

New Zealand Society of Animal Production online archive

This paper is from the New Zealand Society for Animal Production online archive. NZSAP holds a regular annual conference in June or July each year for the presentation of technical and applied topics in animal production. NZSAP plays an important role as a forum fostering research in all areas of animal production including production systems, nutrition, meat science, animal welfare, wool science, animal breeding and genetics.

An invitation is extended to all those involved in the field of animal production to apply for membership of the New Zealand Society of Animal Production at our website www.nzsap.org.nz

[View All Proceedings](#)

[Next Conference](#)

[Join NZSAP](#)

The New Zealand Society of Animal Production in publishing the conference proceedings is engaged in disseminating information, not rendering professional advice or services. The views expressed herein do not necessarily represent the views of the New Zealand Society of Animal Production and the New Zealand Society of Animal Production expressly disclaims any form of liability with respect to anything done or omitted to be done in reliance upon the contents of these proceedings.

This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](http://creativecommons.org/licenses/by-nc-nd/4.0/).



You are free to:

Share— copy and redistribute the material in any medium or format

Under the following terms:

Attribution — You must give [appropriate credit](#), provide a link to the license, and [indicate if changes were made](#). You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.

NonCommercial — You may not use the material for [commercial purposes](#).

NoDerivatives — If you [remix, transform, or build upon](#) the material, you may not distribute the modified material.

<http://creativecommons.org.nz/licences/licences-explained/>

ANIMAL RESEARCH IN A TUSSOCK ENVIRONMENT AT TARA HILLS

J. D. J. SCOTT, T. E. LUDECKE, K. H. C. LEWIS, A. R. DIACK
*Department of Agriculture**

SUMMARY

A brief description is given of the tussock grasslands of the South Island. Included are accounts of the vegetative cover and the changes which have taken place in it, the results of two surveys of livestock production conducted by the New Zealand Meat and Wool Board's Economic Service, and a review of past experimental studies in animal production on tussock country. Experimental work in progress at Tara Hills, a high country run administered by the Department of Agriculture, is described. Interim results show that the growth of early weaned Merino lambs is at least as good as that of late weaned lambs; that the level of performance of ewes wintered on a ration of 1½ lb hay/head/day is only slightly inferior to that of ewes receiving twice this ration; that pre-tupping shearing of two-tooths has no effect on lambing percentage but that it markedly increases wool production. Other work in progress, including a comparison of the performance of Merino and Corriedale ewes, and observations of grazing habits, is outlined.

IN HIS presidential address to the N.Z. Society of Animal Production in 1955, Professor I. E. Coop (1955) stressed the need for the establishment of a high country research station, and said, "I personally am equally concerned with the need for animal research which in the past has been completely lacking."

Today we can report that a high country research area is available and that on it some animal research is in progress. The area or run is known as Tara Hills, and it is situated in the Otago province, a few miles south of Omarama.

The purpose in presenting this paper is not only to review the work which is being undertaken at Tara Hills, but also to describe briefly the high country itself, common farming procedures, and some of the problems encountered.

* Authors located at Wellington, Alexandra, Mosgiel and Kurów respectively.

HIGH COUNTRY

There is no exact definition of high country, but it is generally described as being the area at altitudes of 1,000 ft and higher, clothed mainly in native tussock vegetation, subject to snow risk, and used predominantly for the production of wool and store stock.

The total area of such country in the South Island is about 10 to 12 million acres or 20 to 25% of New Zealand's grazing area. It extends along the eastern side of the main mountain chain from Marlborough to Southland. The area forms the catchment of the eastward flowing rivers. Annual precipitation varies from 13 in. in drier valleys and basins to 80 in. in the headwaters of rivers and on mountain tops.

The area is generally classified according to its dominant tussock cover. Red tussock is found on poorly drained areas; hard or fescue tussock is the common tussock which grows at lower altitudes; and snow tussock grows at higher altitudes and on colder sites. These tussock species either grow alone or in association with smaller, more succulent grasses, herbs and sedges which populate the area around their bases. On all but the more depleted sites, a large number of species is present, up to 50 or more being not uncommon on any one hillside or valley floor.

European settlement of the tussock grasslands commenced about the mid-nineteenth century. The early runs, of very large dimensions, had natural boundaries such as rivers and mountain tops. Under the impact of occupation, deterioration of plant cover was observed in many instances, and this was mainly attributed to excessive burning and overstocking with both domestic and wild animals. Burning was frequently resorted to, to enable stock to move more freely over the vast tracts of grazing land and as a means of providing fresh growth in the form of regenerating plants. Overstocking with sheep was apparently quite common, and this practice was probably encouraged by the relatively low wool prices received and the leasehold tenure conditions then obtaining. Introduced animals, mainly rabbits, deer and goats, found tussock lands favourable for survival and multiplication. It is of interest that, in 1924, more than twenty million rabbit skins were exported from New Zealand.

Deterioration in plant cover varied from area to area and from run to run. Some idea of the severity of deterioration in a particular instance can be gauged from the change in numbers of sheep carried in the tussock country of the Waimakariri River catchment in Canterbury. Six sheep runs

covering 260,000 acres are involved. Sheep numbers were 68,000 in 1879, 92,529 in 1895, 45,422 in 1917, 56,639 in the early thirties, and 41,405 in 1952 (Dick, 1952).

In the areas where plant cover was reduced, soil and water erosion problems are believed to have become much more acute. The high country is economically important, of course, not only for its livestock produce, but also because of its influence on down country hydro-electric, irrigation and river control schemes.

During recent years it does seem that the rate of deterioration in the vegetative cover has decreased, and that in very many cases an improvement has been effected. This improvement has been attributed to a reduction in rabbit numbers, better control of burning and levels of stocking, improved grazing management practices, and the introduction of improved pasture species following oversowing and top-dressing.

PRESENT POSITION

Most high country runs are leasehold properties under the administration of the Lands and Survey Department. Conditions of tenure have improved, and long-term leases are now granted readily to runholders who demonstrate a capacity to farm tussock country efficiently. The Lands and Survey Department is also responsible for adjusting the areas available to individual runholders so that favourable balances of summer and winter country are achieved on all properties. Prior permission from this Department must be obtained before stock numbers may be increased. Permits to burn must be obtained from local catchment boards or commissions, and are granted only where warranted and after careful deliberation. These authorities are also responsible for the administration of subsidies which are granted on fencing, track forming, tree planting, oversowing and other operations which have as their goal the conservation of soil and control of water runoff.

Stock numbers on tussock country have been estimated at about 2,500,000 sheep and 40,000 head of cattle — a stocking rate of about one sheep equivalent for every 4 acres (O'Connor, 1960).

Some data on the type of sheep run on high country and of their production have been collected by the N.Z. Meat and Wool Board's Economic Service. Table 1 shows the breeds used on the runs surveyed (Ward, 1960).

Wool is of very great importance in the economy of high country runs, and on average 82% of gross returns were obtained on these runs from sales of wool (Ward, 1960).

TABLE 1: BREEDS AND NUMBERS OF SHEEP ON SURVEY RUNS

<i>Breed</i>	<i>No. of Runs</i>	<i>Runs (%)</i>	<i>No. of Sheep</i>	<i>Sheep (%)</i>
Merino	21	50	123,719	54
Halfbred	15	36	69,194	30
Corriedale	6	14	35,209	16
<i>Totals</i>	42	100	228,122	100

Source: Ward, 1960.

The proportion of breeding ewes in these flocks ranged from 29 to 72%, with an average of 39%. The scope for ewe selection or flock expansion is thus very small. It appears that a flock must contain approximately 30% of breeding ewes to maintain stable numbers under these conditions. It was also shown that, as the proportion of breeding ewes in flocks increased, the weight of wool shorn per head declined.

In an earlier survey of 23 runs, Ward (1958) found that the average weight of wool per sheep shorn during the year 1955-56 was 8.4 lb, the lambing percentage, calculated from the number of lambs docked in relation to the number of ewes mated, was 77%, and stock losses 6.4%. This last figure was obtained from mustering tallies.

FARMING PROCEDURES

It is obviously very difficult to outline adequately the stock and pasture management practices used on tussock country for these vary widely, but the following general description of activities probably applies to a large proportion of runs.

A run is subdivided normally by fences, but also on occasions by natural boundaries into three main sections, the hogget, ewe, and wether blocks. The hogget block is normally the best in terms of aspect, altitude and pasture cover, and the wether block the highest, steepest and poorest of the three. There is usually an area of relatively flat improved land convenient to the homestead. Frequently this area is used for growing lucerne hay, and some crops for winter use, as well as providing essential holding paddocks.

Traditionally, the ewes stay on their block throughout most of the year. They winter below the normal winter snow level and their pasture diet is sometimes supplemented with hay and crop. They lamb on the block unassisted, in October and November, and remain at lower

levels until weaning about February. After weaning they are removed to higher altitudes and the winter country is then spelled. About April or May, before winter snows are expected, the autumn muster takes place and ewes are returned to their winter area where they are mated in May, or June. Ewes are retained until up to 7½ years of age although many are sold at 5½ years. Cast-for-age Merinos are normally sent directly to works, while Corriedales and Halfbreds find a market amongst fat lamb producers.

The practice of mating old Merino ewes with fat lamb sires and maintaining them under good conditions to produce a crop of fat lambs appears to be a growing one.

Hoggets, both ewe and wether, winter on their block, and are often provided with hay and crop. As first lambing sometimes does not take place until the ewes are four-tooths, the ewe hoggets are retained on their block during their second summer and winter of life. The wether hoggets join the main wether mob as two- or four-tooths.

Wethers stay on their block throughout the year. Theoretically they graze in accordance with snow levels, moving to high altitudes in summer and returning to lower reaches in winter. On country where there is a risk of sheep being entrapped by snow falls, the wethers, along with other classes of stock, are moved to lower and safer levels during the autumn muster. Wethers are normally retained until their ability to survive and produce reasonably well, as judged by their mouths, wool and general condition, is in doubt.

On highly developed and easy runs, farming practices are similar to those on lowland properties. Ewes are lambed first as two-tooths, few, in any, wethers are kept, and Halfbreds or Corriedales rather than Merinos are carried. Because of their locality, however, they encounter, along with the more difficult runs, feeding problems occasioned by long cold winters and, in many cases, dry summers. It will be readily appreciated that, because of the nature of the country and size of the areas involved, the mustering and moving of stock is an arduous and difficult task requiring considerable skill of both men and dogs.

PASTURE IMPROVEMENT

During relatively recent years, since the control of rabbits and the introduction of aerial topdressing, techniques for markedly improving pasture production in lowland tussock country have been developed. The key to improving the

native tussock grasslands is to obtain good legume growth (Walker, *et al.*, 1955; Lobb and Bennetts, 1958). The main nutrient deficiencies which limit the growth of legumes appear to be sulphur, phosphorus and molybdenum (Walker, *et al.*, 1955; Lobb and Bennetts, 1958; Ludecke, 1960, 1962b).

In areas where the rainfall is greater than 25 in., aerial topdressing and oversowing with clovers plus adequate fertilizer have enabled spectacular improvement to be effected in fescue tussock country up to an altitude of 3,000 ft. Areas with rainfall less than 25 in. can be improved by the introduction of dry land lucerne pastures established by the conventional method of land development (Schofield, 1957) or the direct surface introduction method (Ludecke, 1962a).

The aim in tussock improvement is twofold: to increase animal production through carrying more stock and attaining higher individual levels of performance; and to improve lower country so that grazing pressure can be eased on higher snowgrass country where erosion problems are severe.

Important problems of pasture utilization, however, have immediately become apparent following improvement of tussock pastures. For instance, efficient methods of equating feed supplies with animal requirements remain to be determined, as does the problem of utilizing prolific growth on shady faces without over-grazing the relatively sparse vegetation on sunny faces within the same block.

PAST EXPERIMENTAL STUDIES

Although a wealth of words has been written on high country animal management, very few experimental studies have been reported. The survey work of Ward has already been mentioned. Attempts have been made to determine the species eaten by grazing animals. More than 40 years ago, Cockayne (1919) conducted what he called palatability tests on tussock pastures while more recently J. M. Hercus (1961a) examined plants for evidence of defoliation on a Central Otago trial site. B. H. Hercus (1961) has attempted to provide an answer to the same problem by using a technique involving the identification of plant cuticle fragments in faeces. Coop (1952) carried out chemical analyses and digestibility trials on mixtures of species and on individual species collected from untopdressed hill and high country areas, and postulated that many high

country pastures might be deficient in protein and phosphorus for all but the spring period. Grazing management studies consisting of spelling areas from grazing and recording vegetative changes on grazed and ungrazed sections have been conducted by Dick (1952), J. M. Hercus (1961a) and others. These studies have indicated that spelling does encourage plant regeneration even on depleted areas.

TARA HILLS

Tara Hills is owned by the Soil Conservation and Rivers Control Council and has been administered by the Farm Advisory Division of the Department of Agriculture since 1955. It was purchased in 1948 in a severely depleted condition and was used to study soil conservation problems and to demonstrate conservation practices. In 1961 a management committee was established to broaden and intensify the experimental programme.

The run itself consists of 8,250 acres of which 1,460 acres is flat country. The better soil types on the flat have been improved and are now growing lucerne and lucerne grass mixtures and there is 100 acres of irrigated pasture. The average rainfall at the experimental base is 20 in. The hill country ranges from 1,600 ft to 5,000 ft in altitude and is divided into four blocks ranging from 700 acres to 3,400 acres. A lot of the darker, lower hill country has been improved by oversowing and topdressing with outstanding results. Some improvement has been effected on the sunny faces by spelling and oversowing with cocksfoot. The stock wintered in 1962 were:

<i>Sheep</i>	<i>Cattle</i>
1,300 Merino ewes	54 cows
700 mixed sex hoggets	12 steers
600 wethers	2 bulls
50 rams	16 yearling heifers
<hr/> 2,650	<hr/> 84

It is obvious from the brief outline of animal and grazing experiments mentioned previously that the field for study in the high country environment could scarcely have been less explored when animal trials were first planned about 15 months ago. Results presented in this paper merely constitute an interim report. It will be appreciated that the facilities and limited staff available as well as the importance of the problems to be investigated influenced the choice of subjects selected for study.

EARLY WEANING OF LAMBS

Lambs are normally weaned in February at approximately four months of age. Conditions at this time are often dry, and feed is limited. As it has been shown that lambs can be satisfactorily weaned at relatively early ages (Clarke, 1954) this practice was investigated because, apart from normal advantages, if successful under tussock conditions it would also permit earlier spelling of heavily grazed winter areas.

A random sample of 200 lambs from a mixed age Merino ewe flock was weaned on January 15 at an average age of approximately 11 weeks. Half were then grazed on irrigated pasture and the remainder on an improved tussock block. From the same flock 200 comparable lambs were weaned 4 weeks later and divided similarly to join the earlier weaned lambs on irrigated and tussock pastures. Live-weight gains were measured for a further month.

RESULTS

The liveweight gain of early weaned lambs was significantly higher than unweaned lambs, but after the weaning of the late-weaned group gains were similar.

In both early and late weaned groups significantly better growth rates were obtained on improved tussock grazing although in early weaned lambs this effect was restricted to the period following the later weaning (Fig. 1).

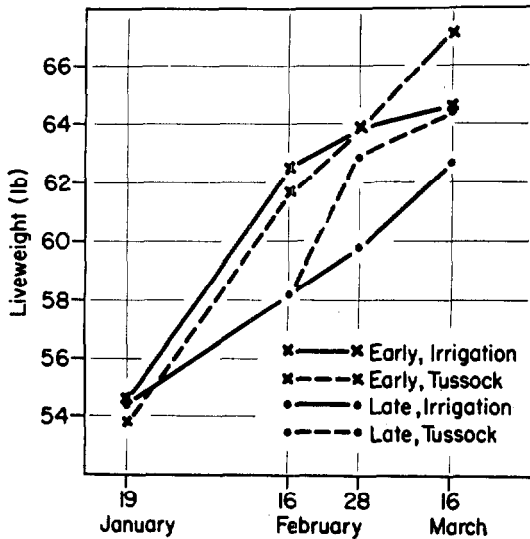


Fig. 1: Liveweight gain of early and late weaned lambs on two types of feed.

The appreciable advantage obtained by early weaning appeared to be associated with a feed shortage in the unweaned group.

The initial liveweight of these lambs at 11 weeks (54 lb) indicates a very satisfactory rate of gain in the lambs of Merinos which are reputed to be poor milkers.

In March, half of the lambs from the early weaned group were dosed with 1 mg selenium. In one month they gained 8.6 lb while undosed lambs gained 4.8 lb. Further investigations of the role of selenium in regard to lamb growth are in progress.

WINTER FEEDING

Winter feeding presents special difficulties in tussock country and carrying capacity is usually determined by the number of ewes which can be wintered. Knowledge of the amount and type of feed required for wintering ewes satisfactorily is necessary for determining optimum stocking rates and grazing management systems. It is here that the efficient economic use of supplements plays an important part.

In 1962 an experiment was conducted in which two groups of 80 ewes were fed at two levels of lucerne hay — 3 lb and 1½ lb per day for two months (August and September) until lambing was imminent. Intake from other sources was considered to be negligible. The ewes were then shorn and half of each group transferred to lucerne grass pastures and fed without restriction. Those remaining on hay were all fed at the higher rate of 3 lb per day for a further six weeks by which time approximately 75% of each group had lambed. All lambed ewes were then run together on pasture until weaning.

RESULTS

Liveweight changes in the two groups of ewes on hay feeding are shown in Table 2 and the production data in Table 3.

The hay was considered to be palatable but of moderate quality only. No chemical analysis is available. Those ewes fed 1½ lb per day ate virtually all their ration but there was a small residue at the 3 lb level.

In the period up to shearing marked body weight differences were induced. By weaning, all groups were similar except for the group fed 3 lb of hay before shearing and pasture thereafter. These were appreciably heavier.

TABLE 2: EWE LIVeweIGHTS (LB)

	<i>1½ lb hay</i>	<i>3lb hay</i>
August 6, 1962	98.6	99.0
August 28, 1962	104.2	109.4
September 28, 1962	103.4	114.8

TABLE 3: WOOL AND LAMB PRODUCTION

	3-3*	3-P*	1½-3*	1½-P*
Fleece weight (lb)				
October 6, 1962		11.4		11.9
February 6, 1963	3.4		3.5	3.0
Lambs born per 100 ewes mated	107	102	90	105
Lamb deaths to tailing	4	2	1	3
Lambs tailed per 100 ewes mated	97	97	87	97
Lamb liveweight at weaning (lb)	67.8	68.1	65.7	69.1
*3-3	3 lb hay before and after shearing			
3-P	3 lb hay before shearing, then pasture			
1½-3	1½ lb hay before shearing, 3 lb hay after			
1½-P	1½ lb hay before shearing, then pasture			

The feeding treatments had little effect on fleece weights although the 1½-3 group produced somewhat less wool in the post-shearing period. Subjective estimates of fleeces at winter shearing showed only slight between-group differences in yield or grade.

Differential feeding before or after shearing did not appear to affect lamb or ewe mortality rates although the numbers involved were small. Lamb tailing and weaning weights were also similar, although the 1½-3 lambs were slightly lighter.

PRE-TUPPING SHEARING

There is evidence which suggests that shearing two-tooths before mating can reduce the number of ewes failing to lamb (McClure, 1960). As low lambing percentages are a characteristic of high country production, this practice was thought worthy of study.

A randomly selected half of a mob of 240 two-tooth Merino ewes was shorn in mid-April approximately one month before mating commenced. Shorn and unshorn groups were run together until lambing but were lambled separately to facilitate the collection of fertility data. Results are shown in Table 4.

TABLE 4: PERFORMANCE OF TWO-TOOTHES

	<i>Shorn</i>	<i>Unshorn</i>
Lambs born per 100 ewes mated	86.0	87.5
Lamb losses to tailing	11	10
Mean lambing date	October 30	October 30
Greasy fleece wt. (lb)		
April 13, 1962	7.3	11.8
October 10, 1962	6.2	

RESULTS

Shearing had no effect on lambing percentage or mean lambing date but increased wool production by 1.7 lb. If the fertility effect of shearing is associated with the relief of heat stress, a response was perhaps unlikely as environmental temperatures at mating are relatively low and Merinos are probably better adapted to high temperatures than Romneys.

BREEDS OF SHEEP

A striking feature of the performance of Merino ewes at Tara Hills is their relatively high production, despite the fact that experiments and experience have suggested that the breed is inherently late maturing, of low fertility, and of poor milking capacity. Because of these beliefs and to obtain a better market for store stock, a breed change to Halfbreds or Corriedales is often made on high country properties once improvements have been effected. To obtain data on the performance of Merinos and Corriedales under the same conditions, it is intended to breed a flock of Corriedales at Tara Hills to compare with Merinos. Two-tooth Corriedale ewes are to be purchased from two or more different sources and mated to Corriedale rams to provide progeny for comparison with Merinos. It is intended to breed a Merino and a Corriedale flock each of about 200 to 250 ewes, and these are to be run together at all times, except during mating. As wide a range of sires as is practicable will be used in each flock to obtain stock of a more representative genetic origin. These flocks are to be run under hill conditions mainly, but for the purpose of collecting accurate fertility data they will be lambed under intensive conditions.

From these flocks data will be accumulated for the purpose of determining the heritabilities of various productive characteristics.

It is of interest that a random sample of 100 replacement Merino ewe hoggets weighed approximately 70 lb liveweight in late September, 1962, and clipped 8.5 lb of greasy wool.

GRAZING HABITS

Observations have been made in autumn, winter and spring of the grazing pattern of Merino, Corriedale and Halfbred hoggets on improved tussock country. Suitable techniques for observing grazing distribution over extensive areas are still being evolved. Coloured plastic collars have been found necessary for breed identification. In general, hoggets have grazed sunny faces rather than shady oversown faces on which feed is abundant. There have been no observable breed differences in grazing pattern.

On the larger wether block (3,400 acres) monthly observations have been made of the distribution of Merino wethers. This area is deeply dissected, but rises to an easy rolling plateau at 4,500 ft. Sheep generally have occupied the lower depleted areas, especially those facing the sun, and very few have been observed in the higher snowgrass regions. In future an attempt will be made to observe from central sites the grazing behaviour of wethers throughout daylight hours.

CATTLE

Cattle can be expected to play an increasing part in the utilization of improved tussock country. With increasing and stable outlets for store stock they could provide a welcome diversification of an essentially wool economy. Known problems of fencing, water supply and winter feeding are very real but information is also needed on the effects of combined sheep and cattle grazing on the vegetative cover and its seasonal utilization.

Tara Hills is suited to the running of beef cattle but, because of the limited number of cattle carried and lack of facilities, investigations may be restricted, initially at least, to a study of the effects of cattle on vegetation rather than beef production as such.

CONCLUSION

This brief summary outlines the major animal projects in progress. It will be appreciated that experimentation under high country conditions presents some special problems, one of which is the difficulty of observing and collecting animals. Although their importance is recognized, pasture utilization studies using grazing animals as indicators of productivity are difficult to execute because comparable areas of adequate size are not easy to locate.

ACKNOWLEDGEMENTS

The authors thank J. W. Kinder and N. Giles and their assistants for the care and recording of experimental

animals. They also wish to thank M. Ball and J. G. Richards for assistance in carrying out some of this work.

REFERENCES

- CLARKE, E. A. (1954): *Proc. Ruakura Fmrs. Conf.*, p. 45.
 COCKAYNE, L. (1919): *N.Z. J. Agric.*, 18: 321.
 COOP, I. E. (1952): *Proc. N.Z. Grassl. Assoc. Conf.*, 14: 109.
 ——— (1955): *Proc. N.Z. Soc. Anim. Prod.*, 15: 5.
 DICK, R. D. (1952): *Proc. N.Z. Grassl. Assoc. Conf.*, 14: 114.
 HERCUS, B. H. (1961): *N.Z. J. Agric.*, 103: 538.
 HERCUS, J. M. (1961a): *N.Z. J. Agric.*, 103: 73.
 ——— (1961b): *N.Z. J. Agric.*, 103: 257.
 LOBB, W. R., BENNETTS, R. L. (1958): *N.Z. J. Agric.*, 96: 537.
 LUDECKE, T. E. (1960): *Proc. N.Z. Grassl. Assoc. Conf.*, 22: 96.
 ——— (1962a): *N.Z. J. Agric.*, 104: 168.
 ——— (1962b): *Proc. N.Z. Grassl. Assoc. Conf.* (in press).
 McCLURE, T. J. (1960): *Proc. Ruakura Fmrs. Conf.*, p. 27.
 O'CONNOR, K. F. (1960): *Proc. Lincoln Fmrs. Conf.*, p. 82.
 SCHOFIELD, R. C. (1957): *N.Z. J. Agric.*, 95: 545.
 WALKER, T. W., ADAMS, A. F. R., ORCHISTON, H. D. (1955): *N.Z. J. Sci. Tech.*, 36A: 470.
 WARD, F. L. (1958): *N.Z. Meat and Wool Board's Econ. Service Bull.* No. 3.
 ——— (1960): *N.Z. Meat and Wool Board's Econ. Service Bull.* No. 8.

DISCUSSION

Q: *What was the condition of the two-tooths in the pre-lambing shearing experiment? Experience has shown that pre-lambing shearing is likely to show benefits only where the two-tooths are in good condition.*

J. D. J. SCOTT: The two-tooths weighed about 90 lb. They had been running on hill country before shearing and from then until mating, one month later, they were run on good lucerne and grass pastures.

Q: *Was there any difference between early and late weaned lambs in worm burden?*

MR SCOTT: We do not know. It is claimed that internal parasites are not a problem under the extensive grazing conditions of high country. This is a matter which is being investigated at present.

Q: *What proportion of South Island hill country is capable of pasture improvement such as has been achieved at Tara Hills?*

MR SCOTT: Dr O'Connor has estimated that about 5 million acres (approximately half) of the high country can be improved substantially. He has calculated that, if this were done, carrying capacity could be increased three- or four-fold.

Q: *Has the pasture production been measured on sunny and shady hill faces? Are the apparent differences not in part due to differences in utilization?*

MR SCOTT: On ungrazed plots, pasture production on oversown sunny faces has been up to 1,000 lb D.M./acre/year compared with 4,000 to 5,000 lb from improved pastures on shady faces.

Q: *Has use been made of the technique of varying cattle to sheep ratios to improve pasture utilization on the shady hill faces?*

MR SCOTT: Not experimentally.