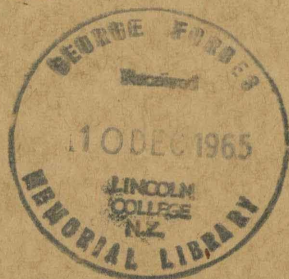


LINCOLN COLLEGE

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SHEEP BREEDING *in* NEW ZEALAND



The Ram Breeding Flocks



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Introduction

Improvement in both the quantity and the quality of sheep products has attracted the attention of investigators working on the problems of inheritance in sheep during the past twenty-five years. The knowledge gained from these investigations has received only limited application in some special aspects of sheep breeding. The wider use of the information available still awaits practicable methods of application.

Unlike the improvement of farm crops which, in New Zealand, has been for some time considered a national undertaking, carried out in well-equipped breeding stations which are staffed with skilled workers, the improvement of farm livestock is still left to the initiative and the resources of the individual stock breeder.

Such has been the case with the British breeders of stock since the evolution and consolidation of the improved British breeds. The foundation of the earliest of these breeds now dates back about 200 years but their present-day characteristics were developed at a much later date. Since some of these are the breeds round which our interest centres it is worth while briefly to review their evolution.

The work of the foundation breeders and those who followed them conforms to a common pattern. The original selection of those animals from amongst the mixed local sheep population which gave the best results in the local environment and which satisfied a market demand for quality, was followed by breeding programmes which invariably resulted in intensive inbreeding and a selection policy which had ruthless culling for its keynote. The extent of the next step, multiplication, depended upon the suitability of the breed for use outside the local boundaries. Some breeds multiplied rapidly and soon attained world-wide distribution while others are still confined to the districts of their origin.

With the consolidation of a breed came the formation of a "Breed Society" and the voluntary acceptance of rules which restricted the breeding programme of members to animals within the group recognised as pure by the Breed Society. That the breeders made a good job has never been seriously questioned but a full realisation of the magnitude of their work has come only in recent times when even skilled investigators have experienced considerable difficulty in affecting any further appreciable and permanent improvement in the production characters of our live-

stock. When we remember that the stock breeders were guided only by the rules of trial and error and not by a knowledge of the nature of inheritance, their work is even more commendable.

Investigators, slowly but surely unravelling the manner of inheritance of all sorts of animal characters and at the same time working on the improvement of all kinds of livestock since the early years of this century, have given us valuable general conclusions. These conclusions applied to breeding methods and selection policies can result in raising the average production qualities of our farm stock. Stock breeders have not always treated the investigators or their findings with the respect and importance to which they are entitled. Certainly most investigators are not stock breeders in the accepted sense of the term but many of them have a full appreciation of the problems confronting the breeder. What is even more important, they are all armed with an understanding of the vagaries of inheritance and have been trained to observe accurately and to measure precisely.

The general conclusion of these workers is that the inheritance of production characters such as fleece, carcase and butterfat is of a complex, not simple, nature. Selection of breeding stock for improvement in these things can be certain only if based on the accurate measurement of these qualities in the progeny. Such a selection policy based on such measurement is termed the "progeny test." Its use takes us back to the celebrated founders of the improved British breeds. Bakewell, of English Leicester fame, based his breeding plan on exactly this method of selection. His policy of hiring out rather than selling his rams enabled him to regain for his own use those rams which proved themselves the sires of the best progeny. Although he and his successors based their judgments on visual and casual observations on individual animals, the long-continued use of the progeny test accompanied by inbreeding and severe culling did much to reduce the variability of characters which had even the complicated inheritance of fleece and carcase. In the words of a present-day investigator, "The persistent, long-continued chipping at even the more difficult characters has so reduced their variability that the adoption of progeny tests based on precise measurements is the only hope for further improvement."

As yet individual breeders and breed societies have shown little inclination to make full and widespread use of such a test as the basis for selection, while sheep improvement as a national undertaking comparable with plant improvement has received no attention at all. Since the

average quality of the sheep in this country, or in any sheep producing country, depends primarily on the average breeding quality of the rams supplied to the grade flocks of the industry, a critical examination of the "ram breeding" flocks will reveal to what extent the recommendations of the investigators can find practical application.

Ram Breeding or Stud Flocks

The ram breeding flocks supplying rams to the industry are owned mainly by the members of a Breed Society and are known generally as "Registered Flocks" or "Stud Flocks." Although each major breed has its own society, the various societies have similar aims and almost identical rules and articles of constitution. From time to time the societies are subject to criticism which is generally based on their failure to tackle the problem of breed improvement along lines in agreement with the modern conception of the inheritance of production characters. It is important to remember, however, that these societies are voluntary organisations composed of active breeders and that their first concern is to preserve the breed. This objective is attained by insisting that all rams used in registered flocks must be "single-entered" with the society. To secure "single-entry" a ram must have been bred in a registered flock and must be of known parentage; that is, it must have a pedigree. The ewes of the registered flocks are subject to compulsory inspection by the society only if transferred from registered flock to registered flock. It is true that in some breeds there is provision for voluntary inspection of young ewes about to enter the flock. In other breeds the compulsory culling of 10 to 20 per cent. of young ewes is demanded but as this percentage is usually based on the number of ewe lambs marked it can be ineffective by the time the one-shear stage is reached.

With the exception of those about to be exported, in no case is there any inspection of rams by the breed society, irrespective of whether they are to be sold or retained for use in the flock of the breeder. On one occasion a society did introduce a voluntary ram-inspection scheme but withdrew it after one season. Such inspections of rams as are carried out are left to the Agricultural and Pastoral Associations which conduct annual ram fairs. This inspection is limited to those rams offered for sale as flock rams. It is customary for such inspections to be carried out by an inspector recognised by the society concerned.

The second aim of the society is to encourage improvement within the breed. The method of securing improvement is left to the devices of the individual breeder but

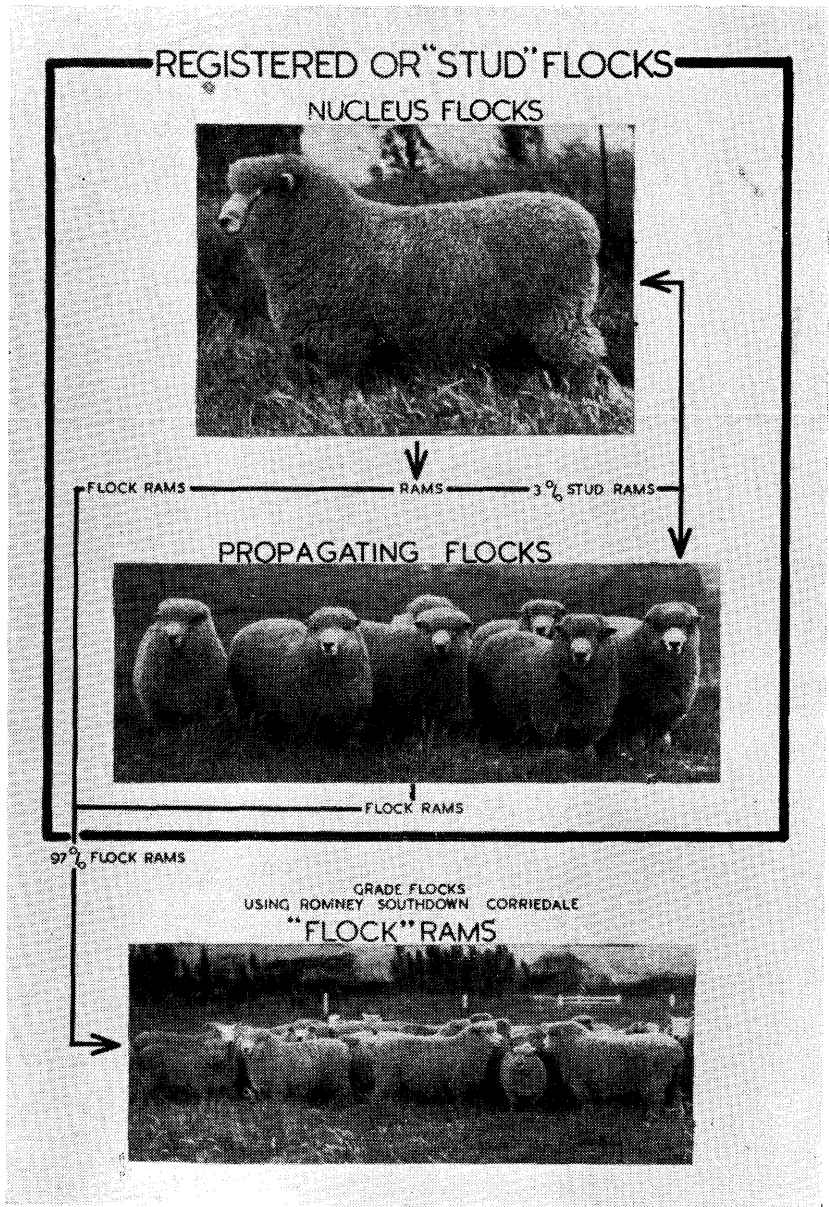


Figure 1

encouragement is given along traditional lines by offering special prizes at shows and fairs for outstanding individual animals of the breed.

Finally, the breed society collects from breeders annual "Flock Returns" which are published as the official "Flock Book" and which form the official history of the breed. It is from this source that the material used in the following parts of this bulletin has been obtained. Perhaps then, there is little foundation for the criticism frequently levelled at the societies. Within the limits of their finances, which are contributed solely by members, and within the limits of the resources of their individual breeder members they accomplish, in the main, what they set out to do.

Although all registered flocks are generally referred to as "stud" flocks there is recognised in practice a nice distinction between those flocks which supply the annual ram replacements of the registered flocks and those which supply the replacement needs of the grade flocks. On this basis registered flocks in each of the breeds can be divided conveniently into two broad groups. In the first group are those flocks which single-enter, for use in registered flocks, a high proportion of the rams they breed but which also supply a limited number of "flock rams" to the grade flocks. Such flocks are the "nucleus" flocks of the breeds. In the second group are those flocks which register few or no rams but which concentrate on breeding replacement rams for the grade flock owners. These flocks can be correctly termed "propagating" flocks.

This organisation of ram breeding is illustrated in Figure 1.

There is one further source of supply of rams for grade flocks; these are the purebred but unregistered flocks. Since there is no accurate information available as to the size and distribution of these flocks this source of supply has been disregarded in the discussions which follow.

The Trend of Sheep Breeding in New Zealand

Before passing to a critical examination of the ram breeding flocks it is important to observe the general trend in numbers of the grade sheep of the industry. These have shown a steady increase in the number of ewes mated from 11,570,000 in 1920 to 20,866,000 in 1945, as is illustrated in Figure 2.

This increase in ewe numbers has demanded a corresponding increase in the ram output of the registered ram breeding flocks. The ways in which the increased ram output has been obtained are shown in Table 1 and are graphically illustrated in Figures 3, 4 and 5.

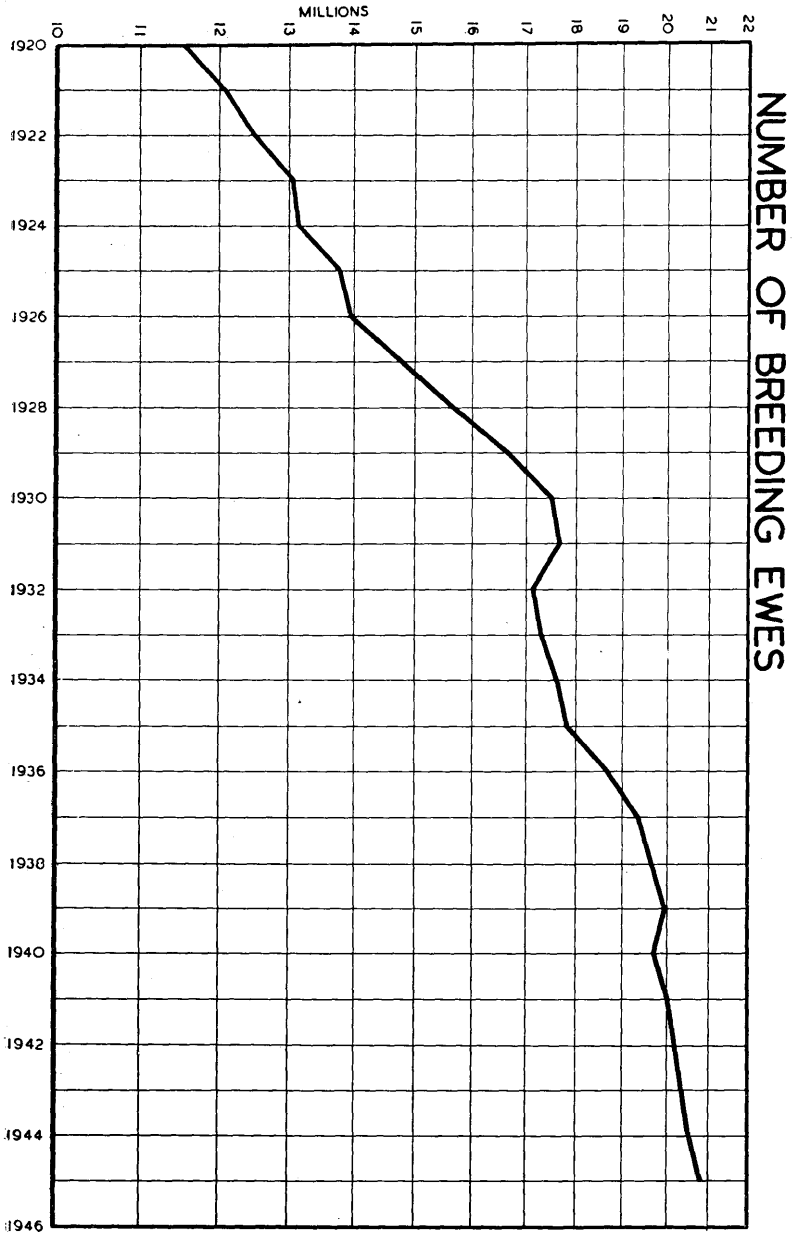


Figure 2

Table I**REGISTERED RAM BREEDING FLOCKS**

Showing numbers of Registered Flocks, Ewes Mated, and Average Flock Size.

Romney Marsh

Year.	No. Registered Flocks.	No. Ewes Mated. (1000's)	Average Flock Size. (Ewes)
1920	600	89	148
1925	600	95	158
1930	630	104	165
1935	553	102	184
1940	757	124	163
1945	836	153	183

Southdown

Year.	No. Registered Flocks.	No. Ewes Mated. (1000's)	Average Flock Size. (Ewes)
1925	399	29	72
1930	593	47	79
1935	700	64	91
1940	840	85	101
1945	1056	106	100

Corriedale

Year.	No. Registered Flocks.	No. Ewes Mated. (1000's)	Average Flock Size. (Ewes)
1925	122	23	189
1930	170	28	165
1935	150	27	180
1940	185	30	162
1945	147	27	163

The figures in these tables indicate a rapid and progressive increase in the number of flocks and the number of ewes mated in the Southdown breed and to a lesser extent in the Romney Marsh. On the other hand Corriedale numbers have remained fairly steady. The consequent limited selection or culling of ewes in the breeds which have shown such spectacular increases in the number of ewes mated (see Figure 4), might be regarded as leading to deterioration in the general quality of these breeds. Conversely, the relatively steady Corriedale numbers which

NUMBER OF FLOCKS

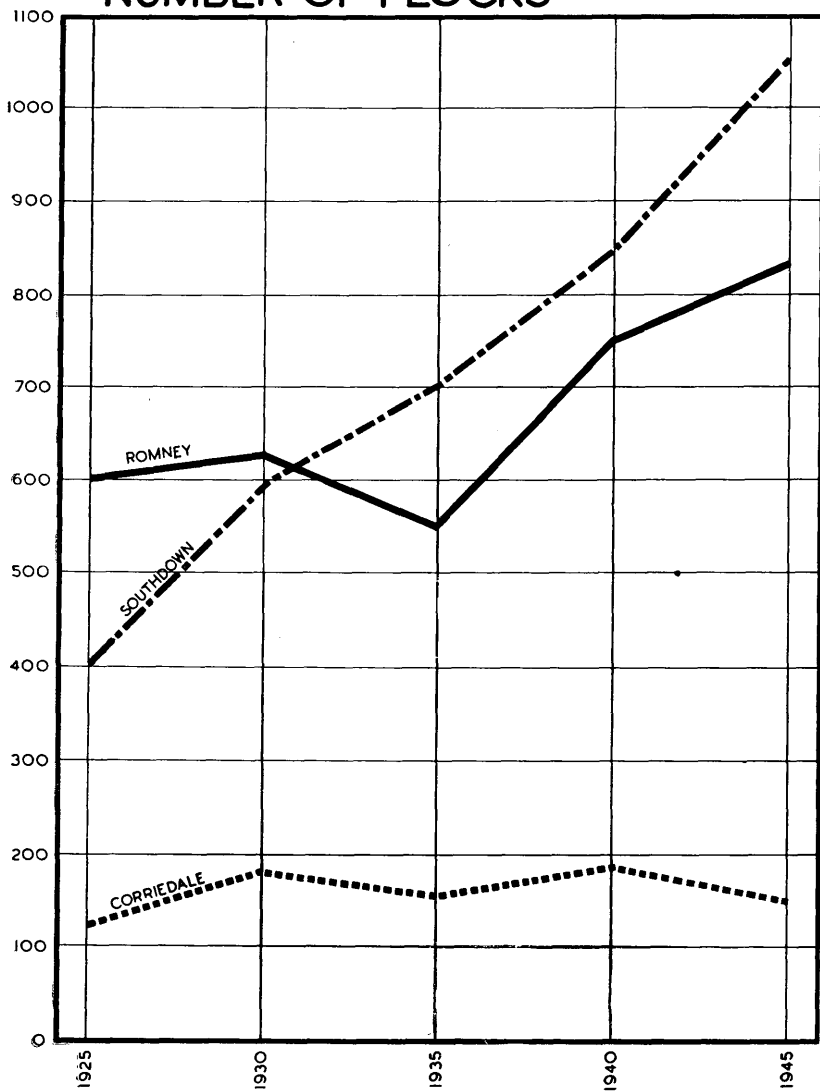


Figure 3

indicate a heavy annual selection or culling might also be interpreted as resulting in appreciable breed improvement. There is much evidence, however, that neither interpretation is correct and that the average quality of each of the breeds has remained stationary. Many investigations bearing on this point have shown that ewe selection based on the retention of the daughters of the best breeding sires is a very slow means of improving the average quality of a flock and, therefore, more so in the improvement of a breed. The usual method of ewe selection based on visual judgment of the individual ewe gives even smaller benefits. Under these methods of selection, therefore, both the flock average and the breed average for such characters as fleece and carcase tend to remain stable irrespective of whether reduction or expansion of breeding ewe numbers is taking place.

The average flock size has remained fairly steady, varying only from 148 to 184 in Romney flocks; 72 to 101 ewes in Southdown flocks and 162 to 189 ewes in Corriedale flocks. It will be observed that the average flock size is small. A better picture of actual flock sizes, however, is obtained from a grouping of flocks based on the number of rams used (Table 2 and Figure 6).

Table 2
REGISTERED RAM BREEDING FLOCKS

Showing flocks grouped according to number of rams used.

Breed.	Romney.		Southdown.		Corriedale.	
	No. of Flocks.	% of Total.	No. of Flocks.	% of Total.	No. of Flocks.	% of Total.
1-3	405	58	628	78.7	112	66.3
4-10	225	32	157	19.7	47	27.8
11-20	56	8	13	1.6	6	3.6
21-40	14	2	—	—	4	2.3
	700	100.0	798	100.0	169	100.0
Av. No. Rams per Flock	3.3		2.6		3.9	

It will be observed that on the basis of this grouping 58 per cent. of Romney flocks, 78.7 per cent. of Southdown flocks, and 66.3 per cent. of Corriedale flocks use only three or fewer rams each year. Such flocks are clearly too small to develop a selection and breeding policy which would give any surety of improvement. They are the "propagating" flocks of the breeds.

The number of flocks in each breed using more than

REGISTERED EWES MATED

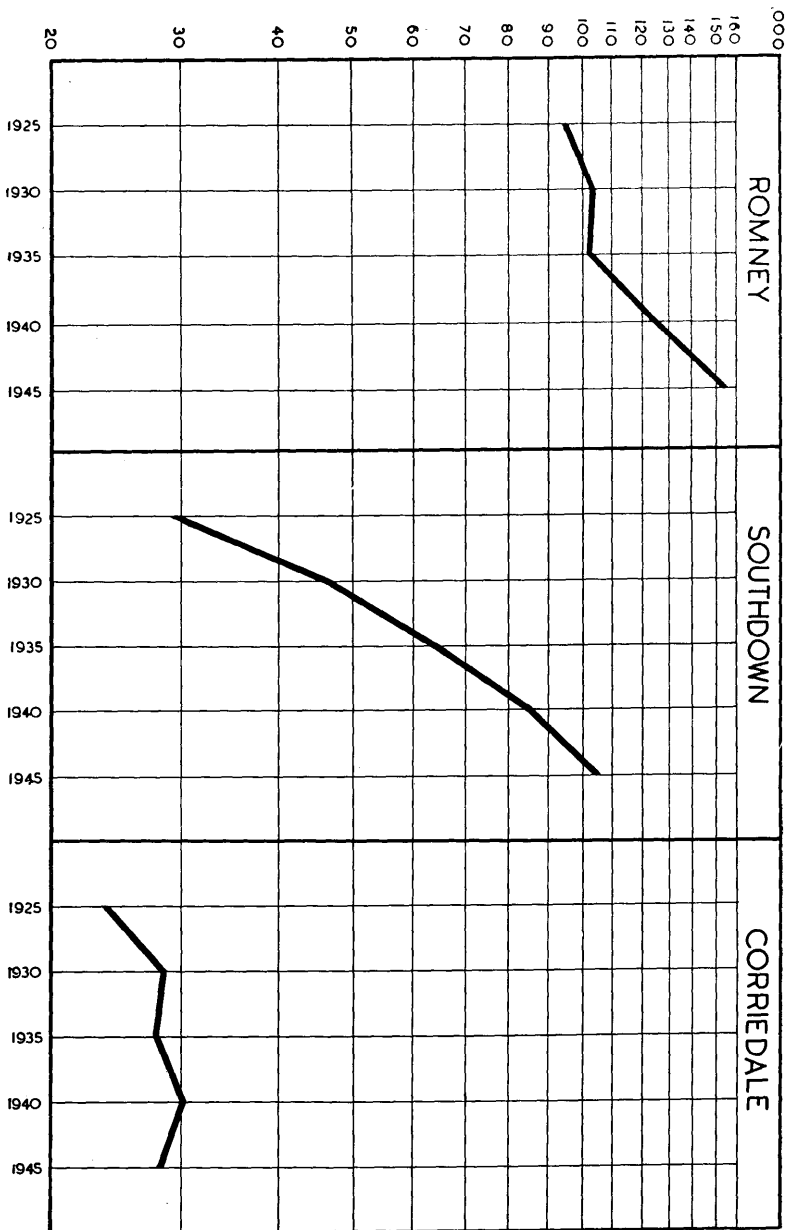


Figure 4

ten rams, and consequently large enough to attempt improvement on the basis of progeny testing, is very small—70 Romney flocks, 13 Southdown flocks and 10 Corriedale flocks. Some, but not all, of these flocks are in the “nucleus” group to which we have already referred, and which we will discuss more fully in later sections.

Single-entered or Stud Rams

As already pointed out, rams used in registered flocks must be single-entered with the society. The prerequisites for single-entry, that the ram must be bred in a registered flock and be of known parentage, and that no inspection is imposed, have already been stressed. These rams are the “stud” rams of the industry.

The number of ewes mated in one year to produce one single entered ram in each of the three breeds is shown in the following table:

Table 3
REGISTERED RAM BREEDING FLOCKS

Ewes mated to produce one single-entered ram.

Breed.	No. of ewes mated.	One shear rams S.E. from this mating.	No. of ewes mated to produce one S.E. ram.
Romney	124,320	1702	73
Southdown	85,550	776	110
Corriedale	29,960	392	76

The number of ewes required to produce one single-entered ram in each of the three breeds shows surprising agreement. These one-shear single entered rams are the young stud rams which are retained for use in the registered flocks. The numbers quoted in the table:—1702 Romney, 776 Southdown, and 392 Corriedale Stud rams—represent 2.5 per cent. to 3.0 per cent. of the total number of one-shear rams available for distribution in the season under review. This proportion, although fluctuating slightly from season to season, is nevertheless common to sheep breeding countries. The remaining 97 per cent. of the rams are available to the grade flocks and are the “flock” rams of the sheep industry. It has been pointed out that there has been a considerable increase in registered flocks in terms of both numbers of flocks and numbers of ewes mated, and it has been emphasised that this, if nothing else, could prevent any effective improvement by means of ewe selection. Obviously improvement based on ram selection when it is necessary to retain only three rams in every hundred for use in registered flocks, can be very

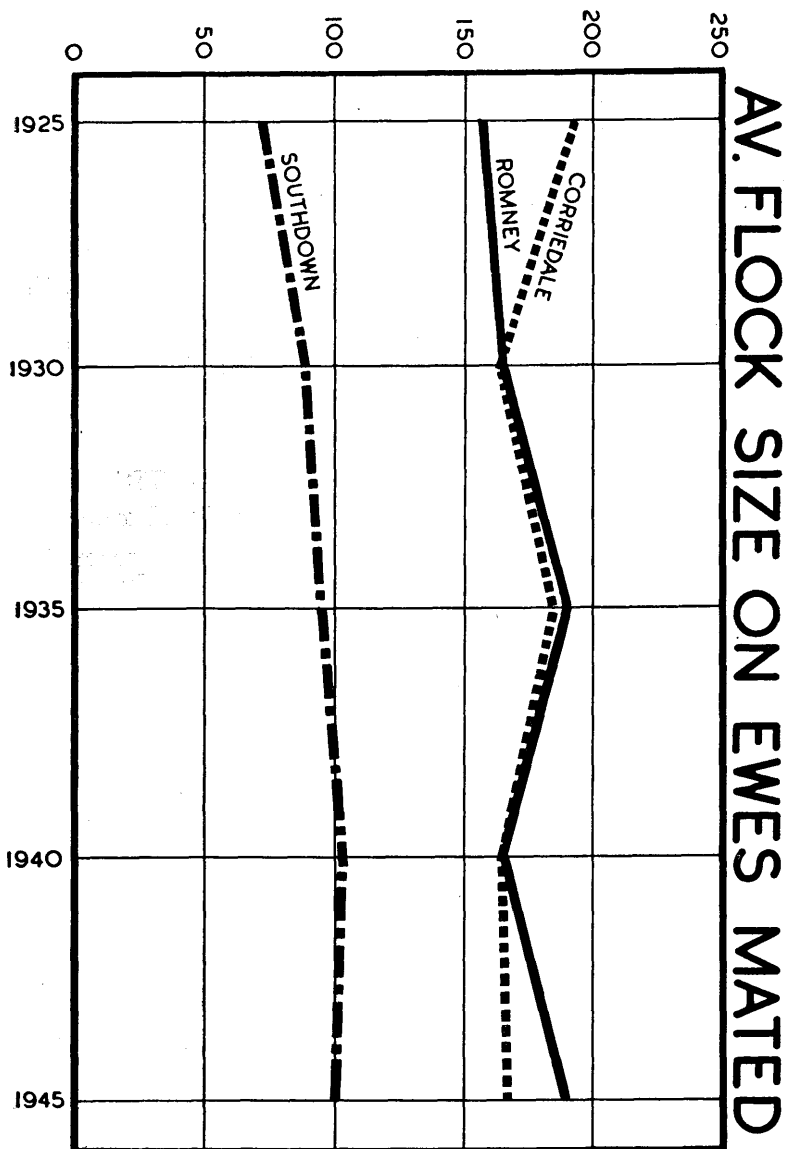


Figure 5

effective providing the three per cent. selected and retained are the really superior breeding rams.

The figures given for the number of ewes mated to produce a single-entered ram—ranging from 73 to 110 (in other words a small flock) include ewes in both “nucleus” and “propagating” flocks.

Some individual flocks have a very narrow ratio of ewes mated to produce one single-entered ram and some of these flocks have been analysed as shown in Table 4.

Table 4

REGISTERED RAM BREEDING FLOCKS

Ewes Mated to Produce one S.E. Ram in some Selected Flocks.

Breed.	Ewes mated.	One-shear rams S.E. from this mating.	Ewes mated to produce one S.E. ram.
Southdown	600	60	10.0
	510	66	7.7
	620	55	11.2
	340	38	9.0
	334	46	7.3
	368	41	9.0
			Average = 9.0
Romney	1500	164	9.0
	700	40	17.5
	852	46	18.5
Corriedale	191	20	9.5
	247	7	35.3
	813	17	47.7

These selected flocks are amongst those which we have termed “nucleus” flocks. They are, in the main, big flocks and it is estimated that some of them sell as single-entered rams as many as 25 per cent. of their annual ram output. These flocks have been selected because they do single-enter a large number of rams.

The analysis may be taken a stage further by tracing the origin of all one-shear rams single-entered in one season and grouping the flocks from which they came according to the number of rams single-entered by each flock.

FLOCK SIZE ON SIRES USED

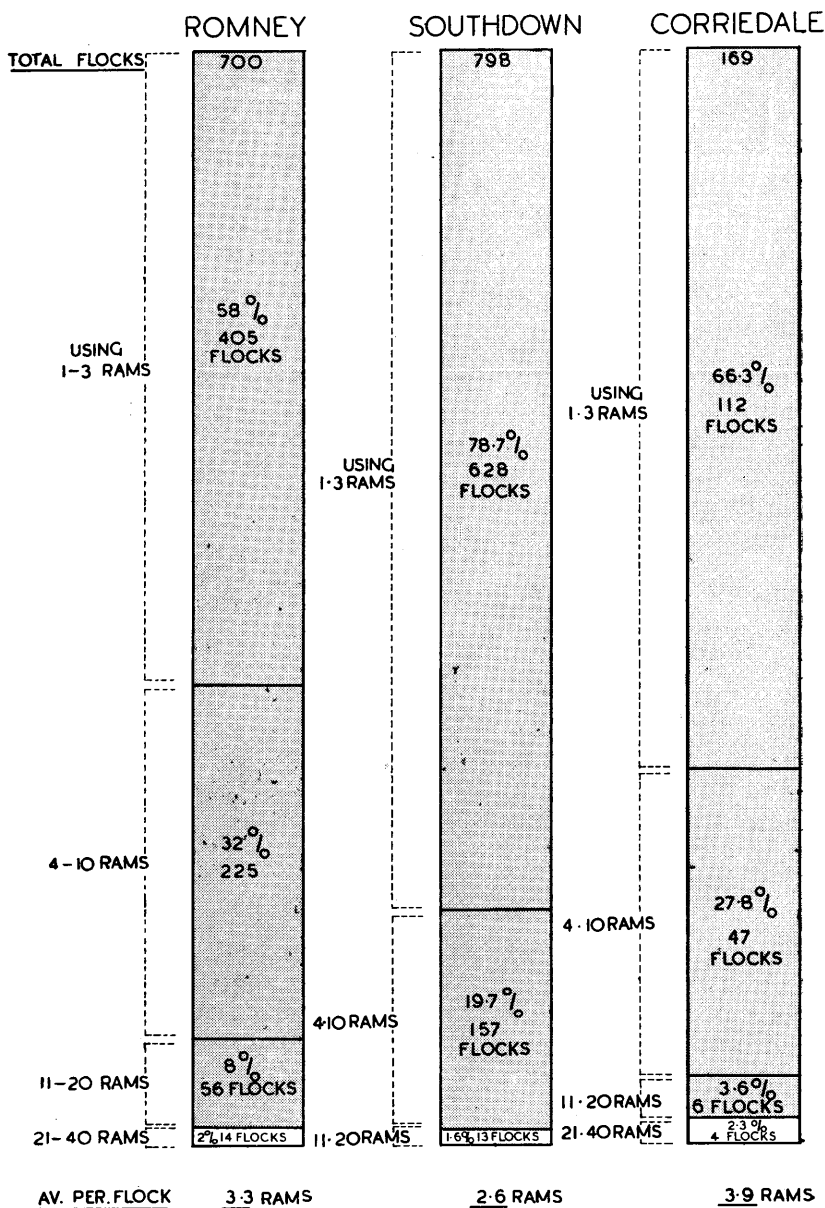


Figure 6

Table 5

REGISTERED RAM BREEDING FLOCKS

Flocks Grouped According to Number of Single-entered Rams Bred.

Romney Marsh

No. of Rams S.E. in each Flock.	No. of Flocks.	% of Total Flocks.	Total No. of Rams S.E.	% of Total Rams S.E.
0	446	63.7	0	0
1-3	145	20.7	246	14.5
4-10	72	10.3	461	27.2
11-19	20	2.9	302	17.8
20-60	16	2.3	524	30.8
61 +	1	0.1	165	9.7
	<hr/> 700	<hr/> 100.0	<hr/> 1698	<hr/> 100.0

Southdown

No. of Rams S.E. in each Flock.	No. of Flocks.	% of Total Flocks.	Total No. of Rams S.E.	% of Total Rams S.E.
0	647	81.1	0	0
1-3	99	12.3	157	20.3
4-10	33	4.2	201	25.9
11-19	11	1.4	146	18.8
20-60	7	0.9	198	25.5
61 +	1	0.1	74	9.5
	<hr/> 798	<hr/> 100.0	<hr/> 776	<hr/> 100.0

Corriedale

No. of Rams S.E. in each Flock.	No. of Flocks.	% of Total Flocks.	Total No. of Rams S.E.	% of Total Rams S.E.
0	100	59.2	0	0
1-3	44	26.1	77	19.6
4-10	14	8.2	91	23.2
11-19	9	5.3	129	32.9
20-60	2	1.2	95	24.3
	<hr/> 169	<hr/> 100.0	<hr/> 392	<hr/> 100.0

PERCENTAGE OF FLOCKS WHICH SINGLE ENTER RAMS

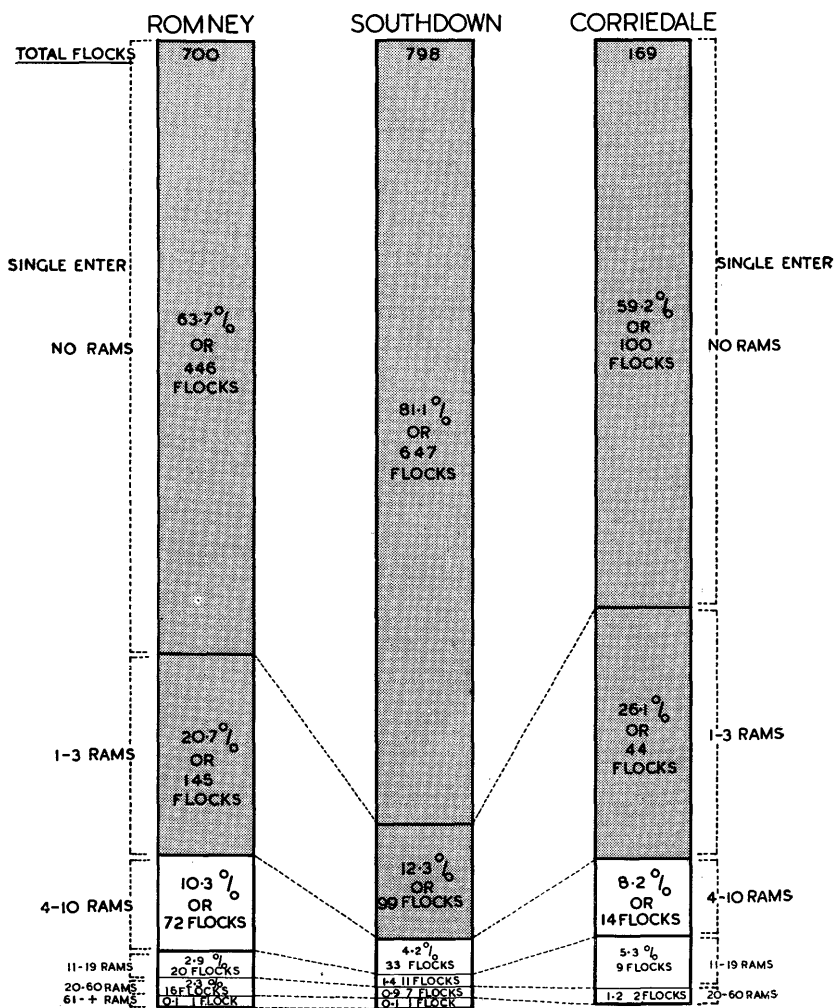


Figure 7

This table reveals several important facts. In each of the breeds the majority of flocks take no active part in the breeding of stud rams; they are purely and simply the "propagating" flocks which supply the rams required by the grade flocks. To put this in terms of figures, 84.4% of registered Romney flocks, 93.4% of registered Southdown flocks and 85.3% of registered Corriedale flocks do not play any part in maintaining or improving the average quality of the breed. As a general policy they buy sires from the nucleus flocks and sell the progeny of these sheep to the grade flock owners. On the other hand, one flock alone in each of the Romney and Southdown breeds supplies approximately 10% of the single-entered one-shear rams while in the Corriedale breed two flocks between them supply nearly 25% of the total. It is clear that these flocks are regarded by breeders as "nucleus" flocks. If we extend this term to include those flocks which single enter more than twenty rams, the total number of flocks involved is still small—17 Romney flocks among 700 active registered flocks, 8 Southdown flocks among 798 flocks and 2 Corriedale flocks among 169 flocks. This is illustrated in Figures 7 and 8.

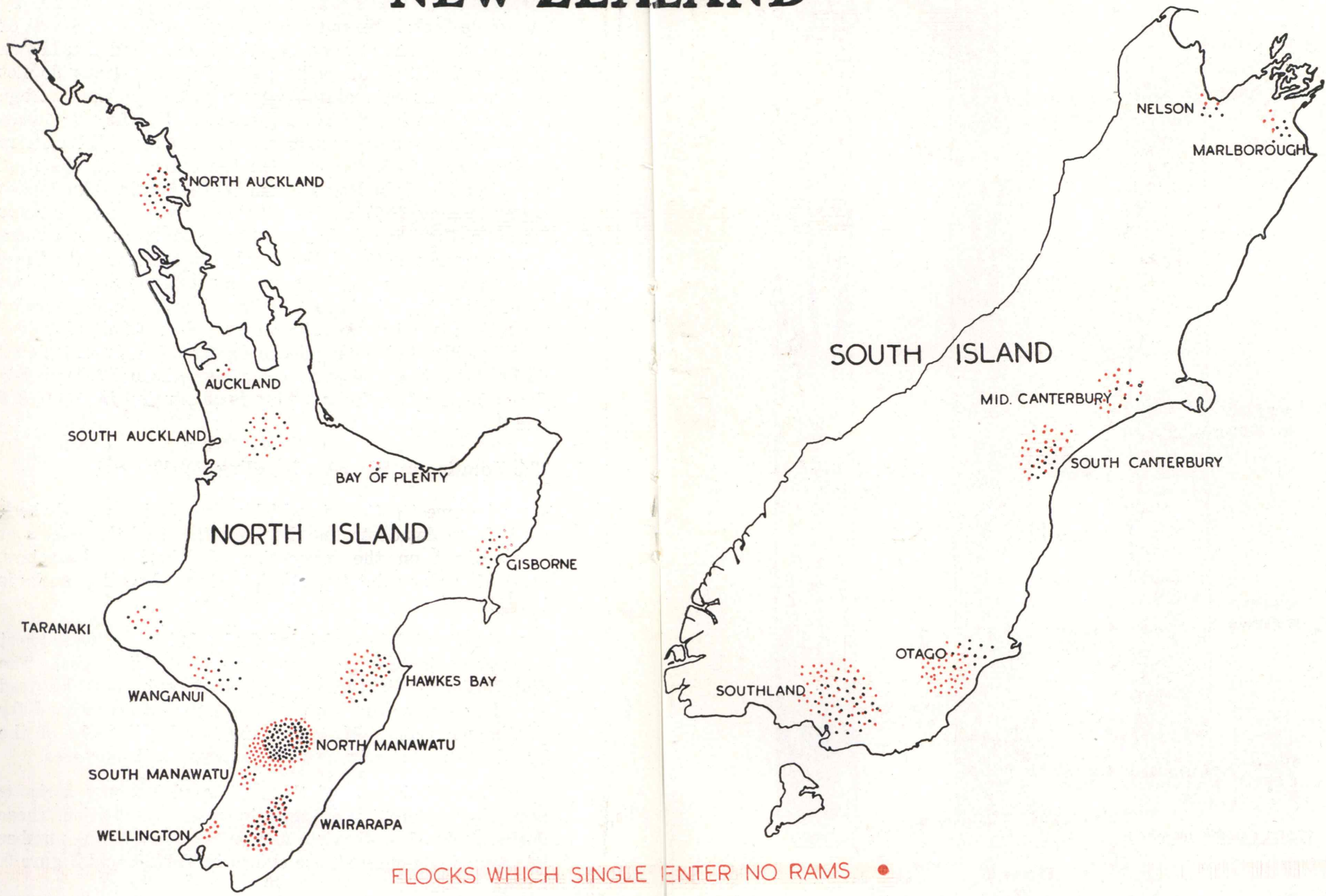
The Location of the Ram Breeding Flocks

The investigations to which reference has already been made have demonstrated the importance of the effects of environment on the expression of inherited characters. From this viewpoint the location of ram breeding flocks is important.

The Corriedale registered flocks, being confined almost entirely to Canterbury, have only a local distribution. The distribution of Southdown registered flocks is widespread and they appear in all areas where there is a demand for Southdown rams. Moreover, the "nucleus" flocks of the breed are not closely confined to any particular area.

The distribution of the registered Romney flocks is somewhat different and warrants closer examination. These flocks, grouped in districts and on the basis of the number of rams single-entered, are shown in Table 6 and Figure 9.

DISTRIBUTION OF REGISTERED ROMNEY FLOCKS IN NEW ZEALAND



FLOCKS WHICH SINGLE ENTER NO RAMS •

FLOCKS WHICH SINGLE ENTER ONE OR MORE RAMS ●

PERCENTAGE OF RAMS FROM FLOCKS WHICH "SINGLE ENTER"

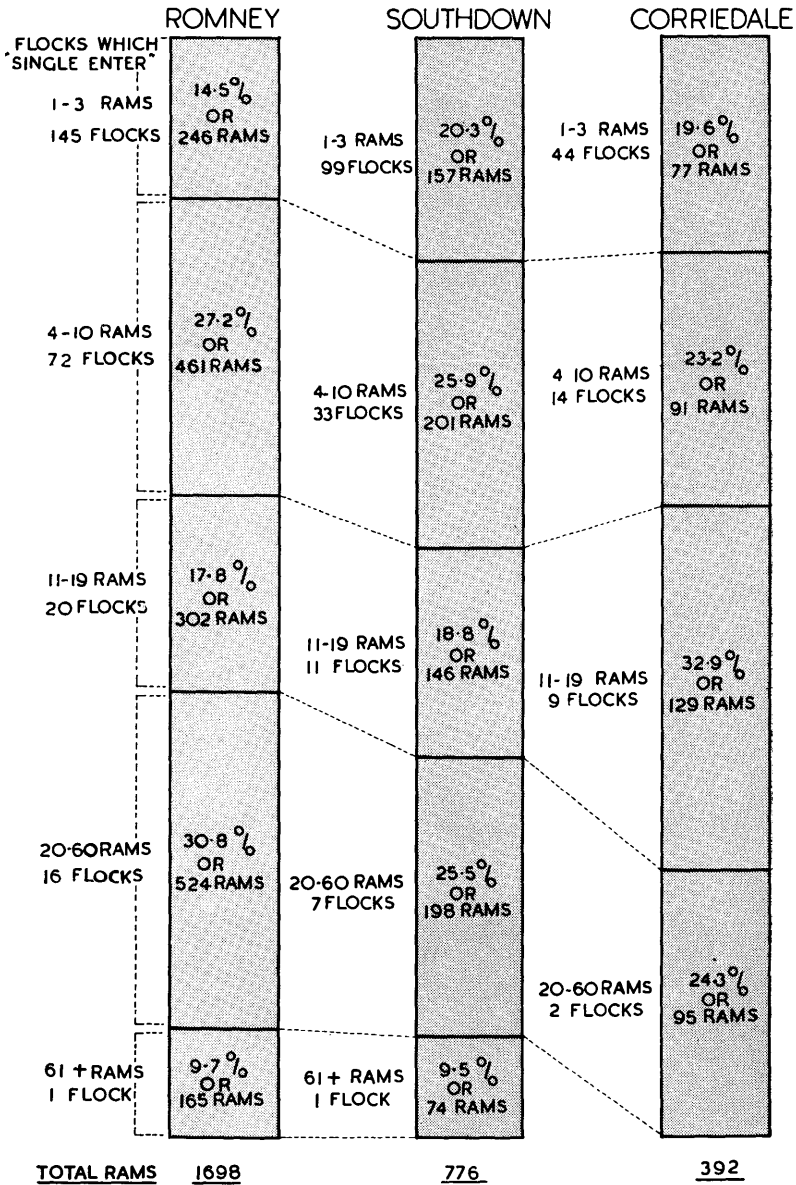


Figure 8

Table 6

REGISTERED RAM BREEDING FLOCKS

Romney Marsh

(Flocks grouped in districts and on basis of number of rams single-entered.)

Number of Flocks which Single-Enter.

DISTRICT	No Rams	1-3	4-10	11-19	20-66	67+
Nth. Auckland	14	9	3	2	—	—
Auckland	2	2	—	—	—	—
Sth. Auckland	16	8	2	1	—	—
Bay of Plenty	2	1	—	—	—	—
Taranaki	7	5	—	—	—	—
Wanganui	8	5	4	2	—	—
Gisborne	11	3	2	2	—	—
Hawkes Bay	26	8	8	2	—	—
Nth. Manawatu	66	45	19	10	7	—
Sth. Manawatu	8	3	—	—	—	—
Wairarapa	35	18	6	4	5	1
Wellington	7	—	—	—	—	—
Nelson	4	3	2	—	—	—
Marlborough	4	3	3	—	—	—
Nth. & Mid-Canty.	17	2	4	—	—	—
Sth. Canterbury	23	6	6	2	—	—
Otago	43	6	3	1	1	—
Southland	50	15	13	2	3	—
	343	142	75	28	16	1

FLOCK LIFETIME FROM FOUNDATION TO WITHDRAWAL

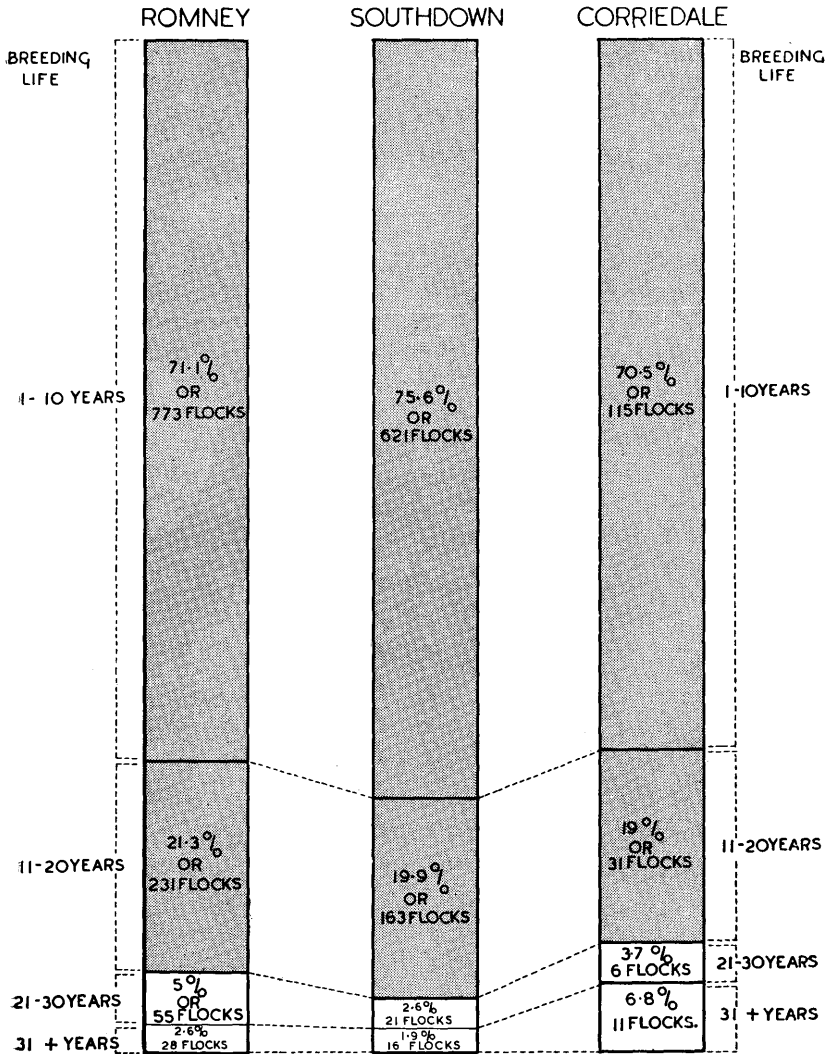


Figure 10

This table throws into sharp relief the importance of the Northern Manawatu and of the Wairarapa as ram-breeding areas. Thirteen of the seventeen flocks or 76% of those which have been styled nucleus flocks are confined to an exceedingly small part of the Dominion. These flocks are drawn upon freely by breeders from all parts of New Zealand and have been so since the early years of this century. Their importance to the maintenance of the breed cannot be over-estimated. There is a temptation, nevertheless, to enquire the reason for their popularity with flock owners who are breeding over a wide and varying range of environmental conditions. Is there in these two small areas, a group of breeders who have in their possession some secrets of breeding denied to others? Have they yet in their sheep a closely guarded superior inheritance despite an annual distribution of rams from their flocks over a long period of time? Or are these flocks in an environment which develops in the rams a full expression of the admired characters of the breed which is accepted as a standard by breeders working under less favourable environmental conditions? The answer is not within the scope of this bulletin.

The Lifetime of Ram Breeding Flocks

Another feature of importance in all flocks is the number of years which elapse between their foundation and their dispersal or withdrawal as registered flocks. This may be aptly stated as flock lifetime.

Flock improvement, under the best environmental conditions and employing the soundest methods of selection and breeding, is indeed a slow business. It is not possible to put in terms of years just how long it might take to produce a flock of outstanding breeding ability but it is clear from the experience of workers in the field of selection and breeding problems that the average working lifetime of a flock owner is all too short. In any case, real improvement policies must be continuous in operation. Few flocks survive even the working lifetime of a flock owner.

An analysis of the length of life of all Southdown, Corriedale and Romney flocks which have been registered with their respective societies is given in Table 7 and Figure 10.

Table 7

REGISTERED RAM BREEDING FLOCKS**Flock Lifetime in Years**

(From Foundation to Dispersal or Withdrawal.)

Southdown Registered Flocks

Breeding Life in Years. Foundation to Dispersal.	Number of Flocks.	Percentage of Total Flocks.	
1—10	621	75.6	} 95.5
11—20	163	19.9	
21—30	21	2.6	} 3.7
31—40	9	1.1	
41—50	6	.7	} 0.8
51+	1	.1	
	821	100	

Corriedale Registered Flocks

1—10	115	70.5	} 89.5
11—20	31	19.0	
21—30	6	3.7	} 9.3
31—40	9	5.6	
41—50	1	.6	} 1.2
51+	1	.6	
	163	100	

Romney Registered Flocks.

1—10	773	71.1	} 92.4
11—20	231	21.3	
21—30	55	5.0	} 6.6
31—40	18	1.6	
41—50	5	.5	} 1.0
51+	5	.5	
	1087	100	

The outstanding feature revealed by these tables is the large proportions of flocks (75.6% Southdown; 70.5% Corriedale and 71.1% Romney flocks) which fail to survive the extremely short breeding lifetime of ten years. If the time is extended to twenty years, still short in terms of sheep generations, 95.5% of the Southdown, 89.5% of the Corriedale and 92.4% of the Romney registered flocks which have been founded and dispersed are accounted for. The most that could be expected of these short lived flocks is that in their time they served as propagating flocks for the breeds concerned.

It is not proposed to discuss the economic and other circumstances which are the fundamental causes of the short lifetime of flocks but it is of interest to observe that of all the Romney flocks which are now non-existent approximately one fifth were withdrawn in the period 1930-1935.

It is clear that only a small proportion of flock owners remain in business sufficiently long to tackle the problem of flock improvement seriously. As a point of further interest the lifetime of all registered flocks at present actively breeding is given in Table 8.

Table 8

REGISTERED RAM BREEDING FLOCKS

Lifetime of All Flocks Active in 1946.

Southdown Flocks.		
Age of Flock in Years.	Number of Flocks.	Percentage of Total Flocks.
1—10	493	50.5
11—20	315	32.2
21—30	123	12.6
31—40	39	4.0
41—50	6	0.6
51+	1	0.1
	977	100.0

Corriedale Flocks

Age of Flock in Years.	Number of Flocks.	Percentage of Total Flocks.
1—10	50	33.8
11—20	33	22.3
21—30	45	30.4
31—40	4	2.7
41—50	5	3.4
51+	11	7.4
	148	100.0

Romney Flocks (active in 1945).

Age of Flock in Years.	Number of Flocks.	Percentage of Total Flocks.
1—10	460	55.0
11—20	160	19.1
21—30	125	15.0
31—40	73	8.7
41—50	2	0.2
51+	16	2.0
	836	100.0

Old age does not, in itself, confer superiority, but at least one of the qualities required to attain old age is the ability of the flock to survive competition. This in turn demands the production of stock which is accepted by breeders as being of superior quality. In addition, these old established flocks have certainly had every opportunity to develop a constructive breeding and selection policy and this, combined with the ability to preserve the flock as an entity, has enabled some of them at least to attain "nucleus" status.

The breeding policy in one of the flocks in the 51+ years group is shown for a period of ten years in Table 9.

Table 9.

Source of Stud Rams as Sires in a Registered Romney Flock established 51+ Years.

Number of Rams Used.

Year	Homebred	Bred in Other Flocks	
		Sons of Homebred Rams Sold	Sons of "other" Rams
1933	.. 44	4	4
1934	.. 31	14	7
1935	.. 30	8	6
1936	.. 31	10	6
1937	.. 28	13	10
1938	.. 24	9	16
1939	.. 27	7	18
1940	.. 32	2	7
1941	.. 36	3	10
1942	.. 30	6	8

The policy adopted during this ten year period is in close agreement with that adopted throughout the breeding lifetime of the flock. The majority of the rams used are homebred or are the sons of rams bred in this flock but sold and used in other flocks. In addition, many of the rams sired by "other" rams are grandsons of sheep bred in the flock and sold or are the sons of ewes sired by rams sold from the flock.

Summary

There is a general pattern running through the organisation of ram breeding flocks in the major breeds which supply replacement rams to the industry. A few flocks are big in size, register a high proportion of their annual

ram output as stud rams, have the advantage of a long flock lifetime and are obviously situated in areas with a favourable environment. Such are the "nucleus" flocks of the breeds.

This analysis, if it serves no other purpose, enables future flock improvement to be discussed in its proper perspective and as a practical and practicable project.

The three major breeds selected fall into two broad groups. The Southdown, used only as a fat lamb sire, requires consideration from that view point only. Since most of the offspring of Southdown rams are exported as fat lambs and are subject to export grading for quality there is already in existence a reasonable practical yardstick for the measurement of the average carcase quality of Down-cross lambs. Later bulletins in this series will contain a critical analysis of the inheritance of carcase quality in such lambs and for that reason it is not proposed to include here further discussion of this breed. The general principles, however, apply equally well to the Southdown as to the two breeds which are specifically discussed.

The Romney Marsh and the Corriedale are the "wool and mutton" breeds of the sheep industry and their importance as such in the farming economy of the country cannot be overestimated. On the breeding quality of the rams supplied to the grade flocks by the ram breeders depends the ability of the next generation of ewe flocks to maintain or improve the quality and quantity of our sheep production. These rams are burdened with a heavy responsibility. Their daughters will be the breeding ewes of the future and their sons fat lambs or fat sheep. The economic future of the sheep breeding industry is tied to their ability to sire offspring capable of producing both profitable fleeces and carcasses. Each year approximately 58,000 Romney and 12,000 Corriedale one-shear rams are made available to grade flocks by the ram breeders. There is too little information available to assess accurately the general effect of each breeding generation of flock rams on the quantity and quality of our sheep production, but there is a strongly-held opinion amongst sheep men that, for the characters which mean income to grade flock owners, no improvement is apparent.

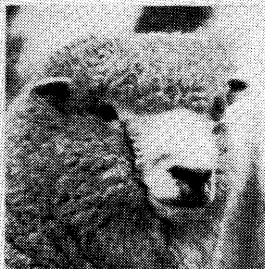
The majority of the rams have come from the flocks of the propagating breeders and have been sired by stud rams bred in the "nucleus" flocks. Any plan which aims at breed improvement obviously must have its starting

PRESENT SELECTION OF STUD RAMS

IS BASED ON

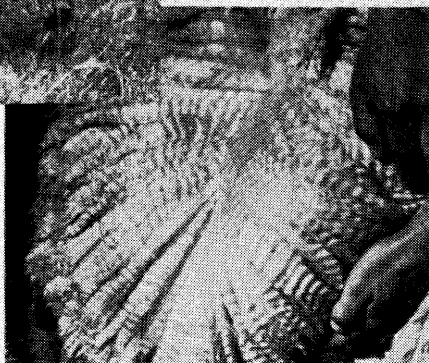
PEDIGREE :- FASHIONABLE STRAINS
AND
VISUAL EVALUATION OF

BREED TYPE



CONFORMATION

FLEECE



FUTURE IMPROVEMENT ?

SELECTION BASED ON
BREEDING ABILITY BY PROGENY TEST!

Figure 11

point in the "nucleus" flocks. Emphasis has been already placed on the exacting ram selection which takes place. Only three rams in every hundred bred are retained for use in all the registered flocks. The number required and retained for use in the select group of "nucleus" flocks is exceedingly small—yet on the breeding quality of these few sheep depends the quality of the rams supplied to the ram breeding flocks. The method of their selection is of paramount importance.

Despite the accumulation of factual information on inheritance, selection of these sheep generally is along traditional lines (illustrated in Figure 11). That such methods proved successful during the formative stages of the breeds has been pointed out; that they are inadequate to secure further and continuous gains has also been stressed. A brief survey of the methods of selection in general use in ram breeding flocks is worth while. Pedigree has always been important, not necessarily the individual pedigree but rather the fact that a sheep belongs to a particular strain or family. Possession of this qualification gives added value to a member of a popular strain. Pedigree also plays an important part in the formation of breeding plans. Strains which produce some superior animals under a policy of inbreeding or linebreeding are usually subjected to such breeding policies, while those strains which react unfavourably are resolutely and continuously outcrossed.

The extent to which "breed type" is expressed is the next important characteristic. The correct size, shape and colour of nostrils, face, poll, ears, legs and so on are regarded as of utmost importance.

Finally, there is a visual assessment of fleece and carcass. Judgment of the fleece usually contents itself with an examination of the wool, while still on the sheep, for character and count only, while the carcass judgment is satisfied by an inspection, on the hoof, of conformation.

Such a selection procedure, based on the history of the animal in the form of its ancestry and its individual merit estimated by visual examination, neglects the most important and the most effective method of selection—that based on the average quality of the progeny sired. In this age there should be no need to emphasise that breeding-worth can be evaluated only by progeny test and it is surely breeding-worth in which all breeders are vitally interested. If pedigree and individual merit of appearance were reliable guides to breeding worth the need to use the cumbersome and laborious progeny test would not arise.

A Plan for the Progeny Test

The organisation of the sheep industry is such that progeny testing could be most effective if carried out in the propagating flocks of each breed. Progeny testing, however, involves a considerable amount of work. In addition, the very nature of the breeding programmes of ram breeding flocks places severe limitations on the number of features for which progeny testing can be carried out in these flocks. Even if such tests are limited to the important fleece features of weight, character and count; to carcase quality based on a visual assessment of conformation; and to breed type judged on the same basis, the amount of work involved is beyond the capacity of even the most enthusiastic breeder. In any case it is a job which would require the services of a team of skilled technicians working in co-operation with the breeder; recorders to assemble the enormous amount of data which accumulates and to attend to the tedious jobs of fleece weighing, character grading and count assessment; statisticians to analyse the mass of information so collected; and consultant breeders who, with a wide knowledge of heredity and a sympathetic understanding of breeders, can interpret the results of the test and assist the breeder to apply them in his breeding programme. Even with such workers and finance necessary to support them, there are still some practical difficulties.

Testing involves ewes for testing purposes but the ewes in ram breeding flocks should have as their primary function the breeding of sires. The use of them through their progeny for testing will be continuous but secondary to their importance as ram breeders. These ewes are the daughters of nucleus sires and nucleus ewes and are in fact the nucleus females of the breed. As such they should be the mothers of the rams to be distributed.

The progeny test outlined envisaged only fleece, conformation and breed type, and in ram breeding flocks there should be no need to ask more. But there must be no pre-ference that these are the only important inherited features in our sheep. The returns of the grade flock owner are directly affected by other equally important characters. Length of productive lifetime or constitution and its complementary flock wastage, lifetime fleece production, mothering ability, fertility and prolificacy, milking capacity, growth rate and rate of maturity, are all features which have an important bearing on the efficiency of production in grade flocks and which are all inherited in a similar manner to those for which we have suggested testing. These features might well be measured and cared for in the flocks of the grade

breeders. The group testing of rams would yield the information required for these features. The grade flock owner using normally twenty rams would be supplied with four groups of five rams. The rams in each group would be closely related but unrelated to the rams of other groups. Topping would necessitate the drafting of the ewe flock into the required four random groups and the marking of the ewes according to their group. The wintering of the ewe flock would present no difficulties but, prior to lambing, the groups would have to be drafted and kept separate until the lambs had received a distinctive sire mark. Group testing in the grade flocks in this manner, carried out in several localities, would allow a check on those features for which it is not possible to test in ram breeding flocks. The task is clearly beyond the resources of the breeder and the need for skilled technical assistance is obvious. Such a plan is illustrated in Figure 12.

The testing of dairy cattle along similar lines is well-established but dairy farmers are not expected to be familiar even with the routine of testing and have certainly never been asked to perform the calculations which are necessary to determine the seasonal production of a cow. Nor have they been asked to bear the full cost of such work. The Dairy Division of the Department of Agriculture has had in operation, since the early part of the century, testing schemes for pedigree cows, while the Herd Improvement Department of the Dairy Board has concerned itself with both pedigree and grade herds. The Herd Improvement Department is a direct descendant of the producer-organised "Group-testing Associations." It is now a department of a producer organisation, the Dairy Board, and it has in operation a herd improvement programme. This work involves primarily the testing of herds of dairy cows in the search for sires which leave daughters with high average production ability. Such work is costly. The Dairy Board, from its funds contributed by dairy farmers and from grants made by the Department of Agriculture, is able to give to its Herd Improvement Department an annual income which has in recent years exceeded £30,000. The future monetary benefits, however, which can be expected by dairy farmers from work already in progress dwarfs even this generosity to insignificance.

Unfortunately, there is no comparable organisation attending in like manner to the producer end of the sheep industry. Individual sheep breeders cannot, and in any case should not, be expected to engage in the laborious and tedious, but sure method of stock improvement through progeny testing; nor can it justly be claimed to be the

N.Z. FLOCK IMPROVEMENT DEPARTMENT

FLOCK IMPROVEMENT PLAN

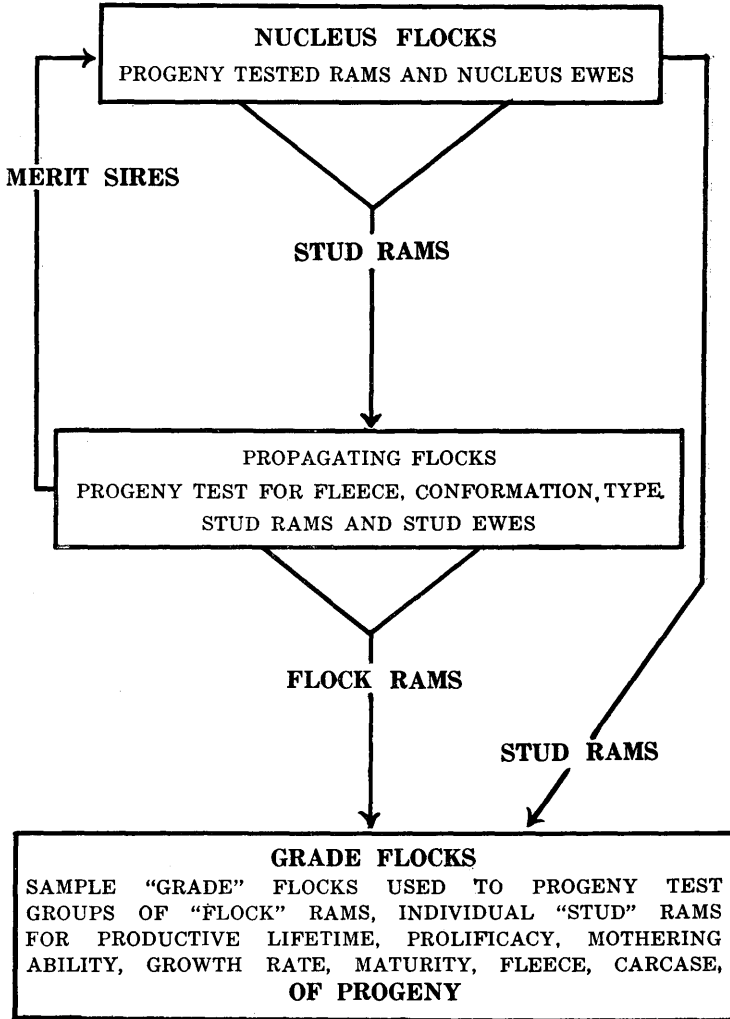


Figure 12

responsibility of the breed societies. Their work is clearly defined by their constitution and rules and, within the limits of their comparatively meagre finances contributed by the members themselves, they do all they claim.

It would appear that the responsibility could reasonably devolve upon the producer organisations of the sheep industry, the New Zealand Meat Producers' Board and the New Zealand Wool Board. It is important to remember that these Boards obtain their income from all sections of the sheep industry and likewise benefits arising from improvement in the quantity and quality of sheep production would be spread over the whole industry.

A Flock Improvement Department attached to and financed by the two Boards could function in the sheep industry in the same manner as the Herd Improvement Department of the Dairy Board functions in the dairy industry. The organisation of such a department in general terms can be best illustrated as in Figure 13.

Its work might be briefly summarised as investigational, instructional and advisory. In the early stages emphasis would be of necessity on the collection of data relating to production on sheep farms. Factual information on such features as quantitative and qualitative wool and carcase production in the widely varying environment conditions under which sheep are kept; on flock replacement with the complementary nature and extent of sheep mortality; and on the relative values of inheritance and husbandry in immediate and long term improvement plans is urgently required as the foundation for detailed improvement schemes.

The special job of improvement through breeding has been illustrated in Figure 12. To be effective this plan requires the co-operation of breeders of both ram breeding and grade flocks with the flock improvement department. It is significant that several flock owners have already opened their flocks to investigators and have obtained some benefits from the progeny test. At least one grade flock owner has given such work whole-hearted commendation. This breeder placed an order with the owner of a progeny tested flock for four flock rams to be the sons of the heaviest clipping sire. It so happened that the progeny of this sire were not only heavy clippers but also had a consistently high wool character grade. The progeny of the four rams reared on second class sheep country and shorn this spring as hoggets clipped 10 pounds of skirted fleece wool. Unfortunately there is no basis for an accurate comparison but the grade flock owner is so well satisfied that he has adopted this method of buying as his permanent policy.

ORGANISATION OF FLOCK IMPROVEMENT

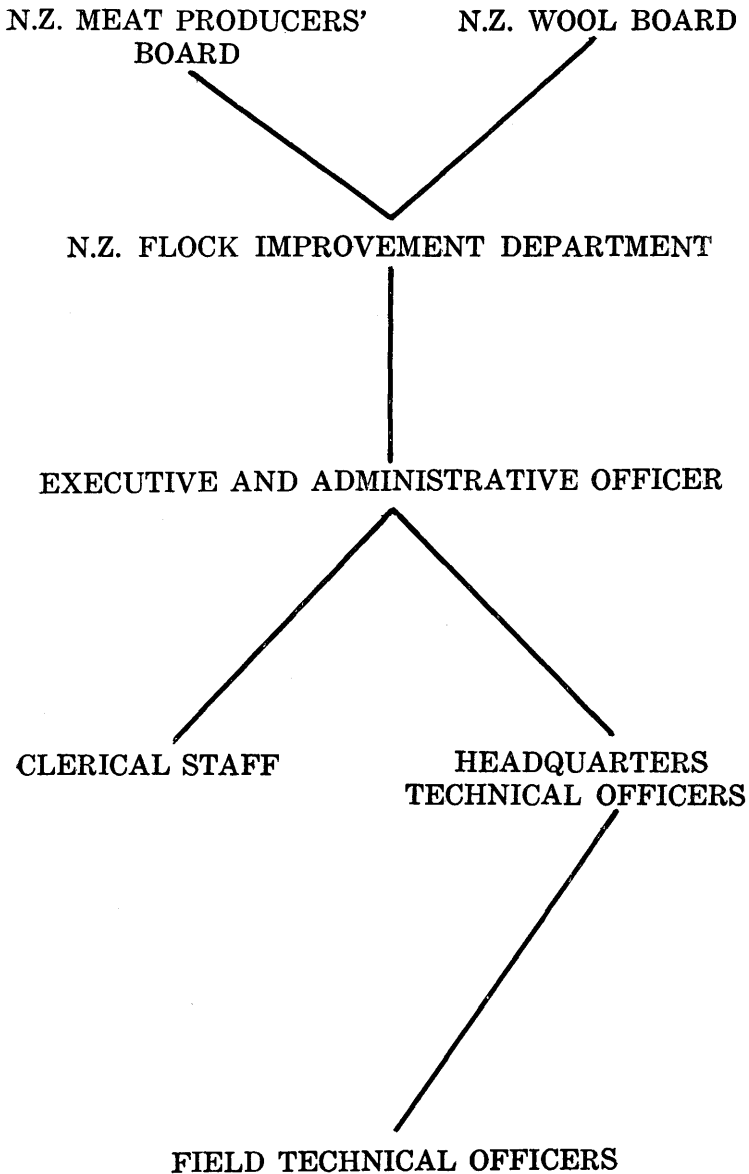


Figure 13

The Corriedale Sheep Society embarked upon its "Progeny Test" with the object of finding within the breed superior breeding rams which could be safely labelled "Merit Sires" by the Society.

Although a considerable amount of progeny testing has been done by and for sheep breeders there is no record of a breed society tackling the problem. In the absence of previous experience as to how a breed society could best put into effect such a test the Corriedale Society had to proceed in a pioneering spirit. The test is now in operation. In consequence in the not distant future the Corriedale Sheep Society might easily become world famous in sheep breeding circles as the first organisation to adopt a progressive breeding policy. It is appropriate that farmers in New Zealand, the home of the breed, should know and understand the method the Society is using to locate superior Corriedale breeding rams.

The first step in the test was to secure an even line of Corriedale breeding ewes. A line of 300 odd ewes which satisfied the specifications of the Society was obtained and the flock was taken over by Lincoln College which accepted the responsibility of carrying out the test for the Society.

Members of the Society were invited to nominate rams for test and, of those nominated, ten were accepted. This was the maximum number which could be taken with the number of ewes available. Meanwhile each ewe had been individually identified by means of an ear tag and the flock divided into ten even groups of 30 ewes. The ram to be mated to each group was then decided by lot. At the conclusion of tugging the rams were returned to their owners.

The ewes have now lambed. At birth each lamb was identified by a metal ear tag and a sire ear notch (a double identification), and fully recorded in the lambing log. In due course the male lambs will be castrated and during the summer will be drafted by a fat lamb buyer and slaughtered at the freezing works. The carcasses will be measured for carcase quality and the ability of each sire as a fat lamb sire evaluated.

The ewe lambs will be carried over and shorn next spring as hoggets. Each fleece will be weighed, graded for character and count, and given a per lb. value. From the information thus obtained it will be possible to rate each sire on his ability to leave profitable fleeces. In the meantime all the progeny will be graded for Breed Type on several occasions by inspectors appointed by the Society.

THE CORRIEDALE PROGENY TEST

(TEN RAMS ACCEPTED FOR TEST)
RAMS

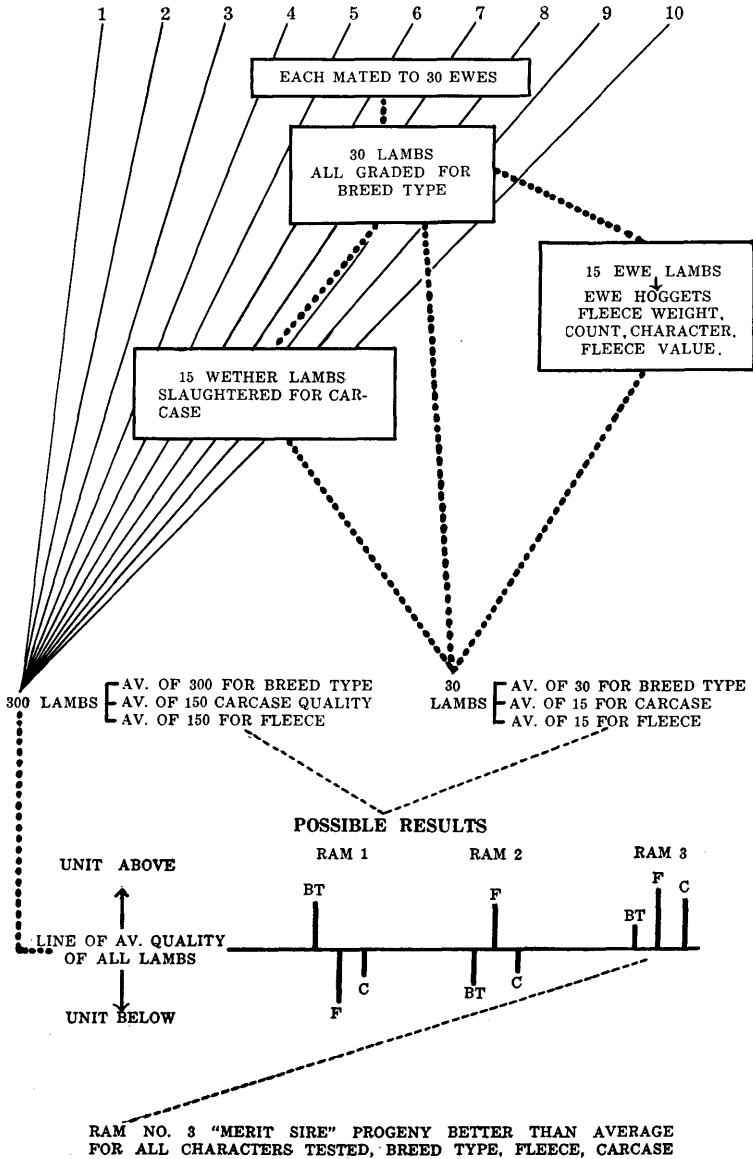


Figure 14

Thus it will be possible to rate each ram on his ability to leave in his progeny **Breed Type, Fleece and Carcase**. These are the three things to which Corriedale breeders attach major importance.

Some of the rams may leave progeny which is superior in one feature, some in another feature, other rams may be superior in two features but the few which are superior in all three features are the rams which will be recognised as "Merit Sires" by the Society.

Comparisons in all features will be made by comparing the average quality of each group with the average quality of all the progeny. For example, if the average for all progeny for fleece weight is 10 lbs. and the average for Ram A. is 12 lbs. then he would be rated as superior for this character. The outline of this test is illustrated in Figure 14.

Conclusion

It has been shown that the set up of the sheep breeding industry lends itself to the adoption of methods of selection and breeding which will ensure improvement in the standard of production in the industry. Individual breeders and one breed society have already interested themselves in these methods and within the limit of their finance and the technical assistance which is available to them they can claim to have made some advance. However, on a national scale this work is obviously beyond the capacity of individuals and breed societies.

Benefits from such improvement would be shared by the sheep industry as a whole and it seems logical that the costs incurred should be shared also by the industry. There are already in existence two producer boards which draw their incomes from sheep production and which therefore have a responsibility in this matter to the industry.

A "Flock Improvement Department" controlled and financed jointly by the N.Z. Meat Producers' Board and the N.Z. Wool Board is the type of organisation which could put into effect the plans which have been outlined.

With combined assets of approximately £742,700 and incomes totalling £191,800, the two producer boards are in an excellent financial position to undertake this task which in the future may mean so much to the sheep industry of New Zealand.

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