REFERENCES

[1] M. HORIO AND T. KONDO, *Text. Research J.*, 23 (1953) 373.
[2] E. H. MERCER, *Text. Research J.*, 23 (1953) 388.
[3] R. D. B. FRASER AND G. E. ROGERS, *Biochim. Biophys. Acta*, 12 (1953) 484.
[4] H. LINDLEY, *Nature*, 160 (1947) 190.
[5] H. LINDLEY, unpublished results.
[6] S. M. PARTRIDGE AND H. F. DAVIS, *Nature*, 165 (1950) 62.
[7] G. BISERTE AND P. PIGACHE, *Bull. Soc. Chim. Biol.*, 33 (1951) 1379.
[8] G. BISERTE AND P. PIGACHE, *ibid.*, 34 (1952) 51.
[9] S. BLACKBURN, *Biochem. J.*, 47 (1950) xxviii.
[10] S. BLACKBURN, *Biochem. J.*, 47 (1950) 443.

Received November 25th, 1953

THE ORIGIN OF SEGMENTATION IN WOOL CORTEX

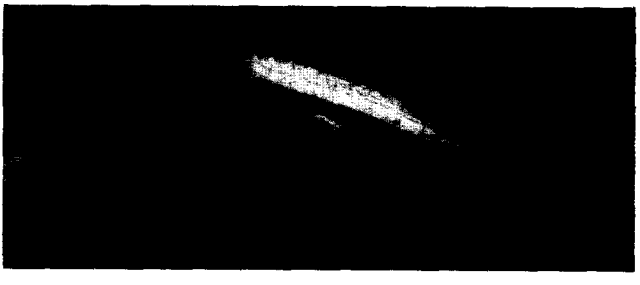
by

R. D. B. FRASER AND G. E. ROGERS

Biochemistry Unit, Wool Textile Research Laboratory, C.S.I.R.O., Melbourne (Australia)

Recently it has been shown[1,2,3,4] that the cortex of crimped wool fibres has a bilateral structure with segments of differing dye-accessibility, alkali sensitivity, cystine content and resistance to enzymic digestion. It is natural to enquire at what stage in the biosynthesis of the wool fibre this differentiation occurs, and we wish to present a preliminary account of our investigations of the origin of cortical segmentation in the follicle.

Fig. 1. (a) Plucked wool root swollen in detergent and alkaline thioglycollate showing segmentation.



(b) The same observed between crossed polaroid screens showing differential loss of birefringence.

The differentiation of cortical cells in the follicle involves a process of elongation accompanied by the deposition of longitudinally oriented fibrils and subsequent hardening or keratinization including the formation of disulphide linkages[5,6]. In freshly plucked roots the unkeratinized portion swells in water and is dispersed by alkali or urea. When the process is observed microscopically

little evidence of a bilateral structure is obtained. However, in roots which have been dried in air or in alcohol segmental development is revealed by the differential swelling in alkalis or detergents. In Fig. 1 the bilateral structure is seen to extend throughout the whole region of cell elongation and cortical pre-keratinization. The presumptive *H* (alkali-resistant) and *S* segments may be distinguished both by a difference in striations and in birefringence.

It is evident that differentiation of the *H* from the *S* segment is not merely a difference in hardening produced in the final stages of the biosynthesis of the wool fibre[2] but must occur in the earliest stages of fibril formation, where birefringence first appears, and may even originate in the germinal layers of the bulb. This conclusion is supported by the fact that the *H* and *S* segments of the wool fibre have different amino-acid compositions[4]. The fibrils which appear early in the differentiation of the cortical cells correspond to protein aggregates which form the basis of the final hardened cortex, and it seems unlikely that a common precursor could lead to final products of such widely different amino acid composition.

In his histological study of keratinization AUBER[6] has shown that crimp formation in the follicle is related to bulb deflection, eccentric disposition of the fibre and asymmetric keratinization. Furthermore he showed that asymmetric keratinization is related to the eccentric disposition in that keratinization begins on the thin side of the inner root sheath and progresses across the fibre cross-section to become complete on the thick side. The –SH reactive pre-keratinization zone terminates asymmetrically and the fully keratinized fibre occupies the remainder of the follicle length.

We have found that follicle cross-sections above the region of keratinization, when stained by the usual histological techniques, do not reveal segmentation in the contained fibre or the relation of the segments to its eccentricity in the follicle. However, by treatment with peracetic acid followed by staining with basic dyes, *e.g.* methylene blue[1], the disposition of the segments is revealed, Fig. 2. The orientation of the segments is such that the *H* segment of the eccentric fibre is associated with the thinner side of the inner root sheath, and is therefore related to the asymmetrical hardening. Swelling experiments on plucked roots give the impression that the completion of keratinization in the *S* segment may not follow immediately upon the completion of keratinization in the *H* segment.

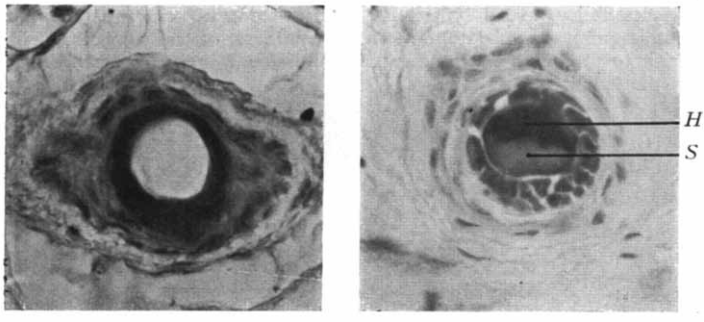


Fig. 2. (a) Skin section stained with methylene blue showing eccentric disposition of fibre in inner root sheat.

(b) Skin section treated with peracetic acid and stained with methylene blue revealing the relation between eccentricity and segmentation.

It is of interest to compare PEARSE's performic acid oxidation method for the histological demonstration of keratin[7] with our results obtained with peracetic acid followed by basic dye staining. PEARSE's reasons for using SCHIFF's reagent to stain hair keratin after oxidation do not appear to be chemically sound although segmentation could be revealed in our experiments by using this reagent as an alternative to basic dyes. He found no evidence of segmentation in hair follicle cross-sections, probably because he used straight medullated hairs.

It is evident from our preliminary observations that the differentiation of the cortical segments in crimped wool occurs at a very early stage in the biosynthesis of the cortex and is not merely a difference of keratinization. The fibre eccentricity, bulb deflection and unsymmetrical keratinization appear to be causally related to the segmentation, although the metabolic implication of these features remains to be elucidated.

REFERENCES

1 M. HORIO AND T. KONDO, *Text. Research J.*, 23 (1953) 373.
2 E. H. MERCER, *Text. Research J.*, 23 (1953) 388.
3 R. D. B. FRASER AND G. E. ROGERS, *Biochim. Biophys. Acta*, 12 (1953) 484.
4 R. D. B. FRASER, H. LINDLEY AND G. E. ROGERS, *Biochim. Biophys. Acta*, 13 (1954) 295.
5 E. H. MERCER, *Biochim. Biophys. Acta*, 3 (1949) 161.
6 L. AUBER, *Trans. Roy. Soc. Edinburgh*, 62 (1950–51) 191.
7 A. G. E. PEARSE, *Quart. J. micr. Sci.*, 92 (1951) 393.

Received November 25th, 1953