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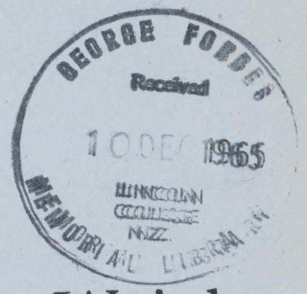

Variation in Fleece Weight and the Significance of Wool-price Differences when Culling

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Senior Lecturer in Wool

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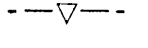

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SUMMARY

Attention is drawn to the productive significance of a consistently-occurring fall in fleece weight with increasing fineness of wool, and to the stable relationship of the price ratios for wool of different qualities.

It is concluded that, providing other productive characters are not affected, there should be a selection bias towards fine-woolled sheep in the Threequarterbred, and Corriedale and Halfbred groups. In the Romney and Crossbred group, medium-woolled sheep should be discriminated against. It is further concluded that efficient selection for fleece weight must involve rejection of low producers within separate quality-groups rather than from the flock as a unit.

VARIATION IN FLEECE WEIGHT AND THE SIGNIFICANCE OF WOOL-PRICE DIFFERENCES WHEN CULLING

INTRODUCTION

Fleece weight differences between individual sheep within a flock are well known. These differences are exploited by the flock-owner when culling, as in practice this is usually directed towards elimination of sheep with low fleece-weight together with selection against various wool faults such as hairy britch. Direct selection of this nature can be effective in raising fleece-weight levels, but it usually fails to take account of quality (fineness) of wool and therefore of the price differentials that exist for wool of differing quality.

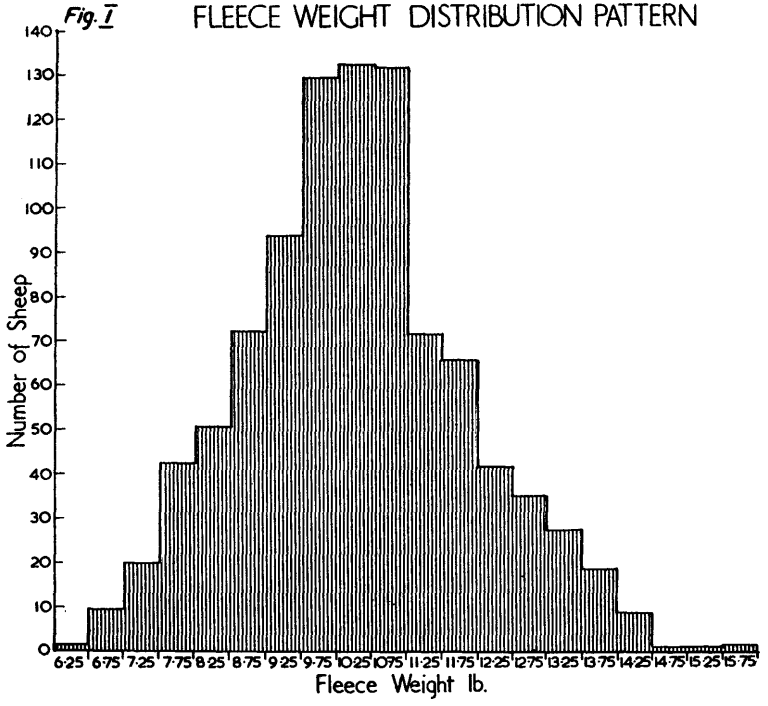
Failure to take wool quality into account may cause culling to be relatively inefficient in that the chief measure of productivity is fleece weight alone rather than monetary return which, to a large extent, is governed by weight and fineness of wool. Weight and quality are inseparable in fixing the worth of sheep as wool producers but, although it is intended to confine this discussion to these two features of the fleece, the importance of grade or excellence has not been overlooked. It has been found that weight and excellence are closely associated so that the sheepbreeder in selecting for weight of fleece would automatically, and with some accuracy, also select for excellence, embracing as it does, crimp, general style, length of staple, staple form, colour and handle. It is not suggested that all these characteristics would automatically be of high standard in a heavy fleece, as one or more could be, in fact, of poor standard. Occasions when the weight/excellence relationship fails may be encountered when a fleece shows a high degree of regional variability, or exhibits an obvious degree of hairiness, or shows discolouration due to some enviromental factor.

In this publication the nature of fleece-weight variation is examined and the significance of trends examined with reference to average price-levels of wools of different quality.

GENERAL VARIATION IN FLEECE WEIGHT

Figure I shows a distribution pattern obtained on analysis of fleece-weight data from a Romney flock. Although other flocks may differ in detail the general pattern remains similar. It is characterised by an obviously-wide range of fleece weights although it will be noted, too, that most fall into several groups clustered near the average.

There are two chief ways of concisely expressing the variation shown in Figure I. The first is by means of a percentage known as "coefficient of variation," which is useful for comparison between flocks but reveals little particular information about a specific group. The second is by means of a figure known as "standard deviation" which gives a very good picture of variation in measurable terms but suffers from the disadvantage that its size is influenced partly by the numerical size of the figures being used. It tends to be large when figures of large value are being used.



In flocks similar to that dealt with in Figure 1 where average fleece weight is of the order of 10lb., standard deviation is approximately one and two-thirds lb. This means that approximately two-thirds of the sheep have fleece weights which fall within limits set by the average plus or minus one and two-thirds lb., in this case between 11.7 and 8.3lb. Approximately one-sixth of the sheep have fleece weights greater than 11.7lb. and the remaining sixth produce less than 8.3lb. The standard deviation falls to something like one and one-quarter lb. when average fleece is approximately 7lb. and at average fleece weights above that of the example quoted, standard deviation becomes larger.

It is clear that variation in any flock is large and that by eliminating low producers the average fleece-weight of the selected sheep can be raised to a figure significantly above the previously unselected flock average. Approximately half the apparent gain is retained by selected sheep in future years, and half is lost through unavoidable mistakes in selection because of non-recurrent random happenings causing fleece weight of some sheep to be high or low at the time selection is made.

While straightforward selection on fleece weight is an effective means of achieving higher fleece-weight levels, it suffers from the disadvantage that quality of wool, and so productivity of sheep in terms of money, is not adequately taken into account.

WOOL QUALITY AND FLEECE WEIGHT

Less well-known, but of more fundamental importance in flock productivity, are the characteristic differences that occur in average fleece-weight between the various quality groups.

It can be shown that within every flock there is a decline in average fleece-weight as wool becomes finer. This means that within a Romney flock the average sheep growing wool of 48s quality produces less than the average sheep with 46s wool and those growing 50s quality produce less than those growing 48s. The average drop in fleece weight (lb.) per whole count-interval of increasing fineness has been determined for three groups of sheep with recognisably different wool characteristics and is shown in Table I.

TABLE I. Mean Fleece Weight Differences Between Quality Groups

Breed Group	Mean Fall in Fleece Weight (lb.) per Whole Count - interval of Increasing Fineness		Approx. Quality-range of Breed Groups
	Greasy basis	Clean basis	
Romney & Crossbred	0.33	0.34	46/54
Threequarter-bred	0.37	0.37	50/56
Halfbred & Corriedale	0.47	0.43	54/64

Although a decline in fleece weight with increasing fineness is an invariable characteristic of all flocks, there are nevertheless great differences between flocks in the rate at which fleece weight falls. In some flocks and sometimes for a particular year, the rate of fall may be only half the above breed average and in other flocks it may approach a figure which is approximately double the breed average. Statistical analysis shows that breed differences are significant and that flocks within breeds differed significantly amongst themselves.

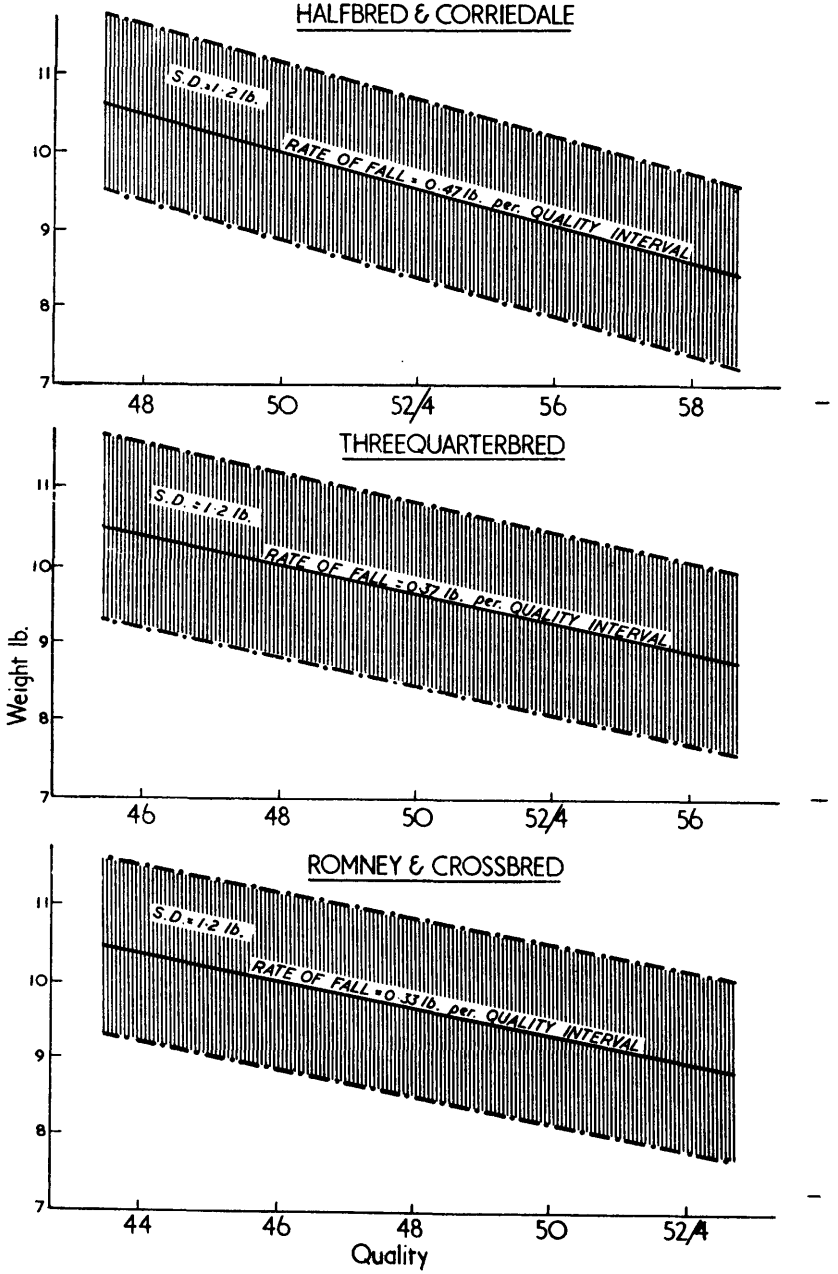
The differences between quality groups are part of the variation in fleece weight of the whole flock and if quality-group differences are removed from the total, it is found that standard deviation of fleece weight within groups is much less than that of the flock as a whole. At average fleece-weight levels of approximately 10lb., standard derivation of fleece weight within a group is approximately one and one-fifth lb. contrasted with one and two-thirds lb. for the flock as a whole. Variation of fleece weight within a flock can thus be divided into two portions—that between quality groups and that within quality. The fleece-weight relationship of one quality group to another and among sheep within a group is more clearly indicated in Figure II. The mean fall in greasy fleece-weight per count-interval for the appropriate breed groups has been used in plotting points upon which the fleece-weight curve is based and the fleece-weight limits within which approximately two-thirds of the fleeces fall (standard deviation) is shown.

WOOL-PRICE RELATIONSHIP

These quality-group fleece-weight differences assume significance when considered along with well-defined price differences which exist between wools of different quality. A study of average wool prices over a considerable period

Fig. II

VARIATION IN GREASY FLEECE WEIGHT BETWEEN & WITHIN QUALITY GROUPS



reveals that although there are some short-term fluctuations, there is a steady quality-group relationship which holds over a great range of wool prices. This is clearly shown in Table II which summarises prices and price ratios for three periods—a pre-World War period of low prices, a war-time period of controlled prices and a post-war period of high prices. The summary of prices has been made from market information published by United Kingdom-Dominions Wool Disposals Ltd. (Wool Digest 1948-1951*) and prices are in pence per lb. clean, delivered London, and refer to Australian, New Zealand and South African super/good/average topmaking fleece, and skirtings bought for combing.

TABLE II. Average Wool Prices and Price Ratios

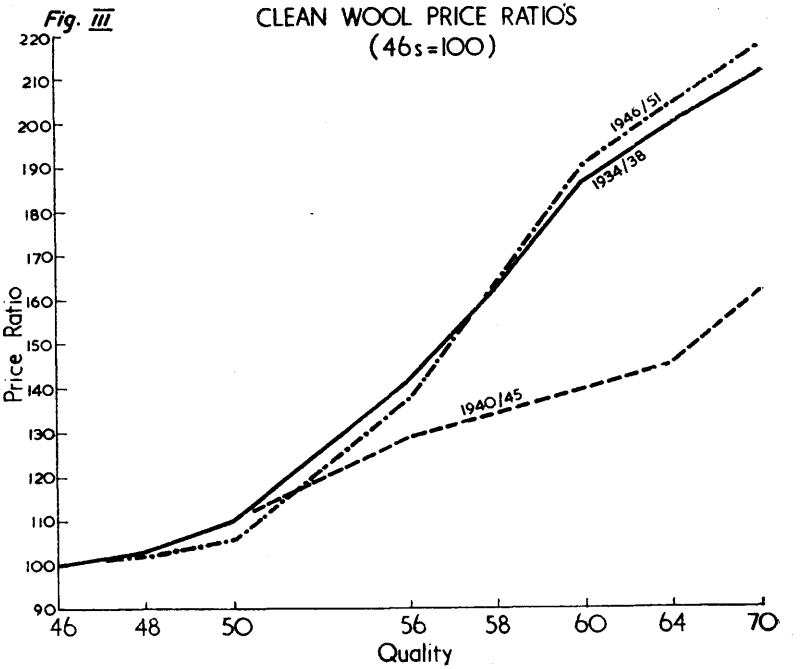
Mean Prices in Pence per lb. Clean

Quality Group	46	48	50	52/54**	56	58	60	64	70
1934/38	12.9	13.3	14.1	16.2	18.3	20.9	24.0	25.7	27.3
1940/45	25.2	25.9	27.7	30.1	32.4	33.8	35.0	36.5	40.8
1946/51	56.8	57.8	60.2	69.0	77.8	91.8	108.0	115.8	123.2
Price Ratios 46s = 100									
1934/38	100	103	110	126	141	162	186	199	211
1940/45	100	103	110	119	129	134	139	145	162
1946/51	100	102	106	122	137	162	190	204	217

A more concise picture of price-ratio relationships is given in Figure III. It is clear that for two periods 1934/38 and 1946/51 during which a free market operated, price ratios are remarkably similar. It is probable that these ratios are a stable feature of the wool trade and would be unlikely to change unless there occurred a radical change in wool utilisation such as would occur in a period of war. The effect of this is well illustrated by the ratios for that period. Short-term fluctuations in peace-time ratios may be of immediate importance, but deliberate change in breeding policy with the idea of turning them to advantage is rendered ineffective because of the slowness with which a breeding change takes effect. It is perhaps unfortunate that prices for wools coarser than 46s are not quoted. In

*"The Wool Digest" (London), 25th May, 1948 and approximately monthly thereafter to December, 1949, and "The World Wool Digest," January, 1950 to September, 1951.

**Estimated.



some flocks there are appreciable numbers of coarse-woolled sheep. However, for New Zealand as a whole, less than 3% of the clip is coarser than 46s (Henderson A. E. and McMahon P. R. 1947, N.Z. J. Sci. and Tech. 29, page 22-43). Of late years wools of 36/44 quality have sold at prices close to those for 46s and at times have been at a premium.

The above price ratios may be used to calculate the average fleece weight at which sheep of different quality or count groups return the same amount of money for wool and this has been done in Table III. The first part of the table gives clean fleece weights and these provide the most accurate measure of productivity. Unfortunately, clean weights are seldom available to the producer and for this reason the clean weights have been converted to greasy equivalents by using a series of yield figures (Table IV) obtained by scouring a large and representative number of fleece samples. Equivalent greasy fleece-weights comprise the second part of Table III. Reading across each line in the table gives the weight of wool the average sheep needs to produce to equal the monetary return of the average sheep in any other quality group. This assumes equal excellence in other fleece characteristics that may affect price.

TABLE III. Average Fleece Weights (lb.) Giving Equivalent Monetary Returns*.

Clean Weights.

46	48	50	52/4**	56	58	60	64	70
10.7	10.5	10.1	8.8	7.8	6.6	5.6	5.3	4.9
10.2	10.0	9.6	8.4	7.4	6.3	5.4	5.0	4.7
9.7	9.5	9.1	7.9	7.1	6.0	5.1	4.8	4.5
9.2	9.0	8.7	7.5	6.7	5.7	4.8	4.5	4.2
8.6	8.5	8.2	7.1	6.3	5.4	4.5	4.2	4.0
8.1	8.0	7.7	6.7	5.9	5.0	4.3	4.0	3.8
7.6	7.5	7.2	6.3	5.6	4.7	4.0	3.7	3.5
7.1	7.0	6.7	5.8	5.2	4.4	3.7	3.5	3.3
6.6	6.5	6.2	5.4	4.8	4.1	3.5	3.2	3.0
6.1	6.0	5.8	5.0	4.5	3.8	3.2	3.0	2.8
5.6	5.5	5.3	4.6	4.1	3.5	2.9	2.7	2.6
5.1	5.0	4.8	4.2	3.7	3.1	2.7	2.5	2.3

Greasy Weights

46	48	50	52/4	56	58	60	64	70
14.2	14.1	13.9	12.4	11.4	10.3	9.3	9.1	9.3
13.5	13.5	13.2	11.8	10.8	9.8	9.0	8.6	9.0
12.9	12.8	12.6	11.1	10.3	9.3	8.5	8.3	8.6
12.2	12.1	12.0	10.5	9.8	8.9	8.0	7.8	8.0
11.4	11.4	11.3	10.0	9.2	8.4	7.5	7.2	7.6
10.8	10.7	10.6	9.4	8.6	7.8	7.2	6.9	7.2
10.1	10.0	9.9	8.8	8.2	7.3	6.7	6.4	6.7
9.4	9.4	9.2	8.2	7.6	6.9	6.2	6.0	6.3
8.8	8.8	8.6	7.6	7.0	6.4	5.8	5.5	5.7
8.1	8.1	8.0	7.0	6.6	5.9	5.3	5.2	5.3
7.4	7.4	7.3	6.5	6.0	5.5	4.8	4.7	5.0
6.8	6.7	6.6	5.9	5.4	4.8	4.5	4.3	4.4

*Based on 1946/51 price ratios. **Estimated.

TABLE IV. Clean Scoured Yield (%) of Quality Groups.

Quality Group	46	48	50	52/54	56	58	60	64	70
Yield %	75.3	74.3	72.5	71.2	68.6	64.2	60.0	58.0	52.5

It is clear that fineness of wool should receive a great deal of attention when selection is being done on a fleece-weight basis. In the part of the table dealing with equivalent greasy weights it will be noted that sheep within the quality range 46s and 50s need to produce very nearly equal amounts of greasy wool to give equal returns. It has been pointed out, however, that among such sheep there is an average fall of approximately one-third lb. per quality-

interval as wool becomes finer. It can be expected therefore that the average sheep growing wool of 50s count will produce approximately two-thirds lb. less wool than those with wool of 46s count. Since nearly equal amounts are required for equivalent return, the average sheep in the 50s group is the less profitable to the extent of almost two-thirds lb. of wool. Many Romney and crossbred sheep, however, produce wool finer than 50s count and much of it is classified as 52s. It will be noted that a sharp rise in price ratio for wool finer than 50s results in a marked drop in the fleece weight required of the finer-woolled sheep for equivalence of return. Actual fleece-weight falls at a slower average rate than this, so that Romney or crossbred sheep with wool above 50s count become more productive in terms of money as wool becomes finer. At an approximate fleece-weight level of 9lb., sheep in the 52/54 quality group have approximately a half-pound advantage over the average sheep of the 50s quality group. Converted into money using a yield figure of 68.6% (Table IV) and a 5-year post-war price average of 77.8d per lb. clean for 56s (Table II) it means that, over a five-year period, very-fine-woolled sheep of the breed under discussion and in flocks averaging approximately 9lb., have returned an annual premium of nearly 4/3d per sheep. Similarly the 46s quality group have had a weight advantage over 50s of approximately two-thirds lb. greasy where only one-fifth lb. was required for equivalence. This amounts to a yearly premium for sheep of the 46s group of approximately 1/9d. It is thus apparent that over a period of years the medium-woolled sheep within the Romney and crossbred range have been the least-profitable wool producers.

For each successive step of increasing fineness in the range of qualities associated with wool from Halfbred and Corriedale sheep, there occurs an increasingly-greater price increment. The trend is more marked in the section of Table III dealing with clean weights but is less apparent in the greasy section because of the effect of the decreasing yield-percentage characteristic of fine wools. It will be remembered that for these breeds there is an average fall in fleece weight per quality-interval of 0.47lb. However, the requirements for equivalence show a decrease in excess of this so that the finer-woolled sheep again show the highest relative return. Beginning with the 50s group, the excess of greasy fleece-weight over that required for equivalence becomes progressively greater for all counts from 50s to 60s. However, at that point a sharp decline in the price-

ratio increment between 60s and 64s causes the average sheep with wool above 60s quality to provide an increasingly-smaller gross return than the 60s group, though still above that for sheep in the coarser groups in the Halfbred and Corriedale range.

The significance of price differences in relation to expected fleece-weight trends is clearly expressed in Figure IV. The curves of expected fleece-weight express the relationship of quality groups in a continuous series, which can be conveniently sectioned into ranges of qualities representative of any particular flock, while the curves of fleece weight required for equivalence of return are relative over the whole range.

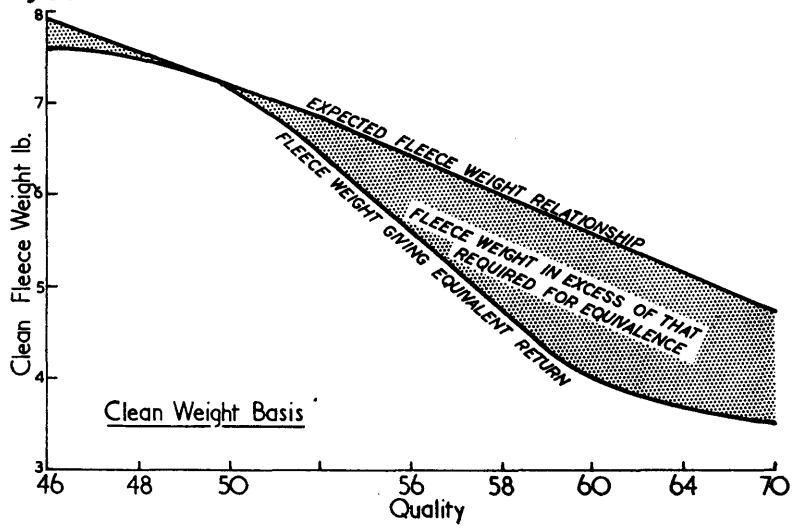
In Figure IV the cross-hatched section is a good measure of the relative productivity of the average sheep within the various quality-groups. It is, however, purely relative and varies in absolute size with level of wool prices and with general fleece-weight levels. It will be noted, too, that yield of the various quality-groups influences the relationship. High yields of clean wool for the lower qualities tend to lower the greasy weight required for equivalence and low yields of fine wools make higher fleece-weights necessary.

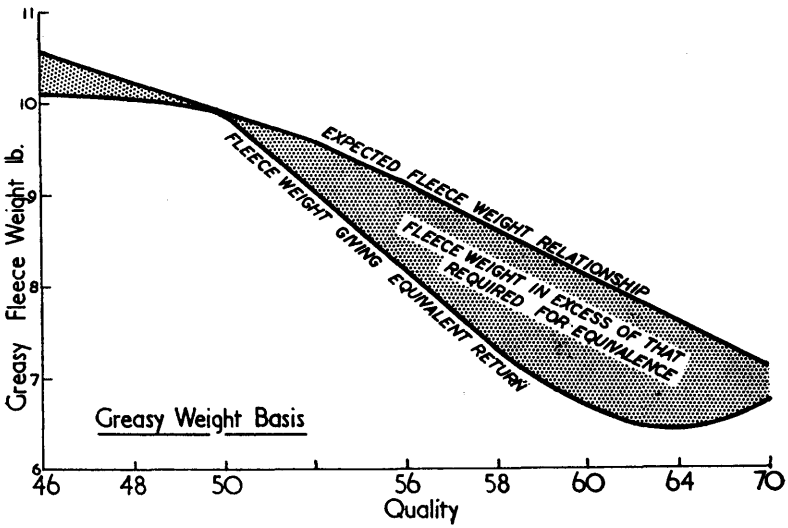
CONCLUSION

There is no doubt that when selecting sheep for retention in the flock, attention should be centred on both kinds of fleece-weight variation that exist—that between groups identifiable by quality of wool, and that among the fleece weights of sheep growing wool of the one quality. Gross fleece-weight does not provide the better measure of productivity and critical assessment of productivity should be based on the fleece weight required for equivalent monetary return among the quality groups. It has been pointed out, however, that within separate groups there are considerable differences in fleece-weight level so that selection should be directed against the least productive sheep in **each quality-group** and not among the sheep of the flock as a whole.

Full use of the information concerning wool-price ratios must inevitably involve a bias towards certain quality-groups. For instance, it has been pointed out that among Romney sheep, those growing wool in the medium range of qualities 48/50s have over a period of time been the

Fig. IV RELATIVE PRODUCTIVITY OF QUALITY GROUPS





least productive. Among Halfbred and Corriedale sheep the 58s and 60s quality-groups have provided the best relative returns. Preference for certain quality-groups can be acted upon fairly effectively either when culling or selecting breeding stock. The average sheepfarmer has a good working knowledge of wool quality and so far as breeding is concerned it is fortunate that heritability of wool quality is fairly high. By judicious selection of rams, the numbers of sheep in any particular quality-group can be increased or decreased fairly rapidly, depending of course upon the rate at which young sheep can be admitted to the flock.

Since the breeds of sheep considered are dual-purpose animals, serious consideration should be given to any secondary effect which may occur because of preference for specific groups within a flock, or for breeds. There are many opinions on the suitability of particular types of fleece for a given environment, but most are unproven. It is recognised, however, that coarse-woolled sheep grow poor-character fleeces where fleece weight is generally low and, furthermore, there is a high incidence of cotting. Then too, it is known that fine-woolled sheep are prone to fleece rot in an environment with a persistent but not necessarily heavy rainfall.

Apart from the effects in the fleece, there are many aspects of flock health and performance associated with breed and environment which need to be carefully considered. The nature of these differences is firmly established, more by opinion than actual fact, but nevertheless it must be respected. Individual behaviour of flocks, however, often deviates from the familiar pattern, perhaps because of specific location or management. The question of preference for sheep of a particular breed or type within a breed is one to be resolved by the individual flock-owner, though he may be guided by common experience.

In this publication an endeavour has been made to show that, with a knowledge of the relative fleece-weight of groups within a flock, with some information regarding the extent of fleece-weight differences between sheep within a group, and with a knowledge of quality-price ratios, selection for wool production can be more efficiently carried out. While it may be desirable to have, for any one flock, particular knowledge of the decline of fleece-weight with increasing fineness of wool, such information cannot be very conveniently obtained in a reliable form. However, since the trend is the same in all flocks, there is consider-

able merit in using a figure representative of the breed average. The variation of fleece weight within a flock is a common characteristic of all flocks and the price ratios are not discriminatory. The selection principles already discussed can therefore be applied generally and can be summarised as follows:—

1. Fleece-weight variation among sheep can be divided into two parts:
   (a) That between sheep groups separated according to wool-quality.
   (b) That between sheep within quality-groups.
2. At average fleece-weights in the region of 10lb, approximately two-thirds of the sheep within a quality-group have fleece weights within plus or minus approximately 1.2lb. of the average. At lower fleece-weights the figure is slightly less than 1.2lb. Elimination of sheep with low fleece-weight has therefore a very positive effect in raising average fleece-weight.
3. Analysis of extensive data shows that there is a consistently-occurring fall in average fleece-weight with increasing quality (fineness) of wool.
4. Breeds differ in the rate at which fleece weight falls For every count-interval of increasing fineness, greasy fleece-weight has been found to fall at the rate of 0.33lb for Romney, 0.37lb. for Threequarterbred, and 0.47lb. for Halfbred and Corriedale sheep.
5. Prices differ for wools of different qualities but the price for any one quality maintains a reasonably-stable relationship with the price of any other quality.
6. Calculation of fleece weights required to maintain equivalence of return for sheep of the different quality-groups, shows that coarse-woolled sheep need to produce more wool than fine-woolled sheep.
7. Because of the necessary different fleece-weight levels required for equivalence of return, fleece weight alone does not provide a reliable index of productivity.
8. It is concluded that within the limits imposed by sound sheep-husbandry, selection for wool productivity (monetary return) should be based on knowledge of variation in fleece weight and of price ratios.
9. On the evidence presented, efficient selection must involve firstly a bias towards sheep with wool of certain qualities, and secondly, rejection of low producers within quality-groups rather than from the flock as a unit.