# A STUDY OF THE FOLLICULAR ORIGIN OF THE FIBRE TYPES OF N-GRADE ROMNEY LAMBS.

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# 1. INTRODUCTION

It has long been realised that a greater understanding of the physiology of wool follicles and the various processes involved in the growth of fibres might reveal simple, economic methods to improve the quantity and quality of wool produced by a sheep.

In physiological studies of wool growth, workers unable to observe directly the functioning of the follicle have used certain features as criteria.

The chief criteria used have been the following: -

i A measure of wool growth.

ii The morphology of the fibre.

iii Anatomy and changes in the anatomy of the skin and the follicles.

In an attempt to explain the morphological differences between birthcoat fibre types, workers have formulated several hypotheses about the forces in the skin during the period of follicle development. (Dry 1933, Sutherland 1939, Goot 1940). Some workers (Galpin 1935, 1936b, Fraser 1951, 1952a 1953) have postulated that changes in the follicle population is the chief cause of these differences. If this is true there should be some relationship between the class of follicle and the type of fibre which it produces. While the relationship between the type of follicle and the fibre it produces has been widely discussed in the literature, little experimental work has

been carried out to find the true origin of the different fibre types.

Experimental accounts of relationships so far published, have with the exception of the work of Fraser and Hamada (1952), all arisen from studies originally designed to provide data on other problems. Consequently our knowledge is not great and the reliance which can be placed on the published relationships is limited.

In a study of the fibre type arrays of sheep of the N/+ nr/nr genotype, a large number of arrays were found in which the distribution of fibre types was difficult to reconcile with what would be expected if the relationships of birthcoat fibres and follicles suggested for the N-type Romney by Fraser, Ross and Wright (1954), held true. Further work on the arrays of Romney N/N and Cheviot and Lincoln cross N-types cast further doubt on whether Fraser et al's relationship could be applied as generally as had been at first supposed.

The problem is of importance for two reasons; firstly certain workers (Dry, Burley and Speakman 1952, Burley and Speakman 1953) have used Dry's fibre type classification as an index of the class of follicle from which the fibre is derived. These fibre types have then been compared in their physical properties, and the results published in terms of the differences between

fibres produced by the different classes of follicles.

Secondly, the morphology of the birthcoat fibres, the expected order of development of birthcoat fibres and the expected relationship between the follicle and the fibre type produced in it, have been used in formulating theories on the physiology of the wool follicle. If the suspected relationships do not hold we may be led into formulating false theories, while conversely if there are relationships of which we do not know the existence, we may miss chances of further advancing our knowledge of follicle physiology.

## II DEFINITION OF TERMS AND ABBREVIATIONS

### A Follicles.

1. Definitions

Primary follicles : (P) Follicles,* each of which possess a complete set of accessory glands consisting of: -

(a) a tubular sudoriferous gland
(b) an arrector pili muscle
(c) an acinous sebaceous gland (generally bilobed)

Secondary follicles : (S) Follicles which do not possess the full complement of accessory glands. Generally secondary follicles possess only a unilobar sebaceous gland, but Burns (1949) has observed follicles classified secondaries having either a sudoriferous gland or an arrector muscle as well as a sebaceous gland.

Primary central : (PC) The central member of a trio of primaries.

Primary lateral : (PL) The lateral primaries of the trio.

Trio : The three P follicles of the normal follicle group.

Trio Group - follicle group. : In sheep it consists typically but not exclusively of a basic group of 3 primaries and a variable number of secondaries (Carter 1955).

*The insertion of each means that only one follicle of a primary bundle (Lyne 1957a) would be considered to be a P follicle.

Bundle : A group of two or more follicles, the fibres of which share a common follicle neck.*

Immature follicles : Follicles which have not produced a fibre which is keratinised at the level of the primary sebaceous glands. (i.e. at the level of sectioning).

2. Abbreviations

The abbreviations used are those suggested by Hardy and Lyne (1956a) as an extension of the abbreviations put forward by Wildman and Carter (1939).

PCX early formed primary central follicle

PCY late formed primary central follicle.

* Duerden and worker at Torridon have generally referred to the follicle group as a "follicle bundle."

PIx primary, lateral to a PCX follicle

PIy primary, lateral to a PCy follicle

SOU unbranched original secondary follicle

SOB branching original secondary follicle

SD secondary follicle derived by branching from the neck of a SOB

Within each type two states of development are recognised.

i incompletely developed (p or s of Carter & Hardy 1947)

f containing a keratinised fibre (P or S of Carter and Hardy).

These symbols are used after the letter denoting the type of follicle, for example Sf: a mature secondary follicle.

n signifies density per square millimetre

$\bar{n}$ signifies mean density per square millimetre

d signifies diameter of the fibre in the follicle

$\bar{d}$ signifies the mean diameter.

For example $\bar{d}P$ signifies mean diameter of primary fibres while $\bar{d}S$ signifies the mean diameter of secondary fibres.

B Fibres.

The fibre types have been described so often in the past (Dry 1935, Sutherland 1939, Goot 1940, Stephenson 1952, 1956) that it is not necessary to detail them fully. However since they are fundamental to the present study a short summary will be given.

1. Pre-curly-tip fibres (pre-CT)

Halo-hairs (HH) Long fibres coarsely medullated throughout

Halo-hair´ (HH') As above but with a short break in the medulla at the birth point

Super-sickle A (SSA) Similar to HH but less robust with a sickle shaped tip

Super-sickle A´ (SSA') As above but with a short break in the medulla at the birth point

Super-Sickle B (SSB) Similar to SSA' but with a longer break in the medulla

Sickle (SK) Have a sickle shaped tip which may or may not be medullated, followed by a thinner, non medullated pre-natal region

2. Curly-tip fibres

Hairy-tip-curly-tips (HTCT) Medullated in the pre-natal region

Checked curly-tips (ChCT) The longest curly tips with a

large number of curls in the tips. No medulla throughout and followed by medullated CT.

Ordinary curly-tips (CT) Curly tipped fibres non medullated in the pre-natal region

3. Post curly-tips

Histerotrichs (Hi) Straight or waved short fibres

Where it is desired to differentiate on the basis of the post-natal medullation the terms "fine" or "medullated" (med) are used. (med = chalky)

Dry (1935) has called the largest, pre-precipice curly tips, peak curly-tips (peak - CT).

Baby fibres Short shed fibres which do not grow after birth

Infant fibres Shed fibres which grow for a short time after birth.

Ribbon-shaped fibres Fibres flattened in cross section. Also called "infilled" or "collapsed" fibres (Elphick 1932) "squeezed" fibres (Sutherland 1939), "partially air-filled" fibres (D.A. Ross 1950) "squashed" fibres (Dry personal communication).

Precipice "Precipice is the term given to the sudden change along the array from the coarse to the fine CT fibres without intermediates". (Galpin unpublished; cited by Sutherland 1939). Fine is not interpreted as non-medullated in this case.

Pre-precipice fibres (pre-pr.) Fibres of size greater than that at which the precipice is judged to occur.

Post-precipice fibres (post-pr.) Fibres of size smaller than that at which the precipice is judged to occur.

"Toughness" Freedom from the pre-natal check as measured in terms of the fibre type array. Plateau is considered "tougher" than saddle which is in turn considered to be "tougher" than ravine etc.

TABLE 1

Fibre types in the different arrays (Based on Stephenson's 1956 graph)

| Array | HH | SSA | SSA' | SSB | Sk | Fine pre-CT | ChCT | HTCT | Med CT | Fine CT | Med Hi | Fine Hi |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Plateau $P_0$ | + | | | | | | | + | + | * | + | + |
| Plateau $P_1$ | + | + | | | | | | + | + | * | + | + |
| Plateau $P_2$ | + | + | + | | | | | + | + | + | + | + |
| Plateau $P_3$ | + | + | + | + | | | | + | + | + | * | + |
| Saddle | + | + | + | + | + | | | + | + | + | * | + |
| Ravine | + | + | + | + | + | + | | + | + | + | o | + |
| Valley | * | * | + | + | + | + | + | | + | + | o | + |
| Plain | * | * | * | * | * | + | ? | | | + | o | + |
| Escarpment | + | + | + | + | | | | | | + | | + |
| All in | + | + | + | + | + | + | + | + | + | + | o | + |
| Incline | + | + | + | + | + | | | | + | + | o | + |

\+ Probably present
* Only occasionally present.
o Presence would not affect classification but never found.
? Some CT present which would be classified as ChCT if med CT were present.