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"NUTRITION AND THE FLEECE."

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Although the existence of important inter-relationships between wool growth and food consumed by sheep has long been recognised, critical nutritional studies on wool have been less numerous than with other animal products. One reason for this lies in the fact that most of the world's wool is produced under extensive pastoral conditions which preclude modification of existing nutritional regimes. Under such conditions the genetic approach may provide the only practical way of improving the efficiency of wool production. For this reason, and because the ultimate gain from the use of better strains can be maintained at negligible cost, it is essential that attempts be made to increase and improve the wool grown by sheep through constructive breeding, despite the fact that returns on a national scale cannot possible be expected from the work in less than seven to ten years. In the meantime, however, we have in New Zealand large areas over which sheep husbandry practice is sufficiently intensive to permit quite close control of nutrition within the limitations of the environment. Indeed, the importance of our export trade in fat lamb is a measure of the effectiveness with which our farming technique is able to supply nutriment over and above that required to maintain breeding flocks.

Evidence already exists in the practical experience of many farmers of the returns to be obtained from the fleece through improved feeding. A more objective estimate of the efficiency of this approach may be made from the fact that in analysing fleece weight data accumulated at Massey Agricultural College over a number of years about 50% of the total variance was found to be associated with random environmental conditions such as nutrition, disease, pregnancy and lactation. (McMahon, 1941.) This leaves 50% of the total variance to be accounted for by individuality - that is the tendency of individual animals to produce similar fleeces in different seasons. Only 10 to 15% of the total variance in fleece weight, however, has been found to be due to simple additive genetic effects, in Romney data (McMahon, 1940), (Rasmusson, 1941), leaving a discrepancy of 35 to 40% still to be accounted for. While portion of this discrepancy is doubtless due to sampling variation and genetic complications, it has been suggested by workers with dairy cattle (Bonnier, 1939), where similar results have been obtained, that early environmental conditions may produce modifications which persist throughout the productive life of the animal. Support for this suggestion is given by recent Australian work on sheep, where the formation of new wool follicles was found to be less rapid on animals subjected to a low plane of nutrition (5th Annual Report, Aust. Wool Board, 1941.) Goot, 1940, has shown that in the New Zealand Romney, no new fibres appear after the 7th month, so that if low plane feeding continued beyond this time the sheep would be permanently handicapped in wool production by low fibre density per unit area of skin. It may well be that the check among fibres starting to grow relatively late is associated with the phenomena observed at Adelaide, while it is stimulating to compare the far-reaching effects on the fleece of the genetic check to fibre development which occurs some time before birth (Dry, 1941.)

INFORMATION AVAILABLE:

Numerous investigations, which have been well summarised by Sackvill and Bowstead, 1938, show that the growth of the fleece can be profoundly modified by changes in quantity, and even quality (Bell Spencer and Hardy, 1936) of food supply. There is, moreover, some evidence of differential sensitivity between breeds in reaction to nutritional changes, and the Romney, so important in New Zealand, seems particularly responsive to high-plane feeding. Wilson, 1931, for example, found great differences in the fleeces grown by Romney wethers when reduced from a fattening diet to a sub-maintenance ration of poor lucerne hay.

TABLE I.

	On low plane reduced to -
Greasy wool production ..	29%
Scoured weight	31
Breaking stress	48
Growth rate	71
Mean fibre diameter near to skin	79
Crimp	Largely lost.

Despite this apparent sensitivity, New Zealand sheep farmers use the Romney over a range of environments comparable with that found to be catered for by a large number of breeds in Great Britain, (c.f. Nichols, 1933, Levy, 1937). This situation has developed for reasons largely unconnected with the fleece and clearly the first plank of our environmental research programme must be to discover whether efficiency of wool production is lowered by endeavouring to mould the environment to the breed, rather than the breed to the environment.

The immediate practical application of the ecological approach, however, is not its only recommendation. Since it involves work on a survey scale, an opportunity is provided for collecting information essential to the logical prosecution of more intensive environmental studies. To determine with some degree of accuracy which defects occur most frequently in our wool clip is surely necessary before commencing expensive laboratory studies, while the extent to which a given fault is consistently produced in successive fleeces on the same sheep will indicate whether aid must be sought in breeding or in feeding. Not least important of these preliminary studies is to discover how the various features of the fleece are related to mutton conformation and other characters valued by the stud breeder, for the sheep as a whole and not the fleece alone, is the unit in which we must deal. Finally, and here again the practical bearing is clear, we must learn something of the lasting qualities of different types of fleece when judged at the hogget stage, by determining lifetime production, which is the only true measure of constitution.

Wool survey work carried out by the author and co-workers during the past two years incorporates all of these objectives. Although our information on some of the long-term projects is not yet complete, exploitation of the variability found within flocks to determine which class of wool is most productive under given conditions has yielded results with immediate practical bearing.

METHODS:

Wool survey work takes advantage of the speed, accuracy and discriminating power of skilled wool classers, who use criteria normally applied in the early stages of wool manufacture, as well as those of the wool grower. To eliminate the human factor certain checks are introduced to relate the results of different workers, and to permit expression of findings in objectively specified terms.

Count has been made the primary basis of classification because of its relative stability (Dumaresque 1938, 40, Ross et al 1937) and because it is recognised as the major factor in determining wool quality. To avoid ambiguity, count, in this work, has been defined solely in terms of fineness, or mean fibre diameter, in the region of the staple grown during the autumn. A secondary basis of classification is obtained by recording the type of the fleece in terms of breed characteristics. In an average crossbred (Romney) flock a range of counts extending from 36's to 54's or 56's is normal, while in fine crossbred (Corriedale or halfbred) the range appears to be from 48's to 70's or finer. The corresponding ranges of types met are: Carpet, Leicester, slightly Leicester, very slightly Leicester, Romney, slightly Ryeland, Ryeland, slightly Down and Down for the crossbred and slightly Leicester, very slightly Leicester, Romney, Corriedale or Halfbred, slightly Down, Down, slightly Merino and Merino for fine crossbred flocks, respectively.

The main index of productive efficiency used against the different counts and types is the weight of clean wool produced; greasy fleece weight being determined at shearing time and corrections for yield applied to the results after scouring tests have been made. Secondary indices of the desirability of the different counts and types are obtained by recording character of back wool, general character of fleece, staple length, soundness (freedom from breaks and tenderness) and by recording the presence of defects.

Briefly, the routine of collecting the data is as follows:-

(a) Each location is visited at shearing time and weighings and gradings made in the shed as the fleeces come from the sheep.

(b) The fleece picker, instead of throwing the fleece on to the table, places it on the scales. Weighing takes 5 to 10 seconds and the fleece is thrown on to the table in the normal way.

(c) While the fleece is being skirted and rolled the grader examines the fleece and takes a sample from the region of the hip on which count, length and soundness are recorded. Type, character and defects are recorded after making an examination of the sample and of the main body of the fleece.

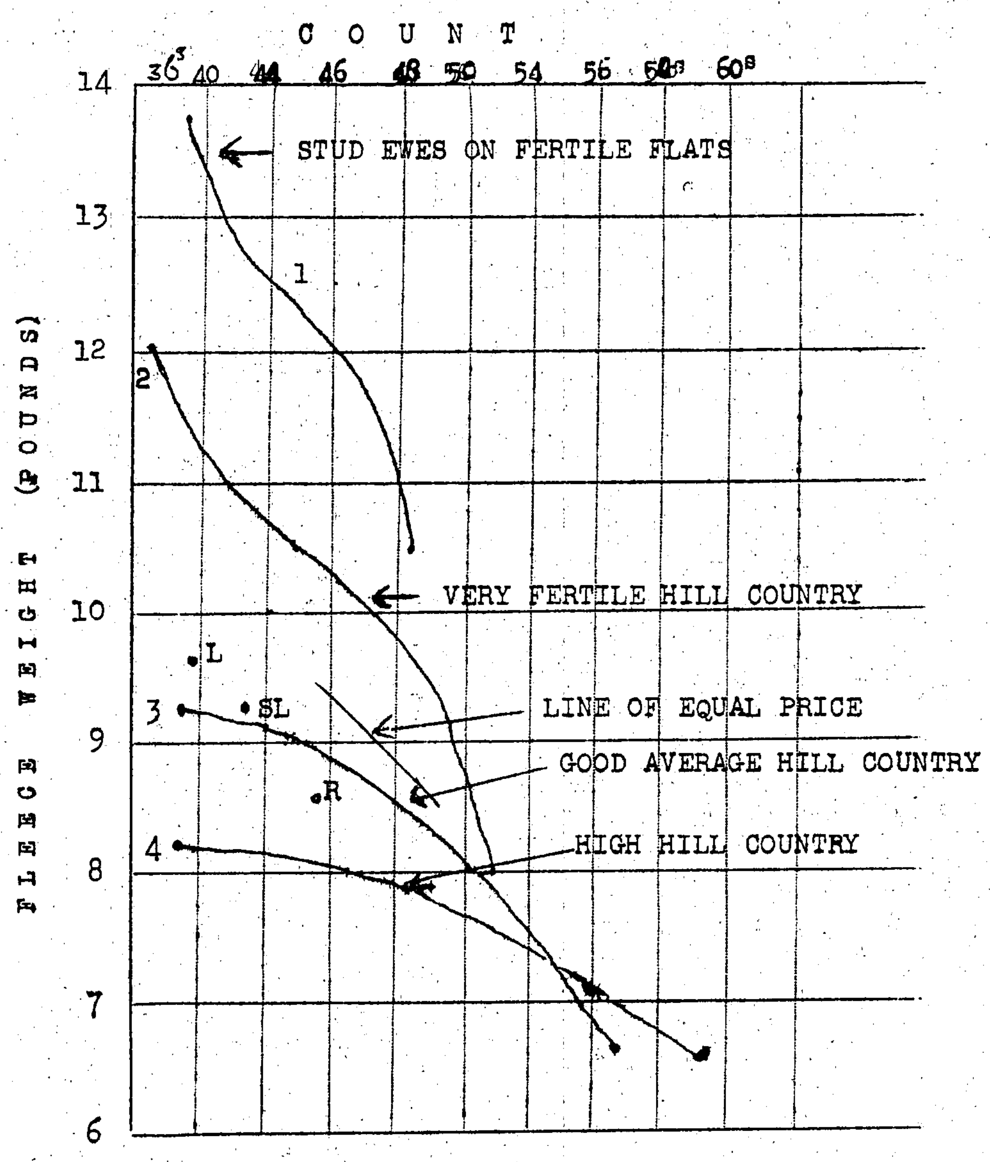
(d) The sample taken from the hip position is placed into a container divided into sections for each count. In this way sufficient wool is accumulated from each property to enable a small scale scouring test to be carried out to determine the yield of each count group, as well as to provide a check on the standards of the grader.

The information collected is sorted graphically into count and type groups and the average weight, and average character grade determined for each. Defects occurring in each group are also counted in relation to fineness and type. This portion of the work takes considerable time, and would probably be carried out more accurately and expeditiously by Powers or Hollerith machinery.

Although we obtain a great deal of information from the above processes, at certain locations animals have been eartagged for following in successive years. Complete fleece gradings are made on these and then after shearing they are judged for mutton conformation and breed type.

RESULTS:

The most outstanding result achieved in this work over the last two years has been to establish the existence of far-reaching differences in the shape and slope of the curves relating count to mean fleece weight. (Curves 1, 2, 3 and 4.) (See chart below).



These differences seem to be associated largely with varying planes of nutrition, although breed and strain almost certainly play a part. Thus Curve 1 was obtained on the ewes of a Romney stud flock in the Manawatu in 1940, where nutrition would be at a maximum; Curve 2 is characteristic of several locations in the Hawke's Bay, some on high fertility limestone (Rendzina) soils, and others from places of high managerial efficiency; Curve 3 seems to be typical of the majority of our better-class sheep farming lands in the North Island, while, where conditions are hard, curves similar to Curve 4 are obtained. Strain and environment have not yet been completely isolated at the latter locations.

The practical application of these results is immediately apparent. It is obvious that growing wool of stronger counts on locations where Curves 1, 2 and possibly 3 are characteristic will enable the production of considerably more wool per head. This can be achieved rapidly by careful choice of bought sheep used for fat lamb production where Curves similar to Curve 1 are obtained; by culling fine wool sheep as hoggets in localities giving Curves 2 and 3 (although in the latter very strong fleeces are clearly not desirable) and by choice of rams leaving offspring centred round the region of most efficient wool production as shown by the curve.

In addition to differences in the shape of the count-fleece weight curves, important differences have been found between wool types judged on efficiency of production. Thus to Curve 3 points have been added showing the position of the average fleeces found for each type in relation to the whole curve. These clearly indicate the desirability of Leicester type fleeces on this environment, since they produce fleeces heavier than the average of all types together. These facts have an obvious bearing on culling and on selection of rams.

ECONOMIC CONSIDERATIONS:

While it may be argued that over a period the fleece giving the maximum weight on a given environment will give the best monetary return, a condition obtaining just prior to the war, a differential price is now being paid to the grower of finer wools, and this seems likely to be characteristic of the market after the war, even if competition from substitutes seems likely to make this phase short lived. The table of values on which New Zealand wools are appraised is a closely guarded secret, but clean prices payable for A. grade wools for a range 46's to 50's have been obtained in connection with other work. Making allowance for the average difference in yield of wools in this range, the drop in greasy fleece weight between 46's and 50's which can be tolerated if there is to be no change in money received for a ten pound fleece has been calculated, and amounts to about 0.75 pound. A line illustrating a drop of $\frac{3}{4}$ of a pound between 46's and 50's has been plotted adjacent to curve 3. The slope of this line clearly establishes the most economic region of the weight count curve under present conditions, to be aimed at in culling and breeding operations. Where the curve is steeper than the price line the breeder is losing money through having his fleeces too fine; where the curve is flatter than the price line, money is being lost because the extra weight of strong wool fleeces is not compensating for lower prices.

On most environments the general effect of using the price line instead of peak fleece weight to define the most efficient region for production is to push the optimum further towards the finer counts. If, as seems likely after the war, demand for strong wools becomes weaker, the slope of the price line will be even steeper; if competition from other wools and from synthetic fibres reduces the premium on fine wools, the price line will become flatter.

UTILIZATION OF WOOL SURVEY RESULTS:

Results of wool survey investigations can be put to immediate use in guiding and directing the culling of young ewes, and a return from the application may be expected after 12 months, when the following year's fleece is shorn. Further emphasis is given to this point by recent work which has established the futility of culling ewes for characters, such as conformation, which are intended to show a return the next generation. No useful gain is obtained unless selection is carried out in such a way that the ewes retained are those with higher average lifetime productivities, by reason of their ability to thrive and produce heavy fleeces, in addition to rearing vigorous lambs. Under these circumstances culling for fleece features can be taken further than would otherwise be possible. (Canterbury Chamber of Commerce, 1942.)

Again, where bought-in ewes have been chosen so that their fleeces are suited to the environment to which they are going, a return may be expected within 12 months. It must be emphasised that the transfer of stock from unsuitable to suitable environment can be put into effect without time lag for breeding, and the increased return is immediate.

The third main application of the survey work lies in guiding the farmer in his choice of rams. Since count is fairly strongly inherited (at least 32%) this selection would be effective, and returns under this heading would be realised within two years, when the first hogget fleeces are shorn from the progeny of chosen rams. Returns under this heading would ultimately be greater than returns under the first heading, especially on properties where management policy is such that only a small proportion of young stock are available for sale each year.

A particularly important application will arise after the war if the demand for finer wools becomes markedly stronger. Results of survey work will show where such wools can be grown most efficiently and where the status quo should be maintained.

While these results in themselves are important, the longer term aspects of wool survey work also deserve mention. If expansion of wool research to meet competition from substitute materials is contemplated, preparatory survey work assumes special importance because of its directive influence in establishing the most important problems for attack by intensive research. Thus in the 1940 data the following percentages of defects were recorded in the 25,000 fleeces examined in the North Island.

Breaks and tender (including slight breaks)	30
Cotts (including slight cotts) ..	20
Sandy and dingy	10
Hairy (including slight hairy tip)	8
Pink rot	0.8

Finally the value of survey work in providing a practical background against which the results of more intensive studies, both nutritional and genetic, can be viewed in perspective cannot be over-emphasised, while participation in survey work gives an appreciation of the limitations set by practice which is essential to anyone entering the field of wool production research.

Even a preliminary account of wool survey work would not be complete without reference to the enthusiastic assistance rendered by Messrs. Dunlop and Henderson, who collected much of the fleece data, and to the careful work of Misses Williamson and Shankland, to whose lot falls the more tedious plotting and averaging. Finally, our best thanks are due to all who placed their clips at our disposal for examination.

SUMMARY.

1. Literature on nutritional aspects of wool growth is briefly reviewed.

2. A progress account is given of recent extensive ecological work which has established far-reaching differences in the weight of wool gained by growing stronger fleeces.

3. While breed and strain doubtless play a part, these differences in the slope and shape of the fleece weight-count curves seem largely to be connected with varying planes of nutrition.

4. The practical application of the conclusions in culling young ewes, selection of rams, and purchase of foundation stock is emphasised.

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