LXIII. UNSCALED FIBRES. A NEW ASPECT OF FIBRE RESEARCH.

By ALBERT THEODORE KING.

From the British Research Association for the Woollen and Worsted Industries, Headingley, Leeds.

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HITHERTO both chemical and physical investigations on wool have dealt with the properties of the fibre as a whole. Conclusions drawn only from such observations as to how the structurally different parts (scale and cortex, and also medulla in the case of kempy fibres) are concerned in the total effect, can only be inferential. To resolve any property of the fibre into the contributory effects of scale and cortex requires removal of the scales in such a way as to leave the residual fibre core intact for separate investigation.

Chemical methods of separating scales and cortex almost certainly involve modifications in their chemical composition, and the examination of fibres so denuded of scales is of little value, so far as the specific effect of the cortex in the complete fibre is concerned. Mechanical separation is the only admissible method, and this can be successfully carried out in the manner described below, and as shown by the accompanying photomicrographs of fibres in various stages of removal of the scales and outer layers.

METHOD OF UNSCALING.

Various methods were tried without success. Eventually it was found that by drawing the fibre with a small weight attached to keep it taut up and down across the edge of an ordinary microscope slide mounted horizontally, complete unscaling could be effected without breaking the fibre or damaging the bared interior. The slides require to be selected carefully. The narrow face must be smooth, and the two bounding edges require to be sharp and free from chipped places, which are easily detected when the finger nail is drawn along them. The severity of the scraping depends on the rate of rise and fall of the fibre, the departure from the vertical between the upper glass edge and the guiding eye placed above it, and the pressure on the glass edge as determined by the weight attached to the fibre. The scraping becomes more pronounced after the edge has been slightly roughened by friction with the fibre. The sound of the scraping is a good guide as to whether the operation is proceeding properly, or the edge is too much roughened for use. By slowly rotating the clip holding the upper end of the fibre while it is being raised and lowered, the weight also revolves and the whole surface becomes equally

scraped. Long coarse fibres are naturally best suited to the treatment, but with due precautions merino fibres can be unscaled with equal success. The scraped fibres have a different lustre, and no longer possess the property of "creeping" when rubbed lengthwise between the thumb and finger. This latter test affords a good indication of the progress of scale removal.

This simple apparatus meets the case where fibres require to be examined singly, for example, in swelling and elasticity investigations, and microscopic studies under various treatments, but for chemical analysis and other work requiring fibres in bulk, more rapid treatment is desirable. This can be effected by making the fibre pass a number of the glass edges suitably spaced, and by building a number of scraping units to treat several fibres simultaneously. An instrument on these lines is being developed, and will be described in a separate paper.

APPEARANCE OF UNSCALED FIBRES.

For the first series of photomicrographs (1, 2 and 3, Plate II), La Concordia Pure Lincoln fibres were used, these being of suitable length and uniformity, and showing a very clear scale structure in their natural condition. Euparal was used as mounting medium in preference to Canada balsam, as the former brings out the scale structure much more clearly. To give contrast the fibres were dyed (with Ponceau R.G.) before scraping.

The disappearance of scale edges and scale markings can be followed by microscopic observation. In the photographs shown, taken from a single fibre which had been subjected to thorough scraping, the middle portion of the fibre (3) is seen to have been considerably reduced in area without suffering, but rather gaining, in regularity of contour. The second photograph (2) shows a lesser degree of scraping, the unscraped end portion being shown on the extreme left (1).

The pores recently observed by Mark [1925] appear more distinctly and generally in increased numbers in the scraped portions. Probably the scales are more opaque than the cortex, and being also irregular in surface, scatter the light and obscure all but those pores immediately beneath them.

The effect of similarly treating Australian Merino fibres is shown in (4) and (5). The fibre cortex, while clearly defined and very regular, does not exhibit pores in the same striking manner as the Lincoln fibre.

The dyed fibres show scarcely any evidence of fibrillar structure in the cortex. Staining with Nile blue results in a striated appearance under the microscope suggesting narrow filaments closely packed, but not revealing any discrete cell structure. It is not impossible that these striae may be merely scratches made during the scraping, though this is regarded as improbable. The scraping is remarkably smooth under properly adjusted conditions, and fibres are rarely damaged. Where damage does occur, it is usually by lateral cuts due to horizontal vibration of the fibre along the glass edge, as shown in (6), Plate II.

By passing the fibre over a single edge and preventing any rotation, a plane surface can be produced on the fibre. By giving a half turn to the fibre clips the opposite side can be scraped, producing a thin ribbon, and interesting longitudinal sections are obtainable in this way. Number (7), Plate II, is a photomicrograph of a plane surface so produced with a La Concordia Lincoln fibre. The better definition thus obtained shows the pore structure much more clearly than is possible with a cylindrical surface.

APPLICATIONS.

The production of such fibres opens up a wide field of investigation into the microscopic structure, chemical composition, behaviour towards reagents, and various physical properties of the fibre cortex as distinct from the complete fibre.

The foregoing observations are of a preliminary nature to indicate broadly the directions in which this method of attack may be of service in fibre research, on which lines investigations are now in hand.

SUMMARY.

A method has been devised for the mechanical removal of the scales or outer layers of wool fibres in such a way as to leave the cortex or inner core intact for physical and chemical investigations. It consists essentially in drawing the fibre across the edge of a glass plate of suitable character, or over a series of such plates suitably arranged. The effectiveness of the method is illustrated by photomicrographs of wool fibres in various stages of scale removal. The method provides a means of ascertaining the chemical and physical characters of the cortex, as distinct from those of the fibre as a whole.

REFERENCE.

Mark (1925). Beiträge zur Kenntniss der Wolle und ihre Bearbeitung, 32.

Magnification $\times 300$.