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SYMPOSIUM PAPER

The Wensleydale Longwool sheep

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When I first started to prepare this talk, I became acutely aware of the limited scope of my knowledge of the breed and the specialized nature of that part of my research work which involved it. However, through the kindness of Mr Turton, Director of the Commonwealth Bureau of Animal Breeding and Genetics in Edinburgh, I was able to borrow the research papers on Wensleydales published by the late Dr F.W. Dry, commencing as long ago as 1921. These deal mainly with the genetics of coat and skin colour, but the first paper contains a brief summary of the history of the breed, provided by Mr Goland Robinson and mainly quoted from Volume 1 of the Stud Book. The precise points are as follows:

The old name for Wensleydales was "Mugs", and they were a branch of the old Teeswaters. It is stated that about 1840 the head and ears were white with black spots. Leicester blood was infused through a ram called Bluecap, which was sired by a previous Bluecap out of a Mug ewe. His sire, its described as of enormous size and substance. The younger bluecap was similar, but "he had a very dark blue head and his skin was nearly black although covered with fine, white, lustrous wool." He and his sons were widely used and the blue colour was transmitted to many of his offspring from spotted-faced Mug ewes. It was found that the rams with blue heads begot lambs from blackface ewes of a darker grey colour about the face and legs. This being a desirable quality in the crossbred offspring, the blue face became a point to be aimed at by ram breeders and soon became a distinct feature of the breed.

Thus the original Teeswaters had black and white faces, as the breed has today. However, the first Teeswaters that I ever saw definitely had blue faces, and were difficult to distinguish from Wensleydales. These were at the farm of Mr. Liddle, one of the active breeders largely responsible for the revival of the Teeswater in the late 1940s and early 50s. Under the blue faces of these Teeswaters, however, I discovered a sort of ghost of a black-and-white pattern. This is of interest because there is a bit of a mystery about the original Bluecaps. Where did the blue face appear from in the white faced Leicester breed? Was there a blue-faced breed in Yorkshire in the time of the great monasteries, and developed by the monks in the hey-day of their wool growing, as has been suggested to me? How was the blue skin retained in the descendants of crosses with the old Teeswater? Dr Dry's work deals with the shade of blue, but not with the presence or absence of blue. The fact that it was retained in the Wensleydales, and that crosses with blackfaced hill sheep gave 'dark' faces suggests that there may be a dominant main gene determining the difference between blue and white face. If this is the case, and if some Wensleydales were used to assist the revival of Teeswaters, the black-and-white colour could easily be restored as, being recessive, black-and-whites bred together would not throw blues. An amusing point is, that during the 1950s, we were told that one of the advantages of the Teeswater over the Wensleydale is that its offspring from the hill ewes have attractive black-and-white faces, in contrast to what Mr Liddle called the 'dirty brown' of Wensleydale crosses. Thus fashions change – from Mr Robinson's day when the 'dark' faces were preferred! There is no doubt of the close relationship of Teeswaters and Wensleydales, and many suppose that the Blue-faced Leicesters, which came into prominence in the 1960s could have originated from a Border Leicester-Wensleydale cross.

Dry's work was largely based on some very remarkable records maintained by Mr G. Goland Robinson (first secretary of the Wensleydale LSB Society) for 24 years, from 1898 when the flock was founded to its dispersal in 1922. This was the Underley flock owned by Lord Henry Bentick. In those records were data on the parentage, sex and colour of nearly 3000 lambs. Dry's analysis of these and other smaller flock records clearly demonstrated that black (fleece and face) behaved as a Mendelian recessive to white fleece (with blue, pale blue, or very occasionally white face colour). In the light of present knowledge it would be more accurate to say that self-colour behaved as a simple recessive to dominant white, and that the breed is probably homozygous for black at the locus which determines whether pigmented animals will have brown or black colour. Dry also observed that a few grey animals occurred, and that grey was dominant (or possibly epistatic) to self, but recessive to white, this dominance order is now well established and known as the "Agouti" series (which also includes two other alleles).

Dry's' first paper on the breed opens with the statement, "A typical Wensleydale sheep is one with white wool and the skin of the face and ears deep blue in colour. In pedigree Wensleydale flocks, though black sheep are never used for breeding, a large number of black lambs are born". We went on to show that the proportion of black lambs born in the Underley flock remained unchanged during the 25 years recorded, at approximately 20 percent. The percentage in other flocks was generally somewhat lower, round about 15 percent. The Underley flock records divided the lambs into three colour classes, pale, deep blue, and black; all rams kept for breeding were deep blue, and only nine ewe lambs graded as pale were kept for breeding in the flock, although 38 (out of 200) were registered. Lambs graded pale at birth quite often darkened with age, and this is no doubt what happened in these 38. Of the total number of lambs recorded (2955), 13.3 percent were graded pale, 66.2 percent blue, and 20.5 percent black or grey. 56.9 percent of the blue ewe lambs were kept for breeding and this was 39 percent of the ewe lambs born alive. It was conclusively shown that the great majority of animals with the required shade of blue skin carried 'self', i.e. they were heterozygous whites. Just a few blue animals were homozygous white. As the blue shades were not sharply distinct from each other, and selection of ewes was less rigorous than selection of rams, most flocks contained a number of homozygous white ewes, but very few homozygous white rams were kept for breeding. Thus the proportion of black lambs born nearly always depended on the percentage of homozygous white ewes in a particular flock (as well as on chance), and was higher in the Underley flock precisely because the ewes were more strictly selected for blue colour. In the third paper of the series, Dry demonstrates the fascinating truth that this extra severity of selection was actually counter-productive. If all rams used are heterozygous, then half the lambs born will be heterozygous whether their dams are homozygous or not, but an increased proportion of heterozygous ewes will give more black and fewer homozygous white lambs, the very opposite of what was desired. Dry also pointed out that the rejection of about one-third of the ewe lambs because their skin colour was too pale, severely limited the possibility of selection for production characters such as fertility or growth rate.

Some workers, who cannot have carefully read Dry's papers, have alleged that he said that the blue colour results from heterozygosity for black, but this is definitely not what he reported. Most of the homozygous whites were too pale a blue colour to please the breeders, quite a number were acceptably dark blue, and only a very few were described as white skinned. In discussing the small number of rams which did not breed a single black lamb among their numerous offspring, Dry states, "The five rams with an all-white record which I have seen were very fairly blue on the face, head and outside of the ears, but the inside of the ears was in every case a coppery colour". It is possible therefore, that animals carrying 'self' (black) can be distinguished from those which do not carry self, by the colour of the inside of their ears. They cannot be so distinguished with any certainty by the colour of their faces, although very pale and the rare white-skinned individuals were perhaps unlikely to be heterozygotes.

All this concerning the shade of blue colour tell us nothing about the genetics of the blue itself. Nevertheless, these papers, as well as observation of the colour of first-crosses between blue-faced breeds and those with white or partly white faces, do seem to me to indicate a high probability that the blue skin is due to a single main gene, dominant to non-blue, and greatly affected in depth of colour by modifiers, among which the 'self' gene must be included. Those few Wensleydales which totally lack the blue colour may be at the extreme end of the range of modification, or they lay lack the basic blue gene.

There is just one more piece of information which I have extracted from Dr Dry's papers, and this concerns lambing percentage. Data from the Underley flock gave an average of 1.82 lambs born per ewe, and remarkably, there is no significant change with age. The average for one year old ewes was 1.81 and for five year olds, 1.88. There was no correlation between dam and daughters, for fertility. The average taken from various flocks in 1927 was 1.71. I have no modern data on this matter. These wonderful old records from the Underley flock should surely encourage today's breeders to emulate Mr Goland Robinson's accurate and patient efforts.

The fleece of the Wensleydale is very special, and I will not discuss it in some detail. It is a luster fleece of great length, very uniform both over the body and within the staple, and as far as I am aware is the finest of the Longwool fleeces. Although few people will disagree with this description, I am not aware of any hard data such as length and diameter measurements assessed from large numbers of fleeces. This is equally true of almost all British breeds of sheep, the wool of which is assessed by the graders rather than by wool biologists, although for a few breeds fairly extensive data on greasy fleece weight probably does exist. It is a tragedy, and indeed in my opinion a disgrace, that in this country the science of wool biology has been almost destroyed by lack of financial support. Dr Ryder at Edinburgh is the last full-time wool biologist as far as I know, and his section is under imminent threat through the ABRO cuts. Young people of a generation ago, trained by Dr Dry and Dr Rudall at Leeds, were forced out of wool biology by lack of jobs, as I was myself. Of course there are numerous wool biologists in other countries, from Australia to Egypt to the Soviet Union, but no one will be left to study British wool in Britain, unless we import someone from abroad. Perhaps the RBST could turn their attention to the conservation of a rare science?

Lustre in wool is due to smoothness of the surface scales which form the outer layer of the fibre. In most wool, the scales overlap in such a way that their distal edges, that is the edges furthest from the skin, stick out a little because of the overlap. In lustre fleeces they project very little, while in mohair the fibre surface is quite smooth. Incidentally, a similar effect can be obtained by wearing away the surface scales by abrasion; this is part of the reason why vigorous brushing of human hair makes it more shiny!

The length attained by any individual wool fibre in a year's growth depends on its speed of growth, usually expressed as length grown per day, and on whether or not it grows continuously throughout the year. Kemp, for example, grows fast but only for a few weeks, whereas fine wool, and also the medullated wool called hair or 'heterotype', normally grow continuously for more than a year, although often growth slows down in winter. Inadequate feed can also slow wool growth, especially when it coincides with the period of shorter daylight. I have no data on pure Wensleydales, but Priestly and Ryder (1981) found growth rates of about 1mm daily in Wensleydale x Blackface lambs; this is two to three times as much as the daily length growth in Merino wool.

So the Wensleydale has smooth scales and high length growth. Fineness and uniformity depend on complex factors, which I shall now try to describe.

Wool (or hair) grows from little sacs in the skin, known technically as follicles. It grows from the base, and the part of the fibre above the skin consists of dead cells which have been hardened into a substance called keratin. This keritinisation takes place in the follicle below the skin surface, and the only living, growing cells are right down in the bulb of the follicle, from which they are pushed up to form the fibre.

In foetal lamb, the first follicles to develop appear between 70 and 80 days after the egg is fertilized, and at about 90-100 days foetal they develop sweat glands and erector muscles. All such follicles are called primary follicles, and they are mostly grouped in threes, the Trio Group. After a pause of about a week, more follicles appear in groups at one side of the P follicles, on the opposite side to the sweat glands. These are secondary follicles, and in most British breeds there are about 4 or 5 secondary follicles per primary or an S/P ratio of 4:0 or 5:0.

Wild sheep have a coat consisting of coarse kemp-like fibres forming an outer coat, with much shorter finer fibres as a wooly undercoat. The outer coat grows in primary follicles, the undercoat in secondaries.

Under the influence of domestication the coat of sheep has been changed in two opposite directions. In temperate and sub-tropical environments the outer coat became reduced in coarseness while the under coat became longer and less fine, and moulting was reduced or totally lost. These changes were associated with, and possibly caused by, something that happens to the primary follicles at about 100 to 120 foetal. At this time, in fine wooled breeds, the bulbs of these follicles have actually been seen to be reduced in size, and measurements of fibre growth show that it is delayed at this period. In coarse-wooled sheep the effect is not so obvious, but that it does occur is shown by a study of the shapes of the tips o fibres in the birthcoat of lambs.

In the he birthcoat of a lamb it is possible to tell which are the older or younger fibres. The Fibre Type Array technique consists of taking a small tuft of lamb's wool, usually 6 to 8 weeks after birth, and arranging the fibres so that those which started to grow earliest are on the left and the latest on the right. Dry developed this method before the order of follicle development was known, but we now know that he was quite correct, in principle, although some different types may start to grow almost simultaneously instead of in strict succession. Fibre types are named according to their shape. Birthcoat kemps or 'Halo hairs' show least effect of the check and resemble the outer coat fibres of primitive sheep. Next come super-sickles (SS), which start coarse and then have a narrow neck, which however is partly or completely medullated, in contrast to sickle fibres (Sk) in which the neck is completely without medulla. Both Ss and Sk may become medullated and coarse again immediately after birth, or they may remain fine. All these fibre types grow only in primary follicles, and in many sheep they are shed at about 8 weeks old; but Sk and SS which remain fine after birth are usually not shed. The next type of fibre, the curly-tips, may grow in both primary and secondary follicles, and their age is judged by the number of curls or waves in the tip part which is grown before birth (the more waves the curlier). They resemble sickle fibres without the sickle-tip, and may be medullated or fine post-natally. Finally, there are the histerotrichs, which do not start to grow until at or after birth, so they have no pre-natal tip, just a pointed tip without curls.

The birthcoat of wild sheep like that of the adult, consists of only two fibre types, coarse kemp-like fibres which have a hollow core, the medulla, and correspond to pale hairs, and fine undercoat fibres, which do not appear above the skin until about the time of birth, and which may have a very thin medulla, but are often non-medullated. In a carpet-wool type of fleece some of the primary fibres start coarse and then show the narrow neck, which may contain thin medulla or may be free of medulla, but at or soon after birth the fibre becomes coarse and medullated again. In fine wooled sheep there is little or no return to coarseness below the neck. This neck, which is formed before birth, is caused by the slowing of growth already mentioned, and this check to fibre growth is called the pre-natal check. Its effect on the size of the follicle bulk, and therefore on the type of fibre produced, is probably permanent. Dry considered that even wild sheep show some signs f the prenatal fibre check, but that it has been much intensified in fleece bearing breeds, and is responsible for the loss of the moult, and, according to its intensity, affects the fineness and medullation of the wool. He considered, however, that there are differences in the wool growth potential of different sheep (which he called differences in base), so that there is a complex interaction between base and check. The check, acting on the primary fibres, upsets the primitive order of fibre size, so that some early-developed follicles may grow finer fibres than some later ones. In fleece bearing sheep, kemp, if it occurs, is normally confined to the very oldest follicles, the central primaries.

The checking of the primary follicles thus leads to reduced difference in size between primary and secondary wool fibres and so to greater uniformity within the staple. The extent of this effect varies between sheep and between different parts of the same sheep. Uniformity of the fleece over the body depends partly on whether the manifestation of check varies, and partly on other factors such as S/P ratio, follicle density, and length growth. Priestley and Ryder (1981) found that, in the Wensleydale x Blackface lambs, length growth on the mid-side and breech was almost the same, whereas commonly the breech wool is longer and coarser than the mid-side. In many breeds, including the Merino, the central primary follicle produces the coarsest fibre despite the pre-natal check, the primitive size order being retained in that the lateral primary fibres are finer than the central primary fibers and the earliest secondaries finer than, or often equal to, the lateral primaries. Dr Dry noticed that regularly in Wensleydales, and occasionally in other breeds, the fibre type array commenced with sickle fibres or early curly tips which were finer than the fibres which followed them. He picturesquely called these arrays "beheaded" or "truncated". The full significance of these arrays was not realized until many years after he named them.

In 1962 I was drawn into discussions about a wool-growing project in Northern Nigeria, in which Merino rams had been crossed with the local hair sheep. The first-cross lambs grew fleeces, but they consisted of a fine undercoat with very many kemps intermingled; in fact, every primary follicle grew kemp and every secondary follicle grew fine wool, just as I wild and primitive sheep. These fleeces were shed at about a year old and annually after that. In considering how to get rid of the kemp, it occurred to me that the Wensleydale, with its extremely checked central primary follicles, might achieve what the Merino had failed to do. In due course, Wensleydale rams were tried both on the Hair Sheep and on the Merino x Hair Sheep crosses. The results supported Dry's principles to an astonishing degree, for kemp was virtually eliminated even in the first cross with hair sheep, and the fleece casting was eliminated. In the first crosses the fleece was composed of long, partly medullated hair (the outer coat) and fine wool which was longer and less crimpy than in the first-cross Merinos. The fleeces of lambs by Wensleydales out of first-cross Merino x Hair Sheep were of two types, hairy with a fine crimpy undercoat, and completely fine; they occurred in very nearly equal numbers. I shall return to this in a minute. I stated earlier that, under domestication, the coat of the sheep has evolved in two opposite directions, the first of which led to fleece bearing breeds. The second direction resulted in the extreme reduction of the undercoat, while the outer coat remained as long kemp-like fibres, which are frequently shed. I did not have the opportunity to study this in the Nigerian Hair sheep, but in West African Dwarf sheep in Ghana I found some hairs re-growing (i.e. with points emerging from the skin) in every month of the year, so it seems that shedding and replacement are continuous processes. I disagree with those who classify African Hair Sheep as primitive; they are in fact highly specialized to tropical climates. Moreover, this specialization of the coat may have taken place twice, the long-legged Sahel type sheep such as those in Northern Nigeria differ sharply from the West African Dwarfs both in horn shape and in fibre type array. This suggests also, that they evolved from fleece-bearing breeds and not independently and directly from wild sheep.

Returning to the Wensleydale x Merino x Hair Sheep, the ratio of 50 percent hairy to 50 percent fine was also found in the 1/4 Merino 3/4 Hair Sheep (but in them there was kemp not hair) indicating segregation of a dominant gene for hairy fleece, as was found by Dry in the NZ Romney, though not of curse necessarily the same gene. This gene must have come from the hair sheep, producing kemp in the Merino crosses but only heterotype hair in the Wensleydale crosses.

Thus from the foregoing reports of scientific work, we have indications that the Wensleydale justifies claims that it has something to offer in crossbreeding, in its special fleece characteristics, and of above average fecundity for a large breed. The third claim made for it, is that the breed produces exceptionally lean carcasses, and that this is associated with the blue face colour. As Dr Dry said cautiously in 1924, "To investigate this question by experiment would be a big undertaking". However, data from the MLC ram breed comparison trial, quoted by Val Stephenson in *The Sheep Farmer* of Sept/Oct 1981 that Wensleydales sire crossbred lambs with a high proportion of lean meat' when compared at the same level of subcutaneous fat, the Wensleydale crosses had the greatest weight of lean meat; we do not know whether the blue face has any direct connection with this leanness, but at the least it seems to be a trademark, indicating Wensleydale breeding.

What then of the present and future of this breed? Numbers have now increased so that there is no immediate danger of extinction, and they are being bred as commercial animals, not as living museum specimens. I not with satisfaction that the breed society ha not instituted individual registration of ewes, which will greatly facilitate analysis of breed structure should this be thought desirable. At the time when Dr

Dry was studying the breed, he found that almost all the rams were provided by a small number of elite herds; perhaps therefore the breed has always been rather inbred. The remarkable uniformity of the fleece, both within and between sheep, suggests to me a high degree of homozygosity both for main genes and modifiers affecting wool characters. I do not know whether breeders still select for dark blue face colour, or whether they are aware of the significant difference between 'blue' or 'coppery' colour inside the ears, but I do have the impression that fewer black lambs are produced (now about 1 percent as reported by Mrs Agnes Winter). This may of course be a delusion, as breeders may just keep quiet about them. The openness of breeders in Dry's day, and the marvelous records kept by Mr Goland Robinson, are I feel examples which every breeder should emulate for the good of the breed.

Traditionally in British livestock farming, every breeder has his own breeding policy (or lack of it), subject only to the rules of the breed societies, if the stock is registered. Breeding policy for rare breeds has been much discussed. Professor Bowman has consistently advised that where numbers are very small, random mating using all available animals should be the policy, in order to preserve the gene pool, and in particular, any rare genes still existing in the remnant of the breed. I do not question the wisdom of this where numbers are really small, although Mr Alderson seems to favour breeding by bloodlines and families, old-fashioned stuff! It is an interesting thought that rare genes could be preserved by random matings between two or more breeds – a pooling of their gene pools. But are we the rare genes survival trust?

In ordinary life, a breed is a dynamic entity not a fixed gene pool. It is under constant selection by breeders who endeavour to enhance those qualities which they consider desirable and to reduce or eliminate those they do not like. At the same time, of course, the pressure of natural selection can never be entirely eliminated, although breeders try, by good husbandry, to restrict nature's culling, in order to leave more opportunity for their own.

I think of random breeding, and freezing of randomly-bred embryos, as methods of static conservation, and I do not agree with the use of selective breeding where breed numbers are dangerously low. Indeed, a case could be made for the maintenance of a section of every breed, including popular ones, in static conservation. However, I do feel that once a breed is out of danger, dynamic conservation also has a place. A rare breed does not necessarily owe its special qualities to rare genes; it may be a rare combination of quite common genes, and especially of those genes with small additive effects known as polygenes. No breed is every likely to be homozygous for polygenes, therefore there will always be variation, and if random mating is substituted for selection, genetic drift away from the breed characteristics could occur, especially if the desired type is even a little less viable than other genotypes within the breed. At least, that is how I see it, but I am not a professional geneticist and may be mistaken.

Returning to our muttons, I would think it desirable to breed Wensleydales selectively in order to retain their special characteristics, especially their ability to breed lean carcasses in crosses and to eliminate kemp. Here I must say a word in praise of Teeswater breeders, who ever since the breed's revival in the late 1940s, have selected their rams partly by assessment of the crossbred offspring. Teeswaters and Wensleydales are very closely related, and I have heard many whispers of surreptitious crossing between them. I am not a pedigree purist, and farmers have always used crossing as a means of improvement. But I do just fear for the central checking, although I believe (on very slender evidence) that most Teeswaters have it, but not as consistently as Wensleydales.

Wensleydale breeders, of course have never selected for central checking as such, but they have established it by stringent selection for fine fleeces of great uniformity over the body. I think that the tendency to central checking probably occurs in all longwools, most of which have never been examined for it; early Wensleydale breeders made it universal in their breed.

At this point I should make it clear that my practical experience of breeding Wensleydales is minimal. I do not know what faults or weaknesses there may be in the breed, except that the lambs are apt to lack vigour during the first 24 hours or so after birth; subsequently they seem to survive well. This problem leads breeders to favour single labs or twins, rather than triplets or higher number. At least, that is my impression. This leads to reluctance to select for higher fertility. So if higher fertility were thought desirable, it would be necessary to examine the problem of lamb vigour at birth. The small size of the lambs and very high post-natal growth rate may be an important breed feature in making for easy parturition, but that lambs can be small yet highly vigorous is demonstrated by the Finnish Landrace with its big litters of tiny lively lambs.

To summarize I suggest that breeding policy should aim to maintain the valuable qualities of the breed which include large size and high growth rate, lean carcasses, central checked long fine fleeces uniform within staple and over the body, fertility around 180 percent or more, and blue faces as a trade mark.

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