Letters to the Editor.

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The Micelle Structure of the Wool Fibre.

THE real existence within the wool fibre of micelles which are impervious to water molecules and dyestuffs has only occasionally been suggested [1] and never demonstrated. Two independent lines of investigation have recently converged, not only to prove the existence of micelles, but also to give some idea of their shape and dimensions, and the manner of attack by certain reagents. In an earlier paper,[2] I was able to show that the size of the capillary spaces in the dry wool fibre is of the same order as the length of the *n*-propyl alcohol molecule. Whereas wool fibres in methyl alcohol and ethylene glycol are easily extensible, in butyl and amyl alcohols they resist extension to a degree closely similar to that of the perfectly dry fibre. When, however, the higher alcohols are mixed with methyl alcohol or ethylene glycol, these latter reagents enter the fibre and cause it to swell, opening the pores until they are able to admit the larger molecules. This is well illustrated by a comparison of the properties of wool fibres in octyl alcohol, ethylene glycol, and mixtures of the two. The potential energy necessary to extend fibres 30 per cent of their length in the various media at 22·2° C. was determined and typical results are quoted below :

Medium.	Potential Energy (gm.cm. per c.c.).
Octyl alcohol	$5{\cdot}17 \times 10^5$
Ethylene glycol	1·63 ,,
Ethylene glycol–octyl alcohol . . .	1·72 ,,

The molecular concentration of ethylene glycol in the above mixture with octyl alcohol was only 60·8 per cent, and since the properties of the fibre in the mixture are almost identical with those in ethylene glycol alone, it seems clear that the pores of the swollen fibre are sufficiently large to admit the octyl alcohol molecule. This great increase in pore size is in striking contrast with the small increase in the over-all dimensions of the fibre. Swelling is greatest in water, but even in this case the increase in length of the dry fibre is only 1·1 per cent and the increase in diameter about 18 per cent. The co-existence of a large increase in pore size with a small increase in cross-sectional area affords a critical proof of the existence within the fibre of micelles which are relatively, if not entirely, impervious to molecules as small as the water molecule.

It has been found possible to extend the preceding argument to give a measure of the thickness of the micelles. Determinations of the potential energy required to stretch fibres were made in a series of mixtures of methyl- and octyl-alcohols. In the region of low concentration of methyl alcohol, the work required to stretch fibres at first decreased slowly with increasing concentration of methyl alcohol, as would be expected by analogy with the properties of wool fibres in atmospheres at various relative humidities. When, however, the concentration of methyl alcohol was great enough to produce a sufficient degree of swelling, octyl alcohol molecules could gain admission to the fibre, causing an immediate fall in the resistance to extension. Determinations of the increase in diameter of wool fibres in the critical mixture required to admit octyl alcohol, combined with the fact that the pore size must have been increased by the difference between the lengths of the *n*-propyl alcohol and octyl alcohol molecules, indicate that the thickness of the micelles must be of the order of 200 A. Knowing the increase in diameter of wool fibres in water and making use of the preceding determination of micellar thickness, it can be shown that the pore size in fibres swollen in water is of the order of 40 A.

From a comparison of the changes in the elastic properties and size characteristics of wool fibres with water adsorption, I have previously deduced [1] that the micelles must be long in comparison with their thickness. Discrimination between the possible shapes which will fulfil this requirement was made possible from observations on the affinity of sodium sulphide treated wools for water. Known weights of purified Cotswold wool were treated with sodium sulphide solution for different times, the loss in weight being in each case ascertained after removing adsorbed sodium compounds by prolonged washing in distilled water. The amounts of water adsorbed by the dry, treated and untreated, wools were then determined at various humidities. A few typical results are given in the following table, the different wools being distinguished by indicating their loss in weight after reaction with sodium sulphide:

Relative Humidity. %	Percentage by Weight of Water adsorbed by			
	Untreated Wool.	Sodium Sulphide treated Wools.		
		13·0% loss.	46·0% loss.	56·7% loss.
24·2	6·80	6·77	6·75	6·93
73·5	17·00	16·82	16·94	17·24
91·3	24·83	24·75	26·01	25·47

It is a highly significant fact that wool treated with sodium sulphide until the loss in weight is as high as 57 per cent should show almost exactly the same affinity for water as untreated wool. In view of the proved existence of micelles which are impervious to water, there can be only one possible explanation of the results : that the ratio of surface to mass remains unaltered with loss in weight. Combining this requirement with those indicated above, it becomes clear that the most probable shape of the micelles is the lamella, and that attack by sodium sulphide is largely confined to the edges, leaving the surface mass ratio sensibly unaltered. In addition, these observations indicate that the disulphide link in wool, which is the point of attack by sodium sulphide, must lie in a plane making an obtuse angle with the large faces of the micelles. Finally, there is now an obvious explanation of Marriott's [3] observation that treatment of hair with sodium sulphide until it shows a 26 per cent loss in weight leaves the ratio of the nitrogen and sulphur contents unaltered.

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The University,
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[1] *J. Soc. Chem. Ind.*, **49**, 209 T ; 1930.
[2] *Trans. Faraday Soc.*, **26**, 61 ; 1930.
[3] *J. Soc. Leather Trades Chemists*, **9**, 618 ; 1925.

Hyperfine Structure in Some Spectral Lines from Highly Ionised Atoms of Thallium and Bismuth.

IN working with spectra in the extreme ultra-violet at the physical laboratory in Uppsala, I have been able to observe a hyperfine structure in some spectral lines in the region 1400-800 A. The lines investigated are due to higher ionisation stages of thallium and bismuth. For thallium, hyperfine structure has been measured before in the arc spectrum and in the first spark spectrum, and for bismuth, in the arc spectrum.