cross proceeded to grow longer hair and presumably hair keeps the cow hot; but the Friesian second cross had a beautifully smooth fine coat. This in even greater degree, is a characteristic of the native cow.

MR. RANSTEAD: Has that shortness of hair any relation to the resistance to ticks or diseases?

COL. MATSON: That is what we concluded. The tick lies in wait in the long grass and it carries disease. The native cow with very short hair can walk through long grass without picking up anything like the same number of ticks as the cow with long hair.

MR. COOPER: About four years ago, Professor Riddet and I were looking for a proven Ayrshire bull. We visited the herd where it was used on both Ayrshires and Jerseys. He was a merit bull on present classification, but that was almost entirely due to the cross-bred daughters rather than the Ayrshire daughters.

DR. McMEEKAN: I congratulate Colonel Matson on drawing attention to the importance of heterosis, but I would ask him not to expect all of us to go all the way with him. He rightly pointed out that a large portion of farmers in New Zealand today are crossing cattle, as one means, I suggest, of overcoming the static position within the pure-breds that we have been discussing during this Conference. But I would also point out that a large proportion of those farmers come to us and ask us what they are going to do next, because they also apparently are experiencing this great variability and lowering of production in the next generation. In other words, while heterosis is a phenomenon which exists, it can be capitalised primarily in the first cross. Our fat lamb industry is a good example. Thereafter segregation on a proportionate Mendelian basis comes into play, and from the breeding point of view we are in trouble. I want to make that point as one way, perhaps, of assisting us in not having so many enquiries as to what to do next.

COL. MATSON: I may have given the impression of exaggerating the question of heterosis. I did not wish to do that. I am convinced it exists, and comes into play in many cases where we do not recognise it.

SOME NOTES ON THE INHERITANCE OF PRODUCTIVITY IN SHEEP

by

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INTRODUCTION:

Inheritance studies of productivity in dairy cattle, pigs and poultry have been proceeding for many years, and from the results it is now possible to give a useful evaluation of the effectiveness of a postulated breeding programme (c.f. Hamilton 1943; Hazel and Dickerson 1944). Except for a contribution from the present author (McMahon 1943), basic data relating to the sheep are largely lacking for New Zealand breeds and New Zealand conditions. During the past four years, the Wool Metrology Laboratory has been interested in a number of projects aimed at evaluating the potentialities of existing and improved breeding methods among grade and pure bred sheep. The following sections summarise briefly the results which have been achieved.

THE ROLE OF THE DAM IN FAT LAMB PRODUCTION:

To the difficulties inherent to the study of productivity in a dual purpose animal is added the complication that on the meat side, both quantity and quality can be finally measured only after slaughter (McMeekan 1941). Live weight, however, is

sufficiently closely correlated (r = 0.94 - McLean 1946) with dressed carcass weight to enable it to be used in estimating the quantity aspect of meat production where slaughter is not practicable.

Although rather outside the scope of our normal activities, this Laboratory has been responsible for a statistical study of lamb growth data accumulated by Mr. T.K. Ewer at the Department of Agriculture, Kirwee Experimental Farm. The information analysed consisted of 100 day body weights of progeny of the same grade Corriedale ewes in three successive years, obtained by interpolation from field weighings at monthly intervals. Individual parentage was known only on the female side; both Southdown and Corriedale sires had been used, with the ewes randomised independently for mating in each season.

In the first study, the total live weight of lamb for which each ewe was responsible was calculated after making small corrections to eliminate variation due to breed of ram used. Analysis of variance was used and components of variance for Season and Age of dam, Individuality of dam and Random Error calculated.

Table I records intraclass correlation coefficients obtained from the components of variance associated with individuality of ewe and random error.

TABLE I

Group No.	No. of ewes	r
1	32	- .102
2	24	.236
3	35	.059
4	26	.084
5	21	.305
6	31	.206
7	28	.165
8	27	- .136
Total Number	224	
Weighted Mean		.091

The intraclass correlation measures the similarity of weight productivity of the same ewe in different seasons. If each ewe had repeated her first year's performance exactly in subsequent years, the correlation would be 1.0; the low value of .091 indicates that there is, in fact, very little difference between the ewes in this aspect of productivity. Any one ewe in this flock has produced just as much live weight at 100 days as any other ewe and differences in the total productivity of the individual ewes can be explained almost entirely by chance. In this analysis, only the ewes which had complete lamb data for the three seasons were included. A further analysis will be carried out for all ewes which will take cognisance of barrenness and it is likely that this analysis will give rather a higher figure.

It is interesting to compare the low results shown in Table I with the entirely different situation obtaining in dairy cattle. A number of different investigations all suggest that the corresponding figure for successive seasons' productivity in the cow is about 0.4 (Lush 1943.)

GROWTH RATE OF SUCCESSIVE LAMBS:

The index of productivity used above contains elements due to fecundity of ewe, her milking capacity, and heritable differences in lamb growth rate. An attempt to study the latter aspects more closely has been made by reducing the data analysed to the basis of single Southdown cross lambs by appropriate ewe corrections. Table II records the results of analyses for corrected live weights at age 100 days.

TABLE II		
Group No.	No. of lambs	r
1	32	.388
2	24	.241
3	35	.119
4	26	.045
5	21	.034
6	31	.078
7	28	.014
8	27	.191
Total Number	224	
Weighted Mean		.144

The weighted average (r = 0.144) of the intraclass correlations shown in Table II is still low, giving little support to the suggestion that individual ewes differ materially in this aspect of productivity. The numbers of sheep studied are not large enough to give great accuracy to a correlation of this order, but it is clear that the true value cannot be a high one. It seems, therefore, that growth rate can play only a small part in creating the general impression current amongst Corriedale breeders that particular ewes consistently raise "good lambs".

These data do not permit an accurate estimate of the percentage of hereditary variance in growth rate because the effect of the milking capacity of the ewe cannot be separated from the effects of genes for growth passed consistently from dam to offspring.

STUDIES OF FLEECE PRODUCTIVITY:

On the fleece side, while the quantity aspect of productivity is fairly easily measured, quality is a complex and even variable concept. From the production side, there is a complicated interaction of wool type with environment (McMahon 1942) which results in a different optimum balance between count and weight according to the type of country. On the utilisation side the vagaries of fashion, the prevailing international situation and market manipulation can all change the price differential for particular types of wool as well as alter the penalty on defects. Apart from a small premium for fineness and a moderately long, sound fibre, it is likely, too, that there can be no complete solution of the wool quality problem because of the manifold uses to which wool is put. Wool which is ideal for one purpose is unsuitable for another, and buyers are neither unanimous in their descriptions of ideal wool nor prepared to pay very much extra for it.*

Even within the main avenues of utilisation with fairly stable requirements, a further difficulty lies in the fact that wool commerce is still based on subjective quality appraisal. The hand and eye of the skilled wool man quickly and consistently estimate a large number of independent fleece features. Although these features can all be measured objectively, complete impersonal description takes several days. Even then, the results can be unacceptable to a wool expert and we do not yet know whether the technologist or the metrologist is correct. It is important, therefore, to recognise clearly that while objective wool measurements may play a part in the future, they are not yet used by wool buyers and wool sorters. Their place in a programme of planned breeding for productivity is in question until the manufacturing significance of each feature measured is understood, brought into perspective with other fleece features and established as a factor which materially

* FOOTNOTE: One example spotlights the situation fairly clearly, although one does not suggest that it is entirely typical. The anomaly in this case was that of a manufacturer who actually introduced a competitive artificial fibre into his wool blend in order to imitate a "defect" which had been carefully eliminated by culling and selective breeding!

influences wool values. Fibre uniformity, fibre contour, and freedom from certain types of medullation all fall into the category of attributes not readily appreciated without elaborate apparatus, and therefore not placed at a premium by the wool buyer.

At the Wool Metrology Laboratory, it has been our policy to measure the quantity aspect of fleece productivity by means of greasy fleece weight which is highly correlated ($r = 0.93$, Barton 1942), with clean scoured weight, carrying out check scouring tests wherever possible. Quality number or count and character grade or style have both been recorded subjectively with the aid of type standards and standard photographs. Soundness, too, is recorded subjectively and plays a major role in influencing the score allotted for character, as also does gross medullation. Staple length can be estimated only roughly in crossbred wool and is of secondary importance except under special circumstances, since sound fleece wool staples seldom fall below the limit of the Noble comb (about $2\frac{1}{2}$ inches). Although staple length is always recorded, the high correlation with fleece weight is sufficient to render a separate study of length unnecessary.

So far, no attempt has been made to reduce fleece productivity to a single index; results for weight, count and character being stated separately. In evaluating these results, fleece weight must clearly be considered in relation to quality number (c.f. Hultz 1941), because of the premium always paid for fine wools, and the complex count-weight relationships uncovered by wool survey work (McMahon 1942). Style grade or character, however, in crossbred wools seems to be of secondary importance in relation to productivity (Henderson and McMahon, 1945.)

BREEDING EXPERIMENTS IN FLEECE PRODUCTIVITY:

An early step in any attempt to breed for productivity must be an endeavour to locate high producing strains for intensive study and further development. During the past shearing season, the first results of experiments designed to this end were collected in the form of strain trials laid down in connection with wool survey investigations.

Strain Trial No. 1: This farmer is in the process of changing his policy of buying high quality rams on phenotype from various sources at ram fairs to the use of specially selected rams from a stud breeder of repute (Strain A). Both types of rams were in use in 1944 season and arrangements were made to have the old rams of mixed origin mated to two-tooths and aged ewes while the young rams of Strain A were mated to four and six-tooth ewes. Ewes and lambs of the two strains were run separately till weaning, but the 1944 ewe fleece weight records suggest that the early environment of the lambs was essentially similar. Ewe lambs of the two strains were all shorn in November, 1944, and from weaning in January, 1945, till the following shearing they were run together in one mob. In October, the hoggets were culled on appearance without reference to strain and the culls shorn. The selected hoggets were shorn in November. Table III records results obtained with all fleece weights corrected to the basis of the first shearing.

TABLE III

	Strain A	Mixed Rams
Total number of fleeces	334	261
Mean Fleece Weight	7.32 lbs.	7.36 lbs.
Mean Count	50's	50's
Mean Character Score (Scale 1-14)	10.21	10.14

The results show no appreciable difference in fleece productivity between the two strains, although the hoggets of strain A were rather less variable than the progeny of rams of mixed origin. Unfortunately, no objective growth rate or body conformation data are available in this trial. The two strains were, however, drafted after shearing and opinion was expressed that strain A might possibly be slightly superior in conformation and rather less variable in type. The difference was not considered to be of economic significance.

Strain Trial No. 2: This breeder has founded a flock for the production of flock rams by the purchase of unregistered stud ewes (Strain B) from an established stud breeder and by a further purchase of registered stud Romney ewes (Strain C) from a different source. In 1944 the strain B ewes were four-tooths and strain C ewes of mixed ages. All the sheep were run as one mob. After weaning, the hoggets, which had been shorn in December, 1944, were run together until the hogget shearings in August and October, when the following results were obtained:-

TABLE IV

RAM HOGGETS/1944	Strain B	Strain C
Number of Rams	33	34
Mean Fleece Weight	8.65 lbs.	8.88 lbs.
Mean Count	50's	50/54's
Mean Character Score	10.72	10.51
EWE HOGGETS/1944		
Number of Ewes	49	25
Mean Fleece Weight	9.13 lbs.	9.12 lbs.
Mean Count	50's	50's
Mean Character Score	9.75	10.50

From these results, it is clear that there is no major difference between the strains in the features studied here. Although strain C may be regarded as slightly superior in productivity in view of its finer wool and better character, the differences are not statistically significant.

Strain Trial No. 3: The owner of this flock is running two separate lines of blood tracing back to two of the most widely separate sources of stud Romney rams in the country. The flock is run as one unit. At shearing in November, 1945, each fleece was recorded and a subsequent analysis of the breeding ewes by strains made. Since the ewes observed represent the result of phenotypic selection at various ages, possibly with some attention to pedigree, a similar analysis was made for data collected in 1944 from a sample of the hogget flock born in 1943.

TABLE V

MATURE EWES	Strain D	Strain E
Number of Ewes	158	145
Mean Fleece Weight	8.73 lbs.	9.13 lbs.
Mean Count	46/48's	46/48's
Mean Character Score	9.32	9.42
EWE HOGGETS BORN, 1943		
Number of Hoggets	35	47
Mean Fleece Weight	9.05 lbs.	9.08 lbs.
Mean Count	50's	50's
Mean Character Score	10.49	10.64

Although the difference between the dams is both highly significant and large enough to be of practical importance, it is not supported by the hogget figures. Since the hogget means are based on relatively small numbers, however, the existence of a small difference between the strains is not disproved.

BREEDING PLANS FOR PRODUCTIVITY:

The close similarity of fleece productivity found between strains from widely different sources reflects the lack of any organised attempt on the part of most stud breeders to select on the basis of systematic measurement and records (c.f. Wheeler 1945). If the weak heritability which we have found for the more important influences on fleece productivity also plays a part, the information presented in the first part of the present paper suggests that parallel atrain trials for mutton productivity would yield a closely similar story.

This conclusion is a disappointing one in view of the highly significant and commercially important differences found between the progeny groups left by stud sires (McMahon 1943) and it seems that a programme for exploiting such differences is long overdue. We do find large differences between sires on progeny test for fleece productivity, and while the correlation between successive progeny tests is not as high as was originally expected, it is sufficiently high to guarantee a reasonably rapid rate of improvement. Although Hazel and Dickerson (1944) advance theoretical reasons why a progeny test programme would be disappointing if applied to features like fleece weight, such a programme does appear to have very real possibilities in medium sized and large stud flocks. In practice, improvement in features which are sensitive to environment must come almost entirely through selection on the male side, and among most ram flocks environmental conditions are such as to obscure any differences present. If, on the other hand, phenotypic selection among rams is concentrated on strongly inherited features, it enables breed standards to be maintained to the satisfaction of the breeder and utilises most economically his power to select at this stage. At the same time, the relatively large group of sires which must be used in flocks of the types mentioned can be regarded as a group of candidates for progeny test. Selection among these sires can be for productivity features on the basis of a progeny index and the best sires then used widely. Finally, future candidates for progeny testing can be chosen from the "nucleus" thus isolated and propagated.

It is easy to formulate breeding programmes, but more difficult to put them into effect, and the usefulness of the suggestions made above is at present being tested on a small scale through breeders who are working in collaboration with this Laboratory. The ultimate test will come only when strain trials with the improved material on flock sheep environments show real differences in productivity.

SUMMARY:

1. An analysis of 100 day live weights of the lambs from 224 grade Corriedale ewes showed a low repeatability (r = 0.091) in total live weight production.

2. A similar analysis with the lamb data corrected to the basis of single, Southdown cross ewe lambs gave only slightly higher repeatability (r = 0.144).

3. The factors affecting fleece productivity are briefly discussed, emphasising the importance of fleece weight and subjective quality appraisal.

4. Strain trial comparisons with Romney sheep at three different localities are described. None of the strains studied showed real superiority in productivity.

5. A breeding programme to exploit the large differences found between the progeny groups of stud rams is outlined.

ACKNOWLEDGEMENTS: Thanks are due to the Department of Agriculture for permission to use data collected at the Kirwee Experimental Farm and to the farmers and breeders who have co-operated in obtaining strain trial information. Special mention must be made of the staff of the Wool Metrology Laboratory on whom has

fallen the tedious routine of calculation.

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DISCUSSION ON DR. McMAHON'S PAPER:

DR. I.E. COOP: I would suggest that the observation of Dr. McMahon's that good ewes do not consistently raise good lambs, is an important observation. I would ask whether the conditions have been sufficiently rigid that this observation can be taken as "gospel"; were the ewes in question all of the same age, and whether the nutritional conditions over the years the comparison was made were relatively good. I presume that the weight of the ewe is not concerned in this.

MR. EWER: Yes, the ewes were all of the same age, and the conditions were roughly the same.

DR. McMAHON: From a statistical point of view, the treatment of the ewes would be more uniform than in an average flock, since we have taken out data within groups, and then combined the values obtained for the groups. I would also emphasise that this is only one aspect of sheep value, and I do think it is highly probable that for features which are strongly inherited - for instance, the suitability of wool type to the environment, as measured by the count of wool, and also this curious question of head shape, which seems to be of overwhelming importance in sheep values - that is apparently more strongly inherited, and I think it is almost certain if you took out similar data for head shape you would get the same ewe throwing a high grading lamb year after year.

DR. McMEEKAN: I have been extremely interested in this paper, which undoubtedly has very many points in relation to the breeding of sheep, and fits very well into the various comments that have been made during the whole of this Conference. There are a few points on which I would like some information: In the first place, can you give me some idea of the number of sheep on which this correlation of .94 between live weight and dressed weight is based, and the conditions under which that was carried out, the point being that our own experience would not suggest that such a high correlation is universal? The second point, in addition to Dr. Coop's question: might it not be possible that the fact that the Kirwee lambs never really did grow well, may have influenced this situation? The relatively low plane of nutrition or environment conditions at Kirwee were certainly responsible for poor lambs, and I just wonder whether this picture would be the same under good growth conditions. Thirdly, does this correlation between greasy fleece weight, and clean, scoured weight, also apply to the experiments you have been conducting on the influence of extremes of differences in planes of nutrition upon the two breeds of sheep, Corriedale and Romney? For instance, you have reported a very high increase in fleece weight under a high plane of nutrition - an extraordinary difference in fleece weight. What I want to know is how much of the increase is real, and how much is due to the non-wool characteristics of fleece weight. My last point: on page 84, Strain

Trial No. 3: I am wondering whether the suggestion that these two strains, D and E, are the most widely separate sources of stud Romney in the country is really justified, in view of the fact tha if my guess is correct, both flocks were founded on precisely the same foundation blood? Both stocks have secured outside rams from precisely the same source. Admitted that there has been a difference - as I indicated yesterday in my discussion on the work of the owner of strain E - due to his concentration on one particular family within that strain, but that concentration was destroyed about 1918, when Mr. Short himself was ill, and purchases were made by the people running the stud from England through the progeny of the imported ewes which I mentioned - ewes which started to play a part about that time, and ewes which came from the same source in Britain as strain D, for which imported rams were procured about the same time. In other words, I suggest it is possible that any differential between these two strains that might have occurred over the first twenty years of their existence might tend to be eliminated by the breeding methods of the people concerned, and would again tend to be eliminated because they both brought in stuff from the same source in about 1918. In other words, when did the man who concentrated on strain E start, and when were his ewes for this purpose purchased?

DR. McMAHON: First regarding the correlation of .94: I had a brief look through the literature and could not find any correlation, and thought it simpler to calculate one myself than hunt any further. The Animal Husbandry Department kindly gave me access to a sample of about 120 Southdown cross with Corriedale lambs; the live weight and the dressed weight would be taken immediately before and after killing respectively. That is roughly the set-up there. They are Southdown-Corriedale lambs and about 120 of them. Regarding the plane of nutrition at Kirwee and the way the lambs did, I just cannot answer that one. I think we were having a discussion about it yesterday in relation to the milk production of the ewe, and the correlation of milk production and growth rate. It is the same question in a different way, and perhaps Dr. Filmer may be able to answer it. Regarding the correlation of .93 for fleece weight: we have a lot of information from our nutrition experiment, but there is still more to come, and therefore no correlation has been worked out. I will say, however, that a change in yield from 75 to 65 per cent has occurred in one case. That is to say, a sheep which at the start of the experiment had a fleece yielding 75% of clean scoured wool, after a high plane of nutrition, had a fleece about three times as heavy in gross fleece weight, but which only yielded 65% of clean scoured wool. Regarding the two strains: these just happen to be two convenient strains. In this type of work, you have to take what you happen to run across. So far as I am able to ascertain - and it is rather difficult to get the information without a more detailed study of the flock books - these two strains are fairly well separated and certainly are regarded as being well separated by commercial breeders. I do not know whether Dr. McMeekan knows of two more widely separated strains - I would be quite interested to know if there were. They are not nearly as close as various flock strains which command high price differences at the ram fairs just because they happen to be a so-called different strain. In other words, these strains are much more widely separated than strains which are regarded by practical men as sufficiently different to command a premium of several hundred guineas.

MR. RANSTEAD: Even if these two strains were from the same source originally, they have been raised under different environment conditions, haven't they, or have they been the same. Perhaps different environment conditions might have had a selective effect on the genes, and you might get two different gene complexes in the two strains.

DR. McMAHON: You will remember that Mr. Stevens yesterday gave us two locations in N.Z. where the Romneys grow better than in the Romney Marshes of Kent - these two strains come from those

two different locations in N.Z., one from the Wairarapa, and the other from the Manawatu. Whether there would be any difference between those two in terms of natural selection I do not really know.

MR. DUNLOP: Was the difference in yield prior to commencing a high plane of nutrition and afterwards entirely a matter of a difference of plane of nutrition?

DR. McMAHON: As I said before there is a large quantity of information from that experiment, and also a large quantity of samples still unscoured. Those will probably be scoured by the time I get back. I would say that in the difference of 10% - between 75 and 65 per cent. - there has been a definite housing effect, because a very large fraction of the increase in shrinkage would be due to suint which has been washed out in the fleece grown outside and would have been washed out, especially from the tip of the staples of the second fleece, under normal conditions.

MR. HANCOCK: First, what actually is the correlation between progeny groups of the same size in different years? Second, just how many offspring should any progeny group contain? It is a point over which there has been some divergence. I think Dr. McMahon two years ago stated that 7 was really enough. Hazel and Dickerson, whom you refer to here, say at least 14 are needed, and I think the Russians require a much higher number than that. It would be interesting to know if the statisticians have been able to come to some sort of agreement, because it affects any progeny testing plan.

DR. McMAHON: The figure of 7 was taken from a very preliminary publication of 1940. The work was just started then and that publication received rather more publicity than it was intended to. The more correct figure of 15, with which Hazel and Dickerson agree was published in 1943 - in a more careful and scientific account of the same work. Fifteen gives a reasonable balance between the obtaining of more accuracy by increased progeny numbers, and the limitation of the number of sires that can be tested with a limited number of ewes. It is a question of accuracy increasing at a diminishing rate as you increase the progeny numbers, and I think 15 is a reasonable compromise between fairly good betting chances and still having a reasonable number of sires tested. However, I indicated in the 1943 paper that, so far as I could see, we would do better in progeny testing not to worry very much about the use of small numbers and a special progeny testing flock, but rather to progeny test using ordinary stud matings - which had to be made anyhow - where the number of ewes per ram would give rather higher than a progeny group of 15. The answer therefore is the more the merrier. Replying to your first question: in the 1943 paper on data obtained from an ordinary commercial flock, the correlation between progeny tests for fleece weight was, I think, about .515. That would contain a certain number of errors of one sort and another. Some of the other features went a bit lower than that. I should think a correlation of .5 would be a fairly safe estimate. That is sufficient guarantee that improvement would go on.

DR. FILMER: Regarding Dr. McMeekan's question as to the rate at which Kirwee lambs grow, I am inclined to think the rate up to 100 days was fairly satisfactory. It was after 100 days that the growth rate flattened out, so there is no great need for concern there. I am, however, a good deal concerned about the conclusion that Dr. McMahon has reached especially as expressed on page 81: "The low value of 0.091 indicates . . . can be explained almost entirely by chance." Just what does that mean? Does it mean that we have reached a stage with our ewes where there is no chance of improving their productivity in the way of fat lambs, or, if they have not reached that stage, does it mean that there is no way in which we can lift it? I do not know what Dr. McMahon really means by the total weight of lamb. I presume he did exclude twins, but if

he did not that is one aspect of very real importance in the North Island. The average lamb is about 90 lb. It is known it can be lifted up to 150 in odd cases, which would make a very great difference to the total weight of lamb which ewes could produce. Looking at the other aspects, surely there must be a difference between ewes in the ability to produce fat lambs. It surely would not be suggested that the Australian, small fine Merino ewes would produce as good fat lambs as our Romney ewes. What I am getting at is this: If there is a variation, is there any way in which we can use that variation to get ewes that will really produce more fat lamb than our present line of ewes? Is it, or is it not, worth while looking at that? I am a little suspicious of statisticians when their figures do not support actual practice, and I suggest in this case, if you look at the extremes, there must be some effect from the ewe. I would ask Dr. McMahon, if there is a difference between ewes, how can we accentuate that difference to make the most of it under New Zealand conditions?

DR. McMAHON: I think my statement is quite well documented by the phrase "in this flock". The results of any analysis such as this can refer only to a particular type of sheep, and any other flock like that would be expected to give similar results, but as soon as you go outside the breed and the particular environment situation, particularly the breeding circumstances, then the results do not necessarily apply. If instead of Corriedale ewes you used Romney ewes, I think you would get bigger overall productivity, provided, of course, the environment was right.

I must confess that I, too, am a little doubtful of the statements of practical men if their results cannot be subjected to statistical analysis successfully. I think Lord Kelvin has said that until a body of information can be reduced to the discipline of number and order, it cannot be said to have assumed the status of a science, and someone else, I think Galton, said something to the effect that general impressions are never to be trusted. I think that is a very real factor here. You get the general impression, because you happen to see one or two ewes out of a large number which have successively given large lambs, that there must be something in it. But your eye misses entirely the number of ewes which produce an entirely variable lamb crop.

With reference to the twin aspect: in this analysis twins were included. This first analysis was based on the total live weight for which each ewe was responsible, so that any inherent differences causing the ewe to have a tendency to produce twins would come into that figure of 0.091. Since there is not a high correlation, it simply means that if the ewe had twins one year, she did not tend to have twins the following year.

MR. DUNCAN: On page 83 Dr. McMahon refers to a premium always being paid for the fineness of wool. That is not entirely correct. It holds good most of the time, but if Dr. McMahon will cast his mind back to the 1936 season, he will remember that in New Zealand cross-bred wool was bringing just as much as Merino wool. Today, we find the Merino breeders complaining that they do not obtain sufficient premium.

I want to make a comment here, mainly for the benefit of our friends in the dairy industry. I would point out that during the last seven years, the wool industry has been experiencing an entirely abnormal period of stability with the appraisal system which has been in operation. That is now coming to an end. We hope that some degree of stability will continue under this new joint organisation scheme which is supposed to run for the next 12 or 13 years. We do not know that it will. In the past, somebody from Bradford remarked that the only certain thing about the wool market is its uncertainty. You dairy people are really fortunate that the things you have to deal with are relatively simple. You can deal with milk weights, and butterfat both of which can be accurately measured,