Letters to the Editor

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Origin of Curls and Twists in Wool Fibres

WILDMAN¹ has recently discussed the sequence of development of the fetal lamb's coat, showing early anterior to posterior and later secondary progressions in follicle initiation over the skin surface. He directs attention to the spiral shape of wool follicles and the changes in direction of the growing point as development proceeds, concluding therefrom that the shape of the fibre is largely determined by the shape of the basal portion of the follicle.

The prototrichs characteristic of the natal coat, as described by Duerden², exhibit all shapes of tip from sickle to fine curly, the form being apparently related to the kind of growth which proceeds. Thus a gradual increase of thickness (presumably with progressive enlargement of the follicle growing zone) leads to the 'sickle tip' condition, while curly tip is associated with a mere elongation of extruded fibre without change of cross-sectional area. Irregular waviness is then exhibited in each prototrich before fibre production 'settles down' to that of the definitive fibre more typical of the adult coat and in general of more regular growth; that is, until the follicle population assumes its normal adult activity, when the definitive fibre structures continue as spirals, waves or with helical twists. The work of S. G. Barker and his collaborators^{3,4} on 'crimp' apparently justifies the conclusion that a straight fleece fibre is extremely rare. The region of activity of the various forces imposing curl and twist upon the fibre must clearly lie within the lower parts of the follicle, although its characteristic shape may conceivably be modified by other forces, acting on the parts still surrounded by the follicle structure, such as varying rates and zones of dehydration (vide King and Nichols⁵). The direction of emergence of the fibre is generally not perpendicular to the skin surface and directional currents of fibre slope may be observed in many forms, though on the fleece areas they may be more or less obscured by the density of the fibre population, and, in the birth coat, by the tendency for groups of extruded fibres to approximate into the familiar lamb's coat 'spirals'.

The different forms of spirals (for example, horns in sheep) which result from larger accretionary growths have been discussed by Thompson⁶ and Huxley⁶ on mathematical premises based upon the existence of growth gradients about different axes of the growing region. A suggestion may be made that similar systems may operate within the comparatively restricted growth zones of hair follicles. It is conceivable that the forces within the follicle required to give rise to the various curved forms of fibre may follow upon different growth intensities (yielding different rates of elaboration of fibre substance) at different aspects of the follicle. Any asymmetry of the follicle growing zone could allow of differential rates of production of fibre constituents, while the disposition and orientation of the follicle in relation to the general growth gradients would affect the direction and magnitude of the forces at play.

Thus the form growth of the wool fibre would simulate in miniature that of the sheep's horn (omitting except in early stages the increase of cross-sectional area). The definitive fibre continues as a spiral, a uniplanar wave or with twist, whichever be the characteristic deformation associated with the type of follicle involved.

As a corollary to Thompson's studies of horn shapes and to the views here proposed, an explanation of the rarity of straight fibres in fleece growth seems possible. The essentials for a perfectly straight fibre would thus be symmetry of the basal portions of a follicle about a line perpendicular to the skin and the absence of differential intensity of growth. The follicle would have to be situated at a point of zero gradient, such as at the centre of a true hair whorl. These considerations would seem to render the production of a perfectly straight fibre extremely improbable.

J. E. NICHOLS.

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¹ *Proc. Zoo. Soc.*, Pt. 2; 1932.

² *NATURE*, 130, 736, Nov. 12, 1932.

³ *vide* "Wool Quality", H.M. Stat. Office, 1931.

⁴ *Trans. Faraday Soc.*, 29, Pt. 1; 1933.

⁵ "Growth and Form", 1917.

⁶ "Problems of Relative Growth", 1932.

Further Mutations in the Amphipod *Gammarus chevreuxi*, Sexton

New developments in *Gammarus chevreuxi* have appeared in the course of some experimental work on the question of the origin of recessive characters, and how far they may be present in the wild.

During the past twenty years we have examined more than half a million of these *Gammarus* as they were brought in from the wild, but with regard to the black reticular pigment of the eye, so far not a single variant has been seen. We have, however, found more particularly in recent years that variations occur in the amount of the white superficial pigment.

In the laboratory¹ on the other hand a number of recessive mendelian characters have arisen, principally relating to the eye, though in one instance², the 'white-body' of Stock II, the body colour was also affected. Changes of colour, such as red, white, purple, took place in the pigment of the reticular cells, and in one mutation, the 'albino' of Stock I, the cells themselves were lacking. In several stocks 'nowhites' appeared, that is, animals with none of the superficial white pigment in their eyes.

A new departure among the recessive characters that have recently appeared is a red-eye with which is associated nowhite, the two characteristics, namely, complete lack of both black reticular pigment and white superficial pigment not having up to now segregated from one another. The original black pair gave a black F_1 brood of 12, which, intermated, produced an F_2 of 49 blacks and 12 of these red-with-nowhites.

This new stock is a very distinct one, as proved by cross-matings with recessives of nine other strains, whitebody, lilac, six other and different reds, and the red-nowhite of Stock I. The last mentioned mating, red-with-nowhite with Stock I red-nowhite gave, for the first time in the nowhite matings of this species, normal blacks, that is, black eyes with the white reticulation.