grassland. Improvement by topdressing is a slow process and you must introduce clover at the same time. I think Lotus major is a different proposition from the white clover or subterranean clover. It does not require topdressing but the problem is to get Lotus major into the sward. I think that in the higher rainfall areas Lotus will be the salvation of a lot of the hill country.

MR. WARD: To what extent in some of the steeper hill country, particularly in the Tutira country in the Hawke's Bay where heavy erosion is taking place, is it going to be economical to hold that country on a long term basis? Can you permanently pasture this area or will the economic losses of the type you mentioned be too great?

MR. SMALLFIELD: I think that undoubtedly certain country will have to go out of occupation. There is no doubt about that, particularly country where there is no easy land at all associated with the most difficult hill country and where it is extraordinarily difficult to carry the right proportion of cattle to sheep. You have a very typical area of such country in the Coromandel Peninsula where you have very poor danthonia hill country and practically no better land for wintering. The hill pastures are in an uneasy balance between danthonia and manuka and ultimately the land will go back into manuka. There are many similar areas but there is also quite a lot of country which although completely reverted may, ultimately, by sowing after secondary burns make quite reasonable grazing country.

FERTILISER, PASTURE CONSIDERATIONS AND MANAGEMENT IN RELATION TO FAT LAMB PRODUCTION

by

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The importance of New Zealand's fat lamb industry and the extent to which it is based on a permanent pasture system of farming has been adequately stressed by many speakers at meetings of this Society. It has been pointed out (Levy 1944) that N.Z. is unique in the possession of relatively large areas, producing or capable of producing permanent pastures of high productivity. Consequent upon the selection and breeding of pure strains of grasses and clovers, the use of artificial fertilisers and high stock concentration, pastures have been established which in favourable climates are capable of producing annually up to 15,000 lbs. of dry matter per acre, or sufficient if completely and efficiently utilised to maintain throughout the year over 10 ewes and fatten their lambs.

In general, our pastures can be considered satisfactory for the health and production of our stock, and methods of grassland farming have been evolved which are fairly efficient. There is a considerable fund of knowledge of factors affecting the production and nutritive value of pastures and the main problems of maximum efficient utilisation are at least fairly well understood, although by no means overcome.

There are, however, very many gaps in our knowledge of the complex reactions between the grazing animal and its environment. The tortuous road leading to the solution of the bush-sickness problem and other mineral deficiencies, facial eczema, the peculiarities of Dwalganup subterranean clover in Western and South Australia serve to remind us of the limitations of our knowledge and emphasise the inadequacy of chemical and biochemical techniques in providing measures of the fluctuations which may occur in pasture quality.

The selection and exploitation of high producing strains of pasture plants, particularly ryegrass and white clover has been accompanied by a reduction in the number of species in the typical sward, brought about by simplification of pasture mixtures sown and the natural aggressiveness of the high producing species in a favourable environment. In many quarters the contention has been advanced that many of our stock troubles may be attributed to this "simplicity" of diet and the definite contention has sometimes been advanced that per-

ennial ryegrass dominant pastures tended to promote ill-thrift in stock, particularly under heavy topdressing which resulted in very lush growth.

In 1939 some grazing trials, to test such points and to study under controlled conditions the management problems, were laid down using simple mixtures of various ryegrass and white clover strains heavily topdressed, and a ryegrass-white clover pasture under various kinds of topdressing. The grazing management was such as to keep the swards young and tender at all times. Thus in the words of Mr. E. Bruce Levy "the stage was set for all the disasters that are held to beset sheep and lamb production on lush, dominant ryegrass-white clover pastures."

It is to be emphasised that the aim of these trials was not to determine accurately carrying capacity but to determine the effect on thrift and productivity of ewes and lambs of the various pastures under a system of management which aimed at keeping the sward young and tender at all times, and with a rate of stocking which enabled the experimental animals to feed to appetite on the pastures alone throughout the year.

I. PASTURE STRAIN TRIAL:

In this trial a further complication was introduced to the lush pasture concept insofar as plant selection and breeding had evolved ryegrass and white clover types higher in production and therefore potentially more lush in the rapidly growing periods than ordinary pasture strains. Further, as progress was made in thebreeding and evolution of a super type white clover the tendency was to breed a clover with a higher cyanogenetic glucoside content in the leaf and it was deemed desirable to test this strain out before large scale seed increases of pedigree white clover were made. The trial was designed therefore to test "pedigree" strains against the best natural ecotype mother strains and to test high cyanogenetic glucoside white clover (Pedigree) against a white clover strain low in the glucoside content.

(a) Establishment and Layout of Plots:

The plots, each of one acre, were situated on two parallel and flattish-topped ridges separated by a gully which is excluded from the trial.

The soil is classed as a yellow-grey loam but because of a somewhat impervious clay subsoil is known popularly as clay soil and mole and tile draining to eliminate the wetness characteristic of this soil in winter and spring was essential.

The layout was on the basis of randomised blocks except that some restriction of randomisation was introduced with the object of distributing the plots as evenly as possible between the ridge top and sloping sides. In each treatment four replications were laid down.

Each plot received 2 tons of ground limestone at the commencement of the trial and 4 cwt. annually of superphosphate with the object of ensuring a favourable soil reaction for both ryegrass and clover and to maintain a high level of phosphate supply thus accentuating clover growth and any possible effects which might be associated with the high and low cyanogenetic glucoside containing clovers respectively.

Simple mixtures of perennial ryegrass and white clover were used as follows:-

1. (P1)	Pedigree perennial ryegrass ..	40 lb.
	Pedigree white clover (high HCN)	3
		43 lbs. per acre.
2. (P2)	Pedigree perennial ryegrass ..	40
	Uncertified white clover (low HCN)	3
		43 lbs. per acre.

3.	(P3)	Pedigree perennial ryegrass ..	40 lb.
		Mother white clover	3
			43 lbs. per acre
4.	(P4)	Mother perennial ryegrass	40
		Mother white clover	3
			43 lbs. per acre
5.	(P5)	Mother perennial ryegrass . ..	40
		Pedigree white clover	3
			43 lbs. per acre

The necessity for the provision of shelter which would be uniform for all plots was recognised in view of the exposed nature of the area. Pampas hedges were sited and provide each plot with shelter from the prevailing northerly and westerly winds and have been keenly appreciated by the stock which soon learned how to take advantage of the shelter provided. Pampas was chosen because of its rapid growth and establishment and ease of control. It grows close to the ground forming a dense draught proof wall which is not too high to give undesirable shadow in the winter but gives adequate shade in summer. It has been found that in these small plots stock have not tended to form camps close to the hedges with the resultant areas of unpalatable and badly controlled pasture. Grazing has been remarkably uniform right to the base of the hedge in every case.

(b) Selection of Experimental Sheep:

The experimental ewes were selected from the 850 cull 2 tooth ewes of the flock of Mr. Frank Armstrong of Akitio. This flock was chosen because a large line was available from which to make a selection and the flock was of a uniformly high standard. A very important consideration was the willingness of Mr. Armstrong to co-operate in every way.

An initial selection was made before shearing and 350 sheep were chosen to be within a limited range for size, wool type, and conformation, in particular, and great care was exercised to avoid all obviously unthrifty sheep.

On arrival at the College in the early autumn, this mob was reduced to 320 by further culling. The experimental groups, each of 16 ewes, were then selected on a restricted random plan (Turner 1936) taking into consideration live weight and wool fineness. It was not considered feasible nor desirable owing to the evenness of the line to take into account any other features. Insofar as wool fineness was concerned, the sheep were merely graded into two approximately equal classes by visual examination.

In addition to the 80 sheep required for this trial, another 100 were selected for another trial to be described later. The surplus sheep then constituted a reserve group to provide replacement ewes as required and additional ewes to cope with feed surplus to the requirements of the experimental sheep. The size of the experimental group was determined at 16 sheep (4 per acre) because this was thought to be a safe minimum number of ewes which could be fed to appetite at all times of the year on all treatments.

Replacements of experimental ewes have been necessitated from time to time chiefly owing to deaths and failure to conceive. The reserve ewes have been carried on the College Farm under the best conditions available and each year as many as possible have been carried on the plots additional to the experimental ewes. It was laid down in the initiation of the experiment that a ewe casualty should be replace by one of the same wool type (i.e. fine or coarse) and of approximatel the same initial body weight (i.e. as at Feb. 1940). In most cases where a replacement has been necessary it has been possible to select a suitable ewe from the reserves running with the experimental sheep.

(c) Care and Management of Experimental Animals:

Insofar as the necessary experimental control has permitted, the management of the stock has been in accordance with practical fat lamb

production under a system of rotational grazing. At no time have the experimental sheep had access to any feed other than the pasture provided by their respective plots. More than usual care has been taken, however, to prevent footrot in the experimental sheep. At the selection of the sheep any with unsound feet or signs of lesions were rejected and regular trimming and bluestone treatment of the experimental sheep has been carried out.

Before tupping in each year any experimental ewes unsatisfactory for further breeding by reason of defects such as udder trouble, bad feet, etc., have been replaced by ewes from the reserve flock. Replacements have also been made of the ewes not in lamb at the conclusion of tupping and of the ewes failing to produce lambs. As many reserve ewes as possible are carried throughout the year on the plots and used to adjust the rate of stocking to suit pasture production.

The system of rotational grazing adopted has been necessitated by the random layout of the plots which has resulted in a 4 day rotation. Our experience over the four years indicates that this rotation is almost ideal for the utilisation and control of these highly improved pastures under the environmental conditions obtaining and this irrespective of the carrying capacity of the different treatments. The concentration of up to 25 sheep per acre is at no time excessive from the point of view of muddying and fouling of pasture and the pugging of the soil, although this is in some measure due to the comparative smallness of each experimental group. It is possible that the same concentration of stock on a ten acre paddock (viz. 250 ewes) would give a less satisfactory result. Yearling cattle have been used in the spring and autumn to control pastures during these periods of rapid growth and have been set stocked on the plots at the rate of one to 3 per acre as required. Owing to the wetness of the soil it has not been feasible to get cattle on the areas as early as would be desirable and it is seldom before the end of September that even yearling cattle can be grazed without causing excessive pugging. In addition to pugging the area excessively, older cattle cause more damage to fences and take longer to settle down in the small plots. Yearling cattle are also more useful grazing units for set stocking one acre areas.

Southdown rams have been used throughout this experiment and were selected as 2 tooths for evenness in size and type from a group by one sire from dams by the same sire. Three rams have been used and the tupping period confined to 9 weeks from about March 20th. The rams have been used in rotation and moved forward twice in 24 hours at about 5 p.m. and 7 a.m. In this way each ram completed a circuit of the five groups in $2\frac{1}{2}$ days and by the end of tupping the three rams had completed an equal number of circuits. The rams were raddled on the brisket in the usual way and the colours changed every 17 days.

The advantages of the system is that infertility in any individual ram, if undetected by the shepherd, cannot differentially affect the groups to any marked extent since each ewe in each group has access to at least 2 rams in each heat period and also the progeny of each ram are as equally distributed as possible throughout the groups. An unavoidable disadvantage is that it is impossible to record the sire of each lamb since a ewe might be served by three rams at any heat period.

(d) Results:

Some of the results relative to fat lamb production were as follows:-

(i) Pasture Production in terms of carrying capacity in ewe units:

In an experiment designed primarily to measure differences in the quality of the herbage produced by the different pastures, in its effects on thrift and production of ewes and lambs fed always to full appetite, the best measurement of pasture production in terms of carrying capacity is not necessarily achieved. Nevertheless it is considered that the stocking records give a valuable indication of the relative production of the different pastures.

The stock carried on each plot was recorded daily in terms of ewes, lambs and cattle. For the purposes of comparing treatments stock carried have been converted to ewe equivalents on the following arbitrary basis:-

1 ewe = 1 e.e.
1 yearling beast = 4 e.e.
1 lamb = 0.5 e.e. (from November).

The factors are based on the approximate appetites of these classes of stock on pasture (Woodman 1936) and are reasonably accurate for purposes of comparison between treatments, since live weight changes in all classes of stock and the spread of lambing have been similar on all treatments. As accurate measures of absolute carrying capacity throughout the year and in different years they would be open to considerable criticism.

The following table illustrates the characteristic and well known fluctuations in pasture production with season:-

TABLE I.

CARRYING CAPACITY IN EWE EQUIVALENTS (EE) PER ACRE BY QUARTERLY PERIODS 1940-43 INCL.

	P.1 EE	P.2 EE	P.3 EE	P.4 EE	P.5 EE
Mar - May, 1940	9.8	9.9	9.5	9.2	10.4
Jun - Aug, 1940	4.0	4.0	4.0	4.0	4.0
Sep - Nov, 1940	10.1	8.1	8.6	8.6	9.8
Dec - Feb, 1941	6.5	6.5	6.5	6.5	6.7
Average 12 months	7.6	7.1	7.1	7.1	7.7
Mar - May, 1941	13.2	11.8	11.7	12.0	13.3
Jun - Aug, 1941	4.8	4.0	4.5	4.6	4.5
Sep - Nov, 1941	12.9	10.5	11.5	11.1	11.9
Dec - Feb, 1942	12.1	10.7	11.5	10.6	11.2
Average 12 months	10.8	9.3	9.8	9.5	10.2
Mar - May, 1942	10.2	9.2	9.0	9.5	10.1
Jun - Aug, 1942	4.5	4.2	4.3	4.3	4.3
Sep - Nov, 1942	18.7	15.5	16.3	15.1	14.4
Dec - Feb, 1943	12.9	10.0	11.5	11.9	13.4
Average 12 months	11.6	9.7	10.3	10.2	10.6
Mar - May, 1943	9.2	9.4	8.9	8.9	9.8
Jun - Aug, 1943	4.8	4.4	4.8	4.4	5.0
Sep - Nov, 1943	12.2	11.5	12.5	12.4	12.7
Dec - Feb, 1944	7.6	7.9	8.1	8.1	8.4
Average 12 months	8.4	8.3	8.6	8.5	9.0
Average for 4 years	9.6	8.6	8.9	8.8	9.4

A winter carrying capacity of over 4 ewes per acre is a tribute to well managed pasture when it is realised that no supplementary feeding whatever was done and that the ewes gained in live weight steadily throughout each winter. A maximum carrying capacity of 18.7 e.e. in the spring (P1. 1942) emphasises the problems of management associated with a perennial "crop" which fluctuates so widely in seasonal production. The higher producing pastures, P1 and P5 were correspondingly more difficult to control as September production was generally considerably greater than on the other pastures. The greater production of these pastures was statistically highly significant and while a tribute to the pedigree strains, in particular to the pedigree white clover, accentuates the difficulties of full utilisation and control.

(ii) LIFE WEIGHT CHANGES IN EWES:

The live weight changes of the ewes' have been followed by weighing at approximately monthly intervals from February to November, except for about two months during lambing. The groups were initially

of the same mean live weight (90 lbs.) and with the same range and standard deviation (7.9 lbs.). Until the first lambing differences between group means were of the order of 2-3 lbs. but thereafter became greater, and during 1941 group P1 established a lead of up to 8-10 lbs. over all other groups which were of a very uniform mean weight. Differences between the means of groups were, however, at no time significant, the standard deviation having increased to 17-18 lbs. as a result of replacements and genetic variability, which would be expected to show itself best under these high nutritional conditions. During the 1943 season the group means were again within a few pounds of one another.

It might be argued that the consistently higher mean weight of group P1 over two seasons was real although statistically non-significant, owing to smallness of numbers, but if so this is the one respect in which superiority of this group has been manifested. In all other ewe and lamb data Group P1 has not shown any advantage over the other groups. The shape of the growth curves, are identical with those to be shown later for the manuring trial which are presented in preference because they are more complete and based on slightly larger numbers.

(iii) DEATHS IN EWES:

Every ewe which died was subjected to post-mortem examination in order to determine the cause of death and the results are shown in the table below:-

TABLE II

CAUSES OF DEATHS IN BREEDING EWES.

Group	Lambing Difficulty	Bearing Trouble	Sleepy Sickness	Haemorrhagic Gastro-Enteritis	Unknown Causes	Totals
	1940 1941 1942 1943	1940 1941 1942 1943	1940 1941 1942 1943	1940 1941 1942 1943	1940 1941 1942 1943	
P.1		2	1			3
P.2			2			2
P.3	2	1	2	1 2		8
P.4	1	1 1	1			4
P.5	1	1			1	3
						20

Apart from three deaths in group P3, due to haemorrhagic gastro-enteritis there were no deaths in the first two years. The greatest number (9) occurred in 1942 when 6 ewes were lost with sleepy sickness (pregnancy toxaemia). It was observed in this and other trials in 1942 that in almost every case (11 out of 12) the ewes which contracted sleepy sickness were also suffering from severe footrot, which it is most probable (Webster (1942)) was responsible for a self-imposed period of starvation in these ewes in high condition of sufficient intensity and duration to bring about acute Ketosis. Using the chi-square test and applying Yate's correction for continuity (Snedecor, 1938), the differences in the total number of deaths in each group have proved to be non-significant.

Over the four years the death rate for all treatments has averaged 6%.

(iv) NUMBER OF "DRY" EWES:

The rams have been left out for 9 weeks and any ewes not in-lamb by that time have been recorded as "dry ewes" and replaced with suitable pregnant ewes from the reserves running with the experimental mobs. The rams raddled black on the brisket have been used at the conclusion of the tupping period to detect ewes which have not conceived. The following table records the number of ewes picked out as "empty" and those failing to lamb, the latter comprising ewes not marked by the "teasers" and also any which may have aborted unnoticed early in the gestation period.

TABLE III

NUMBER OF DRY EWES.

	P.1		P.2		P.3		P.4		P.5		
	A	B	A	B	A	B	A	B	A	B	
1940	3	-	3	-	2	-	-	-	-	2	10
1941	3	-	2	-	-	-	2	-	1	2	10
1942	2	1	-	1	-	-	1	1	-	1	7
1943	2	-	4	1	-	-	2	1	-	-	10
Total	11		11		2		7		6		

A = Ewes marked by teasers at end of tupping period.
B = Ewes empty at lambing time.

Using the chi-square test the differences in total numbers of empty ewes between groups is not significant (P > 5%), although the low number in group P3 (Ped. rye - mother clover) is striking at first sight. It is to be pointed out, however, that groups P1 and P2 (Ped. rye) and P4 (Mother clover) do not support the belief that a treatment effect has been demonstrated.

The total number of ewes "empty" at the conclusion of tupping is unduly high, and is the one unsatisfactory feature in these trials where production has otherwise been so uniformly high. In the first year the number of empty ewes amounting to 12½% is perhaps quite satisfactory for two-tooth ewes off hill country, although they "flushed" ideally before tupping commenced. In subsequent years, the ewes in every case were animals which had bred in all previous years, and the low fertility is perhaps explained by the fact that the animals were overfat, a condition widely postulated as conducive of lowered fertility.

A widely adopted flock management practice based on many years of practical experience is to bring breeding ewes into "fresh store" condition after weaning and to "flush" them from about 2-3 weeks before the rams are turned out. In these trials, although the sheep gained steadily in weight (never less than 1 lb. per week) throughout tupping in each year, the policy of allowing the sheep to feed to appetite at all times did conflict with the generally accepted canons of good ewe management after weaning.

(v) LIVE LAMBS BORN:

The number of lambs born alive in each group is shown in Table 4 below. As has been explained the number of ewes per group was made up after tupping to 16, all presumed to be in lamb. Thus the expected number of births in each group is 16 and where the number is below 16 this is due to abortions, stillborn lambs and the occasional empty ewes not marked by the teasers. The number of aborted lambs observed and stillborn lambs are shown in table 6.

TABLE IV.

LIVE LAMBS BORN.

	P.1			P.2			P.3			P.4			P.5		
	S*	M*	T*	S	M	T	S	M	T	S	M	T	S	M	T
1940	13	1/2	15	12	2/2	16	14	2/2	18	13	1/2	15	9	4/2	17
1941	13	3/2	19	12	4/2	20	14	2/2	18	9	7/2	23	9	6/2	21
1942	7	9/2	25	6	9/2	24	10	6/2	22	11	5/2	21	7	9/2	25
1943	4	7/2,2/3	24	6	5/2	16	4	11/2	26	3	7/2,1/3	20	11	3/2	17
Total	37	20/2,2/3	83	36	20/2	76	42	21/2	84	36	20/2,1/3	79	36	22/2	80

*S = Single lambs
*M = Multiple births (1/2 = 1 pair twins, 1/3 = 1 set triplets
*T = Total lambs.

Differences between treatments in the number of single and multiple births have not been consistent over the 4 years, the 4 year totals being remarkably similar. The lower fertility of the two-tooth is the most clearly demonstrated feature. The lambing percentage, i.e. the number of lambs docked (approximately 3 weeks of age) expressed as a percentage of all ewes put to the ram over the 4 years has been just over 107% and with the two-tooths excluded 115%.

(vi) WEIGHTS OF LAMBS AT 3 DAYS:

Lambs have been weighed to the nearest 0.5 lbs. on the third day from birth when the fleeces were dry. Owing to the fact that many lambs are born during the night it was not practicable to weigh lambs at birth. Also as is well known true birth weights are difficult to determine and are liable to considerable errors associated with variations in the moisture and amniotic fluid content of the fleece. Also under our conditions there were necessarily varying opportunity for the lambs to suckle before being weighed. Weights recorded during the third 24 hours of life are probably somewhat higher than birth weights, according to Hammond (1932) and Donald and McLean (1935).

Mean "birth weights" by groups classified according to sex and number at birth (triplets excluded) are shown in the following table:-

Table V on next page - 83.

Comparisons between groups are rendered difficult by the variations which occur in the sex ratio and in the number of multiple births. In any one year the numbers of lambs are too small to enable valid comparisons to be made between groups but over the four years there are no consistent trends which would suggest that any of the small differences between the 4 year means are significant and this has been confirmed by analysis of variance using Yate's method of unweighted means for disproportionate sub-class numbers (Snedecor and Cox 1935). The only differences between 4 year means which are statistically significant ($P < 1\%$) are those between sexes and number at birth.

The disparity in numbers between Tables 4 and 5 is due to the fact that lambs dying before 3 days are not included in the latter table and also since 1940 each experimental ewe has not been allowed to rear more than one lamb and surplus lambs have not been weighed unless fostered within the group.

The rearing of twins as singles was decided upon at the conclusion of the first season when it was clearly evident that comparisons between groups, particularly in respect to lamb quality and thrift and also in regard to growth and wool production in the ewe, were rendered difficult in these comparatively small groups because of the additional variance introduced by the presence of the numbers of twins reared. Hammond (1932) has shown that twins reared as singles behave similarly to singles in growth and development.

(vii) LAMB DEATHS:

All lamb deaths have been recorded and are broadly classified in the following table:-

TABLE VI

LAMB DEATHS

	P.1				P.2				P.3				P.4				P.5			
	A	S	DB	D3	A	S	DB	D3	A	S	DB	D3	A	S	DB	D3	A	S	DB	D3
1940	1	-	1	-	1/2	-	1	1	-	1	1/1	-	1	1/2	-	-	-	1/1	-	1
1941	-	-	2	1	-	-	-	1	-	-	-	-	-	-	1	2	-	-	1	2
1942	-	-	2	-	-	-	1	-	-	1	1	-	-	-	-	-	-	1	1	-
1943	-	1/2	1	-	-	-	1/2	-	-	-	2/2	-	-	1/2	-	1/2	-	-	-	-
Total	1	2	6	1	2	-	4	2	-	2	6	-	1	4	1	5	-	5	2	3
Total Deaths	10				8				8				11				10			

(footnote to this table at top of page 84)

Contd.

TABLE V.

WEIGHTS OF LAMBS AT THREE DAYS (4 YEAR MEANS)

	P1				P2				P3				P4				P5			
	S		T		S		T		S		T		S		T		S		T	
	E	R	E	R	E	R	E	R	E	R	E	R	E	R	E	R	E	R	E	R
Weight	10.8	10.9	9.6	11.1	10.7	11.7	9.5	11.8	10.9	11.5	10.2	11.2	10.9	11.8	9.8	10.9	11.7	11.9	10	9.5
Number	21	12	10	13	20	14	14	8	25	16	12	10	19	17	7	14	17	16	11	14
Weight	10.84		10.45		11.11		10.34		11.13		10.65		11.22		10.53		11.80		9.72	
Number	33		23		34		22		41		22		36		21		33		25	
Weight	10.67				10.81				10.96				11.03				10.90			
Number	56				56				63				57				58			

S = Single Lambs

T = Twin Lambs

E = Ewe

R = Ram

A = Aborted or premature birth.
S = Stillborn.
DB = Died at birth.
D3 = Died within 3 days of birth.
1/2 = 1 pair of twins
1/1 = 1 of a pair of twins

Only three lambs have died after 3 days of age, viz., one in P1 in 1940 and in 1943, and one in P5 in 1943. These data are clearly not suggestive of any association between pasture types and lamb mortality.

It It will be noted that over the 4 years, some 5-7 lambs per group have died at birth or within 3 days. This represents a death rate on live lambs born of about 7-8% and is also fairly consistent between groups.

(viii) LAMB QUALITY:

Lambs have been selected for slaughter at a live weight (full) which would yield a dressed carcase (hot) of 34-36 lbs. which is normally a very well-finished but not over fat carcase from a Southdown x Romney lamb reared on pasture and unchecked in its growth.

Some 30 measurements were taken on each carcase after the technique of Hammond (1932) Palsson (1939) McMeekan (1939) and others and the Cambridge Block Test (McMeekan 1939) carried out. The value of carcase measurements for describing objectively body form has been discussed recently by Walker and McMeekan (1944) who have also established important relationships between certain internal and external measurements and carcase composition in terms of muscle, bone and fat. In these trials many measurements were made so that if differences between treatments in respect to meat quality were found these could be adequately described. In all these measurements no significant differences between treatments were found.

Results for a few of the more important or better known measures of lamb growth and quality are presented in the following tables (singles and twins reared as singles only) classified by sexes within treatment groups. Walker and McMeekan (1944) have demonstrated sex effects on the quality of Canterbury lambs and conclude that these are of small dimensions and unlikely to be of major commercial importance. In these trials we have found that sex differences in the same measurements studied by Walker and McMeekan, and in other data collected are of greater magnitude than differences between treatments These results, in view of the findings of Walker and McMeekan, serve to place in better perspective any differences observed between treatments, but have warranted the classification of the data by sexes. The numbers in the subclasses are shown in Table 7 and are the same in succeeding tables. In any one year the numbers are too small to enable comparisons between treatments to be made with any confidence, but the four year means are based on reasonable numbers.

(ix) AGE AT SLAUGHTER:

Hammond (1932) Palsson (1939) Verges (1939) for sheep and McMeekan (1939) for pigs have shown that differences in meat quality between animals are largely attributable to differential growth and developmental changes in the tissues of the body due to varying environmental and genetic influences. Rate of growth therefore assumes prime importance in a study designed to compare the effects of different treatments on carcase quality. In the following table the mean age in days of the lambs at slaughter is given by sexes and groups for the four years.

Table VII continued overleaf

TABLE VII

AGE IN DAYS AT SLAUGHTER.

(Number of lambs in brackets)

	P1		P2		P3		P4		P5	
Sex	E	W	E	W	E	W	E	W	E	W
1940	122.0 (8)	102.0 (2)	137.3 (4)	103.3 (6)	137.3 (4)	106.5 (8)	125.2 (5)	117.6 (7)	136.0 (2)	109.0 (1)
1941	110.2 (10)	103.5 (6)	112.0 (11)	106.6 (5)	113.3 (9)	98.9 (7)	113.6 (8)	103.3 (8)	112.7 (9)	111.1 (7)
1942	120.3 (6)	105.2 (10)	114.6 (10)	94.6 (5)	116.9 (8)	109.3 (6)	109.3 (6)	100.9 (10)	124.0 (7)	94.9 (7)
1943	95.5 (11)	84.2 (5)	88.5 (8)	78.8 (5)	85.0 (8)	87.0 (5)	90.3 (8)	85.8 (8)	91.8 (9)	87.8 (6)
Aver. 4 yrs.	109.4	99.9	110.2	96.2	109.8	101.4	107.9	101.3	110.4	99.0
Number	35	23	33	21	29	26	27	33	27	21

Mean square within sub-classes = 188.9

An analysis of variance of these data establishes the non-significance of small differences between treatments. Differences between sexes and years are, however, highly significant ($P < .01$) as is also the sex-year interaction. Differences between years are largely due to age of ewes but similar data from the manuring trials for seven years indicates clearly that season also plays a not unimportant part.

The production of the highest quality export lambs of 34-36 lbs. dressed weight (68-70 lbs. live weight) in 80-90 days and less, as has been achieved with a large number of lambs over the four years on all treatments is a high tribute to the nutritive value and palatability of ryegrass and white clover pastures and the productive capacity of the stock.

(x) EXPORT GRADE:

The system of grading lamb for export is described in the annual reports of the N.Z. Meat Board (1923) (1940). Grading is based primarily on weight, conformation and "finish" or amount and distribution of fat cover and while the method is arbitrary and may not be an accurate measure of meat quality (Walker and McMeekan 1944) it is maintained to standards by constant supervision and gives a measure of meat quality as defined by the trade. In these trials grading was done by a supervising grader of the N.Z. Meat Producers Board for the first two seasons and thereafter under his supervision. As the carcases were all under 36 lbs. frozen weight they all fall within the same weight grade and there are three grades on quality and in order of merit these are:- Prime Down Cross, Prime Cross-bred and Second Quality.

The following table gives the numbers of carcases in each grade by sexes for each of the five groups for the four seasons.

TABLE 8

FAT LAMB GRADING (4 SEASONS)

	EWE			WETHER			EWE AND WETHER		
	2nd	P	D	2nd	P	D	2nd	P	D
P1	1	7	27	6	8	9	7	15	36
P2	1	5	27	1	10	10	2	15	37
P3	1	7	21	4	11	12	5	18	33
P4	-	7	20	4	2	20	4	16	40
P5	3	9	15	3	9	10	6	18	25

2nd = Second Quality
P = Prime Crossbred
D = Down Cross

Although there is a difference between the sexes in the proportions of different grades which is in line with the findings of Walker and McMeekan (1944) that the ewe lamb has a small advantage over the wether in conformation and fatness, there are no significant differences in the ratio of the different grades in each treatment group. Chi-square determined from the numbers of prime crossbred and prime down cross lambs by sexes in each group yields a non-significant figure (P = 50%). The apparent inferiority of group P5 is not disclosed by the block test results, age at slaughter, or by any of the internal and external carcase measurements some of which are to be shown. This result is, therefore, probably fortuitious and due to the subjective nature of the grading system.

The smaller numbers in group P5 are due to the greater number of twins in this group in the first year which have not been included in this table and the accidental loss of two lambs. Over the 4 year period there has been in each group except P4 the odd lamb which has not been killed owing to failure to reach the live-weight specified. Apart from these all lambs have been killed off the mothers before weaning time, about mid January.

The standard of commercial grade over all treatments is very satisfactory when it is considered that the lambs were picked solely on the basis of liveweight and irrespective of finish. That at heavier weights many of the second quality and prime crossbred lambs would have graded higher is indicated by the performance of the lambs of reserve ewes on these pastures.

(xi) CAMBRIDGE BLOCK TEST:

This test devised by Hammond has been described by McMeekan (1939). Maximum points total 200 divided into 100 for weight suitability and 100 for conformation and finish under various headings and include points awarded on measurement of muscle and fat development in the region of the last rib. Group averages by sexes and years are shown below.

TABLE 9

CAMBRIDGE BLOCK TEST (TOTAL POINTS).

	P1		P2		P3		P4		P5	
	E	W	E	W	E	W	E	W	E	W
1940/1	178.3	176.5	176.8	169.3	176.5	172.0	177.2	173.7	173.0	184.0
1941/2	176.0	174.0	176.6	172.2	173.0	174.6	178.8	173.4	174.8	169.7
1942/3	167.8	164.5	175.6	171.6	169.8	171.7	173.8	170.9	172.0	172.0
1943/4	176.0	177.0	175.1	170.0	173.9	173.0	178.6	173.8	173.7	171.1
Mean 4 seasons	175.1	170.7	175.9	170.7	172.8	172.8	177.3	172.8	173.6	171.6

It is quite clear from the random distribution of the group means in each of the four seasons and the similarity of the 4 year means that treatment effects cannot be demonstrated and this has been confirmed by analysis of variance.

The block test is arbitrary and entirely subjective in respect to points awarded for conformation and shape, and in setting our standards we set them high. Also the 36 lb. lamb automatically loses 8 points on weight suitability, the test defining the ideal weight at 28 lbs. and under. On these grounds it is considered that the means shown in table 9 indicate a very good general average of quality.

(xii) DEPTH OF EYE MUSCLE:

This measurement has an important qualitative significance in studying meat quality and the results of Walker and McMeekan (1944) also show that it is strongly correlated with the muscle:bone ratio in lambs. In table 10 below the mean values for depth of eye muscle (millimetres) by sexes are given for the five treatments.

TABLE 10

DEPTH OF EYE MUSCLE (B).

	P1		P2		P3		P4		P5	
	E	W	E	W	E	W	E	W	E	W
1940/1	32.4	32.0	31.8	32.7	31.3	31.6	30.6	30.9	31.0	35.0
1941/2	30.5	30.7	31.6	30.8	28.4	33.4	31.5	29.6	31.0	29.7
1942/3	27.3	26.0	30.2	29.2	28.6	27.5	28.0	29.4	28.3	27.9
1943/4	31.6	31.2	32.5	29.4	31.3	31.5	32.0	30.5	31.3	31.1
Means 4 seasons	30.7	28.9	31.4	30.6	29.7	31.2	30.7	30.0	30.4	29.8

The lack of trends in these data is clear and analysis of variance has confirmed the lack of significance of differences between means of treatments. Sex differences are, however, highly significant, as are also differences between years.

These values for a comparatively late developing character are good by commercial standards and very good when the comparative immaturity of these lambs is taken into consideration.

(xiii) DEPTH OF FAT OVER THE EYE MUSCLE:

This is one of the best measures of "finish" in lambs and is strongly correlated with commercial grade. The optimum is about 5 mms. and it will be seen in table 11 below that in these lambs the ideal has been very closely approached.

TABLE 11

DEPTH OF FAT OVER EYE MUSCLE (C).

	P1		P2		P3		P4		P5	
	E	W	E	W	E	W	E	W	E	W
1940/1	4.3	5.0	5.5	3.8	4.8	3.4	4.0	3.9	3.5	5.0
1941/2	5.5	5.0	5.2	4.2	5.4	4.4	4.8	4.6	4.0	3.4
1942/3	4.3	2.4	4.4	2.8	4.1	3.5	5.0	3.8	3.3	4.3
1943/4	4.7	4.8	4.5	4.2	5.4	3.7	4.9	3.9	4.4	3.6
Mean 4 seasons	4.8	3.8	4.8	3.8	5.0	3.7	4.7	4.0	3.9	3.8

Analysis of variance shows that sex and year differences are highly significant but differences between treatments are non-significant.

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2. MANURING TRIALS:

This trial was laid down at the same time and adjacent to the strain trial. The same layout was used and stock and pasture management was identical at all times except that in this trial there were five replications of each of five treatments mentioned below, therefore a five day rotation, and each experimental flock consisted of 20 sheep.

A simple seeds mixture consisting of certified mother seed perennial ryegrass 40 lbs., certified mother seed white clover 2 lbs., was used throughout and the following are the details of the five manuring treatments:-

Treatment 1 (M.1.):

One cwt. of superphosphate per acre per annum. It was considered that this was the minimum quantity of fertiliser and the kind most likely to maintain a pasture in which ryegrass and white clover would be dominant species.

Treatment 2 (M.2.):

Four cwt. of superphosphate per acre per annum. It is not uncommon for farmers to attribute various stock ailments to the consistent use of heavy dressing of super. Difficulties of management of pasture associated with the rapid spring flush resulting from the use of super are also experienced. Consequently it was decided to use a dressing 50% to 100% heavier than normally used in order to accentuate any possible effects of super.

Treatment 3 (M.3.):

Four cwt. of basic slag per acre per annum. Slag topdressed pastures are generally said to be relished by stock and easier to control than super topdressed pastures, there being a rather less intense spring flush. Also the "minor" elements in basic slag are often credited with an effect on the health of stock which has been neither proved nor disproved. The quantity stated was applied with the idea of accentuating any of these benefits and also to ensure a total quantity of phosphate reasonably comparable with that of 4 cwts of super. It was anticipated, too, that the "lime value" of slag, approximately equal to its own weight of ground limestone, would manifest itself.

Treatment 4 (M.4.):

Four cwt. of super per acre annually plus an initial application of 2 tons of ground limestone and 5 cwt. annually thereafter. The soil is rather acid in its natural condition and the quantity of lime applied was designed to demonstrate the effect, if any, on the thrift of stock resulting from an increase in the lime statics of the soil and the increase in calcium in the herbage.

Treatment 5 (M.5.):

As for treatment 4 plus 2 cwt. of 30% potash salts per acre per annum. When potash fails to give an impressive effect on quantity of herbage produced, its virtues in improving "quality" and hence thrift of stock are extolled. The fairly liberal application of 2 cwt. of 30% salts was introduced to test the validity of this contention.

RESULTS:

Precisely the same records have been kept in this trial as in the strain trial and similarly no significant differences between treatments have been demonstrated except with regard to carrying capacity. In all cases results have been of the same order and almost identical with those for the strain trials. This series has now completed its seventh year having been restocked with 2 tooth sheep from the same source again in 1944. As a result of slightly larger groups (20 sheep) and repetition over a longer time, the complete lack of differences between treatments is more clearly demonstrated than in the case of the strain trials. In view of the limited time available, it would serve no useful purpose to present a selection of these results except carrying capacity and the growth curves of the ewes for the first 4 years.

(i) PASTURE PRODUCTION IN TERMS OF CARRYING CAPACITY IN EWE UNITS:

As in the case of the strain trials the carrying capacity of each plot has been recorded daily and stock carried has been reduced to ewe equivalents on the same arbitrary basis. The carrying capacity of each treatment is summarised in table 12.

TABLE 12.

CARRYING CAPACITIES IN EWE EQUIVALENTS (EE) BY QUARTERLY PERIODS.

1940 - 1943 incl.

	M.1	M.2	M.3	M.4	M.5
March - May, 1940	11.2	11.2	11.5	10.7	11.1
June - Aug. 1940	4.1	4.1	4.1	4.1	4.1
Sept. - Nov. 1940	9.9	10.5	10.0	10.0	9.8
Dec. - Feb. 1941	5.0	5.3	5.3	5.2	6.8
Average 12 months	7.6	7.8	7.7	7.5	7.9
March - May, 1941	9.9	10.0	10.8	10.9	11.3
June - Aug. 1941	4.0	4.2	4.2	4.3	4.6
Sept. - Nov. 1941	8.7	8.6	9.0	10.8	11.2
Dec. - Feb. 1942	9.8	10.2	10.8	11.1	11.2
Average 12 months	8.1	8.3	8.7	9.3	9.6
March - May, 1942	8.8	9.2	8.7	9.6	9.8
June - Aug. 1942	4.0	4.0	4.1	4.3	4.3
Sept. - Nov. 1942	11.1	15.6	16.2	18.0	17.9
Dec. - Feb. 1943	8.8	10.1	10.2	11.5	11.6
Average 12 months	8.2	9.7	9.8	10.9	10.9
March - May, 1943	9.0	8.6	9.1	9.3	9.3
June - Aug. 1943	4.0	4.0	4.2	4.6	5.1
Sept. - Nov. 1943	11.5	12.3	12.8	13.9	13.7
Average 12 months	8.1	8.2	8.6	9.1	9.1
Average for 4 years	8.0	8.5	8.7	9.2	9.4

The only differences which are not statistically significant over the 4 years are those between M.2 (4 cwts. super) and M.3 (4 cwts. slag) and between M.4 (super and lime) and M.5 (super and lime and potash). The effect of heavy dressings of fertilisers in accentuating the seasonal nature of pasture production is clearly seen. This has been even more clearly defined over the past 3 years when the M.1 plots (1 cwt. of super) have shown a tendency to decline in carrying capacity along with a noticeable increase of flat weeds, annuals and brown top, while the lime plots in particular (M.4 and M.5) have shown an increase in production.

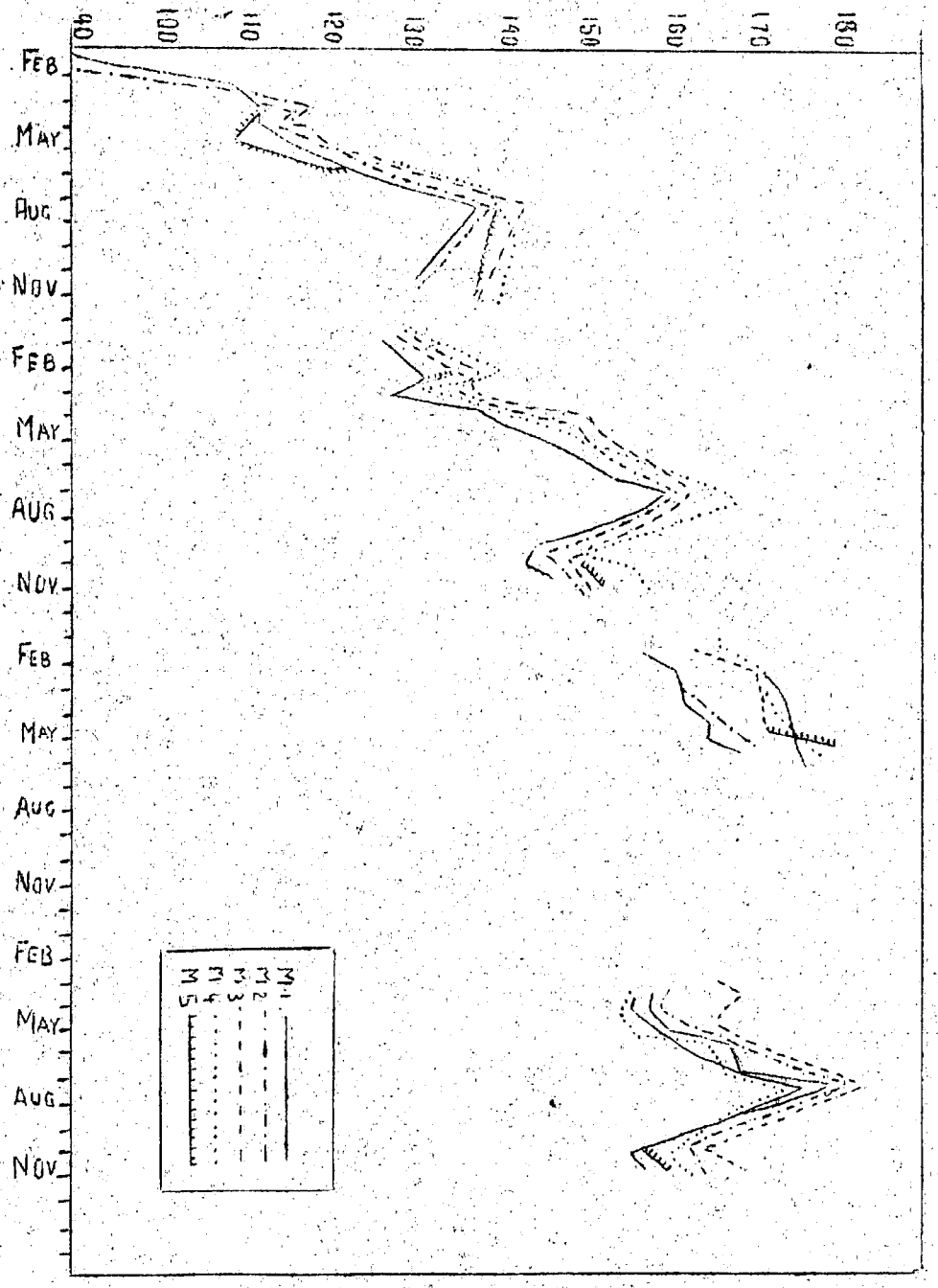
The same difficulties were encountered in keeping the pastures controlled as were met with in the strain trials. It is important to note that in the case of the M.3 plots (slag) the resultant pasture appears to be more evenly grazed at all times. Very marked differences between any of the other plots in this respect have not been observed although over the last two years the lime plots also (M.4 and M.5) have shown evidence of more even grazing. If this evenness of grazing is indicative of greater palatability no effects whatever have been noted on the growth and production of the ewes and lambs, to suggest differences in appetite. As in the case of the strain trials the problems of control and utilisation were proportionately more difficult with the higher producing pastures.

(ii) LIVE WEIGHT CHANGES IN EWES.

As in the case of the strain trials regular weighings of the ewes have been made. The mean weights by groups at approximately monthly intervals from February to August and again in November are shown below. Owing to war conditions the data for 1942 are incomplete.

(Fig. 1 on next page)

FIG. 7 - LIVE WEIGHT - LBS.



It is clear that differences between groups are most inconsistent and non-significant.

It is not pertinent to this discussion to discuss the shape of the curves, but it is interesting to note the rapid rate of growth, and the high mean live weights which have been attained subsequent to the first year, and which indicate the high condition of these ewes which has been referred to in connection with their fertility. When the weight of foetus, membranes and fluids is allowed for it is clear that there has been no loss of condition between August and November. Between November and February in each year wool averaging 13.3, 11.9, 12.3 and 11.2 lbs. per sheep has been removed.

SUMMARY AND GENERAL DISCUSSION OF MANURING AND STRAIN TRIALS:

Most careful consideration of all the results, some few of which have been presented in this paper leads to the conclusion that insofar as thrift and productivity of ewes and lambs are concerned, under the environmental conditions and system of management obtaining, there have been no differential effects, that could be demonstrated from the various pastures and manuring treatments under trial.

Effects there may well be, however, but if so, they are of small order and unlikely to be of any great commercial importance. We certainly have no evidence to support contentions such as those raised in the opening sections of this paper.

Considering the trials as a whole, production has been of a high order as judged by the number of stock carried, wool production, the growth of ewes and lambs, and the quality of the lambs; bearing in mind in the case of the latter, the restrictions imposed by the method of selection on a live weight basis. Even so, in some seasons over 80% and in one season (1944-5) 97% of the lambs were of highest grade (Down cross) and over the seven years the average has been just under 75%. In the first year the incidence of goitre in lambs on all treatments was high and resulted in a higher death rate at birth, and poorer quality in general. Since that year the trouble has not manifested itself, although the thyroid glands are somewhat heavier than normal.

In addition to evidences of high thrift which have been previously mentioned, it is very pertinent to note that throughout the seven years of these trials, dagging of ewes and lambs has not been necessary. For the first month or so after the two-tooth ewes were introduced to the pastures some dagging of ewes was carried out and very occasionally a lamb has required attention. This freedom from scouring is no doubt due to the fact that the quality of the pasture is kept at a very uniform level under the system of management adopted. Drenches have not been used for either ewes or lambs at any time except that in two seasons two or three lambs not killed by weaning time were drenched as a matter of course by the shepherd. The growth rate of the sheep and the lack of a "tail end" to the lamb crop as well as the complete absence at all times of any of the usual symptoms, is to be regarded as evidence of comparative freedom from internal parasites. Also in the 1940 season in 138 lambs slaughtered, counts made of the worm populations in the stomachs and small intestines showed the level of infestation to be of a low order for Ostertagia, Cooperia, Nemotodirus, and Trichostrongylus axei, the latter not being found in the majority of lambs (Tetley 1945). While it is recognised that parasitic troubles in lambs are relatively unimportant our freedom from noticeable trouble in all stock over the seven years is certainly above average in this district for the same classes of stock and is probably attributable to the consistently high level of nutrition. The extent to which pasture control, the use of cattle and also the prevention of excessively close grazing has played a part by its effects on the intermediate stages of the parasite is a matter for conjecture.

The least satisfactory results in these trials have been with reference to fertility in the ewes and deaths in the lambs. Over the 7 years in all experimental sheep the number of dry ewes has averaged 10% and excluding the two-tooth ewes, 8% of the ewes put to the ram. There is a lack of satisfactory standards with which to make comparisons but in cast for age ewes off hill country mated to Southdown rams on the College farm the number of dry ewes has averaged 7% over a ten year period. In several Romney studs from which reliable information was available, the figure has been 10-12% on the average. None of these cases quoted, however, are quite comparable, but serve to indicate that in these trials the number of dry ewes is not excessively high and one wonders to what extent the high condition of the ewes has influenced fertility.

In regard to lamb deaths it is again difficult to determine the situation obtaining in commercial flocks. In one stud flock over approximately the same time the average loss has been just under 14% of all lambs born, and in one grade Romney flock for which accurate figures were available the death rate on the same basis for the years 1941-44 has ranged from 8-15% with an average of 11%. In these trials (over 7 years) the rate has averaged 11.9%, and 9.7 with the two-tooth ewes excluded and less than 1% of these deaths have occurred after 3 days of age. In the first year thyroid hypertrophy was held responsible for a number of the deaths but the cause of death in the majority of cases could not be diagnosed. In commercial flocks the annual loss of lambs is probably very considerable and in only a

few cases is its magnitude realised.

Over the seven years the death rate in ewes has averaged 5.6% which is slightly less than the rate in somewhat comparable commercial flocks for which information has been available.

Lambing percentage calculated as the number of lambs docked as a percentage of the ewes put to the ram takes account of losses mentioned and is a figure more commonly kept by farmers. In these trials over the seven years the lambing percentage has averaged nearly 106% and with the two-tooth ewes excluded 115%, which is probably not below average for comparable cases.

A commonly heard criticism of ryegrass-white clover pastures is that they are relatively unpalatable. In these trials the sheep have at all times been confined to their own particular plots and have had no opportunity to show any preferences. They have apparently had similar appetites on all treatments judging by the uniform results for growth and production and pastures have been evenly grazed. It has been mentioned that the slag and the lime plots appeared to be more evenly grazed, but differences were small and at no time very obvious.

Over the seven years we have had no experience of rust on the ryegrass, or the effects of a dry season such as experienced in Hawke's Bay and Canterbury. At all times pastures have remained green and continued to grow.

Pasture control has aimed on the one hand at keeping the herbage below about 3-4" high, and on the other, at preventing overgrazing. This has been achieved in general, but in some plots areas of rank growth did occasionally develop. It was noted that sheep after grazing tended to congregate in one or more groups to rest and ruminate. In an isolated flat paddock such camping places seemed to be chosen at random except that shelter or shade might be sought. When, however, two paddocks adjoined, the tendency was for the sheep in each paddock to draw to the common fence to camp. Pasture growing on these areas tended to become rank and unpalatable and uneven grazing resulted. Similar conditions have obtained in paddocks adjoining roads subject to regular traffic where the sheep after grazing tended to camp as far from the road as possible.

Areas of ranker growth were impossible to control with sheep when alternative shorter grazing was available. Folding sheep on these areas with hurdles was tried but with poor results and when cattle were not available, mowing had to be resorted to. The amount of mown grass was seldom sufficient to warrant removal, and apparently it becomes more palatable after mowing since the bulk of it is consumed by the stock.

These are the only observations offered on the question of palatability. The more vigorous the growth either as the result of strain or fertilisers, the more difficult was the problem of even control. Irrespective of strain or manuring treatment, however, well controlled pasture was apparently very palatable and invariably evenly grazed.

In these trials pasture control approaching the ideal has been achieved by drawing upon additional stock kept solely for the purpose and over six ewes with lambs and up to 3 yearling beasts per acre have been used in the spring. In the use of cattle the ideal would be to introduce them gradually from the commencement of the spring flush so that all growth is kept under control. Even under these experimental conditions although light cattle were available a compromise had often to be made between pugging the turf and effecting adequate control in the early spring, and this in spite of particularly intensive drainage.

Under commercial farming conditions control such as achieved with these small experimental paddocks is probably never attained largely because of economic factors. To what extent inadequate con-

trol and consequent deterioration in digestibility, nutritive value and palatability is responsible for the unfavourable criticism often heard of such highly productive pastures remains a matter yet to be investigated. We conclude from the trials reported that under the particular environmental conditions such pastures adequately controlled are highly satisfactory for ewes and lambs.

ACKNOWLEDGMENTS:

Acknowledgment is made to Professor G.S. Peren, Mr. E.B. Levy, Mr. F.R. Callaghan and Mr. A.W. Hudson for their work and enthusiasm in the planning and laying down of these trials and for their continued interest and support, and also to Mr. G.S. Wilson who has managed these trials from the outset. The collection and analysis of data has called for co-operative effort and acknowledgment is made to all who have assisted, in particular Messrs. G.S. Wilson, R.A. Barton, A.L. Rae and the late E. Gould.

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DISCUSSION ON MR. CLARKE'S PAPER:

DR. FILMER: I think that this paper should in some way have been given more prominence on our agenda. I believe that it describes one of the most outstanding experiments in animal research that has so far been done in New Zealand. I would like to draw attention to the design of the experiment. We have for the first time had a really well designed paddock experiment. In his introduction Mr. Clarke pointed out that our knowledge is not nearly sufficiently complete to allow us to assess pastures by their chemical composition or by any other system that can be measured by laboratory methods. We have to submit them to the test of the animal. Mr. Clarke and his co-workers have been able to design an experiment which submits the work of the agrostologist to the judgment of the ewe and lamb, and still preserve that design which the mathematician tells us is necessary to obtain significant results. I wish to congratulate them on their work.

MR. LYNCH: One point I would like to ask is whether the paddocks concerned were predominantly ryegrass-white clover or whether there were any measurable proportions of other grasses?

MR. CLARKE: The pastures were predominantly ryegrass-white clover although Poa triveatis and Poa annua were noticeable after a wet season. On the one cwt. of super plots flat weeds, brown top and annuals are becoming more evident each year. Although the pasture would still be described as dominant ryegrass-white clover.

MR. CRAWFORD: Were any observations made as to the number of ewes cast? Ewes cast very much more on topdressed paddocks and where shepherds can get round only once a day it can be a considerable loss in hill country which is topdressed.

MR. CLARKE: No ewes were lost from that cause. It would not be expected under the intensive conditions. The ewes were always in a very thrifty condition and very few cast ewes were seen. There was a daily shift which involved crossing a gully to give them exercise. They were very vigorous sheep at all times except just at lambing times.

MR. SWAN: Mr. Clarke said he would tell us something about the measures for foot rot control. I was interested because of its relation to ketosis in ewes.

MR. CLARKE: The reference was with regard to the relationship between foot rot and ketosis. Eleven out of twelve cases of sleepy sickness had severe foot rot. Before commencing the experiment we went over the sheep very carefully and even scrubbed the feet so that a thorough inspection could be made and sheep with any signs of the trouble were culled. We had no cases of foot rot for eighteen months and then an outbreak occurred with which was associated a loss of ewes from ketosis. We again eliminated the trouble and the sheep were free for another twelve months when an outbreak occurred. It is a small area surrounded by property where foot rot is very prevalent so it is not surprising that we did get foot rot in. Strict quarantine of the area did not prove to be feasible.

MR. DUNCAN: What was the effect of these conditions on the wool? Was the crimp unusually even?

MR. CLARKE: There was nothing unusual about the wool. It was just good average cross-bred wool. One of the disappointing things was that though the fleeces averaged 13 lbs. in the first year and declined only slightly each year there was nothing very even about the crimp. It was clean and well grown wool apart from slight breaks but the character was not of a very high level.

MR. CRAWFORD: Your figures give deaths only. Were there many cases in which treatment was necessary for milk fever in ewes and have you a record of those that required assistance at lambing?

MR. CLARKE: The number of ewes assisted at lambing did not amount to very many. There were quite a number of two-tooth ewes that were assisted to lamb. In the older sheep assistance was seldom required apart from those which had bearing trouble. There may have been an odd case of milk fever but none have been treated and there have been no deaths from this cause.

MR. McGUINNESS: Did Mr. Clarke find the incidence of bearing trouble to be greater there than on the rest of the college farm?

MR. CLARKE: No. The incidence was no greater. For the first year we were quite free but in subsequent years we did get cases. Over the seven year period, approximately 50% of the losses have been due to bearing trouble and sleepy sickness - sleepy sickness has been responsible for slightly the greater loss.

MR. FIELD: Was any treatment carried out on ewes which experienced bearing trouble?

MR. CLARKE: No treatment other than the usual practice was carried out.

DR. WALLACE: Did any ewes that were lost with sleepy sickness carry twin or triplet lambs?

MR. CLARKE: Yes. Some were carrying singles and some were carrying twins.
