The Fleece as a Factor in Sheep Adaptation

A. E. HENDERSON
Canterbury Agricultural College, Christchurch

AT the 1943 Conference of this Society Dr. McMeekan delivered a Presidential address entitled "The Control of Adaptability Phenomena." In this address he pointed out that most biologists overlook the farm animal in their study of adaptability and he cited two probable reasons for this. One was that adaptability phonomena were frequently more subtle in farm animals than in animals favoured in biology studies. The second was that adaptability phenomena in farm animals occurred under our very noses and thus tended to escape warrantable attention.

These observations have much point so far as the fleece is concerned. There is no doubt that the fleece is likely to have subtle effects on the wellbeing of the animal, and the fleece is so obvious and accepted that we tend to overlook its real importance to the animal.

In a discussion concerning the fleece and adaptability we cannot proceed far until we have a clear idea of what we require of the sheep. Primarily it must be able to live, reproduce, maintain good health, and live to a reasonable age in the surroundings in which it finds itself. According to situation, chiefly geographical, it must excel in certain forms of production, either milk, meat, or wool, or a combination of these. The less the farmer needs to assist the animal in achieving any chosen objective then the more profitable the farming operation. Breeds or strains of sheep that require special provision of production facilities, whether in the form of foodstuffs or attention, are thus less well adapted and less profitable than those requiring a minimum of special treatment.

Attempts to find authoritative information regarding the actual influence of the fleece on adaptation has brought to light much interesting conjecture but practically no fact. There is no doubt, however, that the subject is a wide one and has considerable importance. It can and should be approached in two different ways.

Firstly we can consider the effect the fleece has on physiological adaptation.

The belief that the fleece has an effect is shown by the fact that we habitually use wool type in our selection of sheep for particular purposes and situations. Because the fleece can always be easily observed we use it as an indicator of probable physical reaction and behaviour towards a particular chosen set of circumstances. Convenient though this may be, there is a great tendency to regard manifestations of adaptability, or otherwise, as being due to wool or fleece type, when in reality such effects may be due chiefly to physiological pecularities of the animal.

Throughout sheep farming history there has been a very logical opinion that the fleece is there to keep the animal warm and dry. Regarding warmth, there appears to be no data on the amount of wool required to provide for critical needs. But clothing studies indicate that probably half-an-inch of wool would be entirely sufficient for conservation of the required amount of body heat. Compared with cattle and man, the sheep uses the skin less, and respiratory ventilation more, in regulating body temperature (Knapp and Robinson 1954). It is certain that our farm and station sheep grow a great deal more wool than is required to keep the animal warm and it seems unlikely that the quantity grown is sufficient to significantly impair normal heat regulation in prevailing summer temperatures.

More importance can be attached to the effects of wetness. It is popular belief that a fleece that parts down the back and in which the staples lie like shingles on a roof is effectively waterproof. The very dense, flat-tipped and fine fleece, is supposed to have a like merit. It would be hard to doubt that continued wetness of the skin would be undesirable from a stock health point of view. Indeed Hayman (1953) has claimed that continued wetness leads to a pathogenic condition of the skin which may be supposed to affect performance. Wetness to a point where the animal is uncomfortable may logically lead to direct effects on grazing behaviour and food intake which could well be important from a productive point of view.

The whole question of fleece effects on behaviour is rather a subtle one, and it is common to find high country graziers who have opinions regarding the optimum fleece weight their sheep should achieve. Such opinions are based on a belief that after a certain point, increasing fleece weight becomes an encumbrance. There is a great lack of critical evidence to support these beliefs, but we have at first hand the field evidence that lambs thrive more if shorn and that early spring shearing of breeding ewes leads to a marked difference in their behaviour pattern. If we can use lamb growth-rate as criteria, we can believe that the early shorn ewe grazes more extensively in the most critical spring period. It is appropriate, too, in this connection, to draw attention to interesting information regarding the inferior performance of woolly-faced as compared with clear-faced sheep. (Terrill 1946).

The second and perhaps most important aspect of the adaptability question is that of adaptation of the fleece itself. Unless a reasonable quantity of wool of reasonable excellence can be grown, and what is most important, sheared from the sheep in good condition, then there must be defects in adaptability both of the fleece and the sheep. Not only must the fleece function as a protective covering but it must eventually be yielded up as a reward. The wool fibre grows continuously and in the fleece we eventually obtain, there is wool that has been exposed to the elements for some twelve months and there is some that has been above the skin for as little as a few days. From the time the first wool of the fleece is grown until it is shorn it suffers considerable damage of one sort or another. But not all fleeces are affected to the same extent and it should be obvious that those that suffer least are those most suitable for the environment. In other words they have a degree of adaptation not possessed by all fleeces. There are obvious examples of this that have been noticed and acted upon. For instance many years ago the Cheviot, once popular, lost favour because with many the fleece tended to strip off before the animal could be shorn. In the early days of the Romney in New Zealand and on rough country the coarse hairy-tip type of fleece was favoured because such a fleece was believed to withstand much mechanical interference. To-day our problems are much more subtle. We are not so much troubled by the gross effects already mentioned as with problems of continuous degradation and loss and staining.

It is obvious that weak back wool is a major fault particularly with the Romney, and unfortunately no one has yet measured the actual loss that takes place. Since the back is the area of highest production (Henderson 1953) this loss must be very considerable and it is due almost entirely to the degrading effects of sunlight. However not all fleeces are affected to the same extent and least damage is suffered by dense flat-tipped fleeces. In this, then, architecture of the fleece has a bearing on adaptability.

Accompanying degradation and loss of fibre we very often encounter staining of various kinds. Yellow discolouration is probably the most common followed by green, brown and pink stains chiefly of bacterial origin and found mostly among fine-woolled sheep. It

is well established that there is a high correlation between incidence of staining and rainfall. However, not all sheep are affected at any one time and indeed some are apparently immune whatever the climatic circumstances (Hayman 1953). In short, certain fleeces show a degree of adaptation not possessed by others. Effects such as these have been very apparent in Canterbury in recent years and a study of the problem is being made. We are using Corriedale sheep and have been able to recognise the immune type of fleece; but only in a subjective fashion. It is very white and particularly soft to the touch. So far we have not been able to find any easily measured or architectural characteristic by which it differs from susceptible fleeces. Since much degradation is caused by micro-organisms, attention has been focussed on the micro-climate of the fleece, in particular the pattern and times of wetting and drying and the variations in relative humidity of the fleece atmosphere.

The data (Fraser 1954) so far obtained shows that relative humidity of the fleece atmosphere is generally very low. The outer layers have a relative humidity that approximates and quickly follows that of the macroclimate. In the absence of precipitation, humidities at the base of the staple are of the order of 25 per cent to 35 per cent and these values alter very little and with a considerable time lag following macroclimatic changes.

In the first stages of wetting, the immune and susceptible fleece types studied behave in like fashion, the outer third of the staple quickly becomes saturated and moisture or water vapour begins to percolate or diffuse toward skin level causing a rapid rise in relative humidity of the fleece atmosphere. Table I shows changes that have been recorded on the occurrence of rain.

TABLE I

Relative Humidity of Fleece Atmosphere of Immune and Susceptible Fleece Types

	Tip Third of Staple		Mid Third of Staple		Basal Third of Staple	
	I.	S.	I.	S.	I.	S.
Before rain	29%	35%	18%	25%	13%	15%
After 0.01 inch rain	59%	55%	33%	37%	19%	17%

A similar situation is shown by the following fleece moisture records which were obtained after sheep had been exposed to a total of one inch of rain falling on two days.

TABLE II

Percentage Moisture in Immune and Susceptible Fleece Types after Wetting

	Tip Third of Staple	Mid Third of Staple	Basal Third of Staple
Immune Type	53.0	23.7	22.5
Susceptible Type	52.6	25.9	31.0

It should be mentioned that not all the moisture present is free. Wool fibre and suint are both hygroscopic and thus varying percentages of moisture are absorbed by these substances depending on the proportions of fleece constituents and on temperatures and relative humidity. It will be noted from Table I that tip-thirds of both fleece types are wet to approximately the same extent but that penetration of moisture has occurred to a lesser degree in immune type fleeces in which it is probable that insignificant amounts of unabsorbed water are present.

On drying, these two types of fleece behave in a markedly different fashion. After 24 hours drying in a moderate wind, and temperatures and relative humidity of 55-60 degrees F and approximately 70 per cent respectively, the following fleece moisture figures were recorded.

TABLE III

Percentage Moisture in Immune and Susceptible Fleece Types after Drying

	Tip Third of Staple	Mid Third of Staple	Basal Third of Staple
Immune Type	13.8	13.8	10.7
Susceptible Type	18.7	25.9	17.4

It will be noted in connection with the immune type of fleece that at all staple levels drying has proceeded to its approximate conclusion. The percentage of moisture shown is approximately that likely to be absorbed by suint and fibre substance. On the other hand susceptible type fleeces have still, in their mid-staple region particularly, a large quantity of moisture. The lag in drying of susceptible types is of the order of 48 hours for mid staple and slightly less for tip and base regions. There is evidence from other data on drying that in certain fleeces of the susceptible type, water vapour diffuses in the direction of tip to base and eventually causes the establishment within the fleece of a relatively-stable high-moisture-content zone. The exact reasons for this behaviour have not been established.

Apart from this aspect of fleece behaviour the common fault of cotting or matting of the fleece is also of some importance. It is a general practice to use the coarser woolled sheep of a breed on heavy country or country with a high rainfall. Fine-woolled sheep are most often restricted to land of low carrying capacity. Fundamentally this procedure is sound from a wool point of view because the finer wools tend to retain their grade to a greater extent under nutritional stress. If the coarser woolled sheep of a breed are being used then wool growth conditions must be consistently good before high-grade wool can be produced. If they are not good then there may be extensive shedding of fibres chiefly among the most coarse-woolled sheep and this may lead to a good deal of cotting. A survey among Romney sheep has shown that where the quality of free fleeces is 48s the average of cotted fleeces is 44/46s. Cotting can only be regarded as a primary fault since it has also been found that the incidence of a number of discolourations associated with wetting are highest in cotted fleeces. From a wool point of view the occurrence of cotting is an indication of maladjustment of wool type to environment and there must be clear advantages in other directions before selection of coarse-woolled Romneys can be justified on any but the most fertile of our farm lands.

It has no doubt become well apparent that in the ordinary practice of sheep selection, we use the fleece very loosely and perhaps unjustifiably. However we cannot do other wise until we know a great deal more about its real influence on physical adaptability of the animal. It appears likely that these influences are of small moment compared with the importance of the fleece being able to look after itself rather than look after the sheep. The fleece itself should show adaptation apart from any advantages it may confer on the animal.

References

Fraser, I. A. S. (1954): Unpublished.
Hayman, R. H. (1953): Aust. J. Agric. Res. 4: 430.
Henderson, A. E., (1953): J. Agric. Sci 43 : 12.
Knapp, B. J. and Robinson, K.W. (1954): Aust. J. Agric. Res. 5: 568
Terrill, C. E. (1949): Nat. Wool Grower 36: 17.