,
National Physical Laboratory.
March 3.

[1] Zernike, F., *Z. tech. Phys.*, **16**, 454 (1935).

[2] Griffiths, W. T., Pfeil, L. B., and Allen, N. P., 2nd Report of the Alloy Steels Research Committee, pp. 343–367. (Iron and Steel Institute, 1939. Special Report No. 24.)

[3] Mahl, H., *Z. tech. Phys.*, **21**, 17 (1940). Schaefer, V. J., and Harker, D., *J. App. Phys.*, **13**, 427 (1942).

Felting of Animal Fibres

WHEN a mass of loose wool or fur is rubbed in presence of an aqueous solution of acid or alkali, a felt is produced because the surface scale structure of the fibres causes them to migrate in the direction of their root ends. In the preparation of rabbit fur for felting, it is customary to treat the tip ends of the fibres, before the skin is cut away, with a solution of mercuric nitrate in nitric acid. The process, known as 'carroting', has the effect of enhancing the felting power of the fibres, and similar results can be obtained with other oxidizing agents, such as hydrogen peroxide, in presence of suitable catalysts. In all cases, the essential reaction is disulphide-bond breakdown, which was believed to be beneficial[1] because the tip ends of rabbit fibres are coarser than the roots. After treatment, the tips of the fibres are much less resistant to deformation, with the result that they are able to follow the finer root ends through entanglements which would otherwise have obstructed further movement and felting.

Although the process of 'carroting' is centuries old, its exact purpose has only recently been recognized[1], and no attempt has been made, therefore, to enhance the felting power of fur fibres by using reducing agents, instead of oxidizing agents, to cause disulphide-bond breakdown in the tips. It has now been found that treatment with a 10 per cent solution of sodium metabisulphite in aqueous alcohol[2] for one hour at 50° C. is particularly effective, even with wool fibres, which are uniform in diameter along their length.

Locks of 58's Australian cross-bred wool were treated with sodium metabisulphite over various fractions of their lengths, starting from the tip, 'carded', and then felted (4-gm. samples) for 30 minutes in presence of soap in a model felting machine[3]. The results are given in Table 1, where the degree of felting is indicated by the value of the 'compression resistance', which is the ratio of the thicknesses of the felted pad under standard high and low pressures. Maximum felting is obtained when half the length of the fibres, starting from the tip, is treated with sodium metabisulphite.

TABLE 1

Reagent	Fraction of lock treated	Compression resistance
Sodium metabisulphite	None	0·717
	Tip ¼	0·814
	Tip ½	0·826
	Tip ¾	0·720
	Whole lock	0·609

It is obvious that such a high degree of entanglement as exists in a finished felt could not be brought about unless the root ends of migrating fibres are sufficiently rigid to force a way through entanglements made in earlier stages of the felting process[4]. This is, no doubt, the reason why the degree of felting is least when the whole fibre is treated with sodium metabisulphite. As, however, the flexural rigidity of intact wool fibres is low, it seemed likely that improved felting might be obtained by hardening the root ends of fibres instead of softening the tips. This deduction was confirmed by treating locks of wool with a solution of mercuric acetate ($0 \cdot 1M$) in acetic acid ($0 \cdot 1N$) for one hour at 25° C. Mercuric acetate is by far the most effective cross-linking agent for animal fibres[5], and the results obtained with wools which were cross-linked over various fractions of their lengths, starting from the root end, are given in Table 2.

TABLE 2

Reagent	Fraction of lock treated	Compression resistance
Mercuric acetate	None	0·717
	Root ¼	0·761
	Root ½	0·694
	Root ¾	0·545
	Whole lock	0·387

The highest degree of felting is obtained when about a quarter of the length of the fibres, starting from the root end, is treated with mercuric acetate.

As would be expected, there is a dramatic rise in the felting power of animal fibres when hardening of the root ends is combined with softening of the tips, and this principle is likely to form the basis of the 'carroting' processes of the future. At present, the best practical means of carrying out such processes seems to be to harden the whole fibre with cross-linking agents and then to soften the tip by means of reagents which cause disulphide-bond breakdown.

We are indebted to the International Wool Secretariat for grants in aid of the investigation.

J. MENKART
J. B. SPEAKMAN

Textile Chemistry Laboratory,
Department of Textile Industries,
University, Leeds.
March 8.

[1] Speakman, *J. Text. Inst.*, **32**, T83 (1941).

[2] Speakman, B.P. 453,700.

[3] Chamberlain and Menkart, *J. Soc. Dyers and Col.*, **61**, 286 (1945).

[4] Martin, *J. Soc. Dyers and Col.*, **60**, 325 (1944).

[5] Speakman and Coke, *Trans. Farad. Soc.*, **35**, 246 (1939). Barr and Speakman, *J. Soc. Dyers and Col.*, **60**, 335 (1944).

Total Emission Noise in Diodes

C. N. SMYTH[1] has shown that the space-charge between anode and cathode in the cut-off region of a diode gives rise to a large input conductance $1/R$ at ultra-high frequencies. He has also put forward arguments that the space-charge behaves as an additional source of noise at ultra-high frequencies. Hence it might be worth while to measure the 'equivalent noise temperature' T_e of the conductance $1/R$, T_e being defined by

$$\overline{i^2} = \frac{4k\, T_e\, \Delta\nu}{R}, \tag{1}$$

in which $\overline{i^2}$ denotes the mean square noise current in a frequency interval $\Delta\nu$ and k is Boltzmann's constant.