TUSSOCK GRASSLANDS AND MOUNTAIN LANDS INSTITUTE

REVIEW

No. 14

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*The Institute does not necessarily agree with the views expressed in contributed papers published in the “Review.”*

Cover drawing by J. Morgan.
As any runholder is well aware, sudden cold climatic conditions can be disastrous to stock production. Deaths due to cold stress are obvious but one often forgets that even non-lethal cold can be a heavy hidden drain on animal productivity. In practice it is often hard to separate the effects of cold weather on stock, from the effect of less food due to reduced
plant growth during cold weather. In this article I will discuss how climate affects animals and how animals can resist these cold conditions. I will deal mainly with sheep, but will refer to cattle where it applies.

We must consider five factors when relating climatic conditions to animal production:

1. The coldness of the climate in different parts of New Zealand, and how animals adapt themselves.
2. The protection from cold given by the fleece or hair coat, and whether different breeds or individuals are better able to withstand cold conditions.
3. Which weather components — wind, humidity, etc. — most affect the animals' heat losses.
4. The effect of level of feeding on how the animal responds to cold, and the effect of cold on the feed requirements of the sheep. In this section is the effect of shearing.
5. The effectiveness of shelter.

NEW ZEALAND CLIMATE AND ITS COMPONENTS

Components of climate that could have an important effect on sheep are:

(a) Air temperature.
(b) Wind speed.
(c) Humidity, rain, hail and snow.
(d) Sunshine and other forms of radiation.

All are part of the environment so all must be considered together—not just air temperature alone. It is well known that wind makes an already cold air temperature seem worse. Scientists studying heat loss from animals calculate the effect of wind to arrive at an "equivalent still-air temperature". This is the theoretical still-air temperature which would seem as cold to a sheep as the actual wind and air temperature it is experiencing. It takes note of only wind speed and air temperature. The effect of rainfall and sunshine can also be added to give the full degree of coldness that the stock are exposed to. Figure I shows the "equivalent still-air temperature" at several sites from 1958 to 1962. It clearly shows the relative coldness of the South Island environment.

Even though actual air temperatures are often lower at Tara Hills than at Gore or Lincoln, the more frequent and stronger winds at Gore and Lincoln give them a lower calculated "equivalent still-air temperature" in every month of the year compared to Tara Hills in the high country!
PROTECTIVE ABILITY OF THE FLEECE AND HAIR COAT

The fleece or hair coat acts as a barrier preventing the loss of heat from the animal to the cold environment. The animal must conserve heat to keep the constant body temperature so essential for life processes within the body.

Under hot conditions sheep and cattle keep cooler by increasing their rate of breathing. This causes faster evaporation of water from the respiratory tract. Animals also sweat, but less than humans.

Under cold conditions the animal conserves heat by decreasing the amount of blood flowing in the outer layers of the body, reducing the blood supply to the legs and ears (important regions of heat loss), raising the coat hairs to increase the coat depth, and changing its body posture, such as curling up. When these protective measures are no longer enough to stop the lowering of deep body temperature, the animal must increase the level of heat production within the body. Up to this point the heat produced by normal body functions has been enough. If the climate gets still colder, the animal must then start increasing its rate of heat production.
The air temperature at which this happens is called the critical temperature. This critical temperature is affected by both level of feeding and fleece or coat length (as Table 1).

**TABLE 1: CRITICAL TEMPERATURE IN STILL AIR**
(The temperature at which the animal must produce more than normal body heat.)

<table>
<thead>
<tr>
<th>Maintenance Feed</th>
<th>Full Feed</th>
</tr>
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<tbody>
<tr>
<td>Man</td>
<td>77°F</td>
</tr>
<tr>
<td>Shorn sheep</td>
<td>68°F</td>
</tr>
<tr>
<td>Full fleeced sheep</td>
<td>21°F</td>
</tr>
<tr>
<td>Short coated steer</td>
<td>50°F</td>
</tr>
<tr>
<td>Fully coated steer</td>
<td>14°F</td>
</tr>
<tr>
<td>3 day calf 1 gallon milk/day</td>
<td>55°F</td>
</tr>
<tr>
<td>20 day calf 1½ gallons milk/day</td>
<td>46°F</td>
</tr>
<tr>
<td>New born lamb</td>
<td>84°F</td>
</tr>
</tbody>
</table>

This clearly shows the big difference between the air temperature a full-fed shorn sheep will stand, compared to a shorn sheep fed only a maintenance ration. The critical temperature of Cheviot sheep fed at a maintenance level under still air conditions has been shown by experiments to be—

**Fleece Length** 1-5 in. 2-5 in. 4-5 in. 2 in.  
**“Critical Temperature”** 73°F 68°F 59°F 36°F  
(Maintenance level, still air)

Once the critical temperature of an animal has been reached, heat production increases in direct proportion to the drop in temperature no matter how much extra food the sheep gets. This is shown in Figure 2.

It is very difficult to sort out the separate effect of each different component of the weather on heat production in the animal. Therefore, it is more usual to talk about insulation values rather than levels of heat production. High insulation values mean a good ability to reduce heat loss. Similarly materials with low insulation values offer little resistance to the flow of heat. (Insulation values are usually given simply as “insulation units”.)

The insulation between the inner regions of the animal’s body and the environment, can be thought of as having two parts. The inner one is the skin itself and the outer one is the fleece or coat, together with the layer of air at the coat surface. Animals can increase their insulation by reducing blood flow to their skins. Once they have done this they cannot
increase their tissue insulation any further. Cattle and sheep on average have similar tissue insulation (of 5 to 6 insulation units) although individuals and breeds can vary. For instance, the resistance to heat losses from Cheviot sheep shorn of all their wool will be almost twice that of Down sheep. This difference is most probably due to differences in the blood supply of the skins of Cheviot and Down sheep.

Almost nothing is known about the insulative properties of the fleeces of different breeds of sheep, other than that Merino fleeces tend to have greater insulative properties than others. Only staple or hair length has been shown to be of importance. We know, however, that new-born Merino lambs with hairy coats are able to conserve heat better than similar lambs with fine coats. The hairy coats have twice the insulation value of the fine coats. It is coat properties such as these that allow greater chances of animal survival under cold conditions.

The outer insulation is made up of the still-air layer on
the fleece surface and the fleece itself. Even if the animal had no fleece and only bare skin, e.g., man and pig, it would get considerable insulation from the still-air at the skin’s surface. Under still-air conditions the insulation value of this air layer lies somewhere between five and six insulation units. This layer of insulation is, however, very easily broken down by increasing air movement.

The insulative value of the fleece alone under still-air conditions is about 3-3½ insulation units per 1-5 inch of fleece depth (as shown in Table 2).

**TABLE 2: INSULATION OF FLEECE IN STILL AIR**

<table>
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<tr>
<th>Breed of Sheep</th>
<th>Units of insulation per mm of fleece depth</th>
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</thead>
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<tr>
<td>Suffolk Cross</td>
<td>0.75</td>
</tr>
<tr>
<td>Scottish Blackface</td>
<td>0.60</td>
</tr>
<tr>
<td>Down Cross</td>
<td>0.59</td>
</tr>
<tr>
<td>Cheviot</td>
<td>0.60</td>
</tr>
<tr>
<td>New-born fine coated Merino lambs</td>
<td>0.45</td>
</tr>
<tr>
<td>New-born hairy coated Merino lambs</td>
<td>0.61</td>
</tr>
<tr>
<td>Merino sheep</td>
<td>1.0 - 1.3</td>
</tr>
</tbody>
</table>

(25.4 mm = 1 inch or 5 mm = 1-5 inch)

Insulation values of the Merino fleece appear to be twice those of results found for other breeds. If we use an insulation value of 3½ units per 1-5 inch of fleece depth, and assume the fleece to grow from 1-5 inch to 4 inches over the 12-month period between shearings, and include a skin insulation of six units, and an air insulation of six units, then the total animal insulation will increase from 15 to 77 insulation units. Comparable figures for Merino sheep would be an increase from 18 to 127 insulation units from shearing to full wool.

While an animal can lower the rate of heat loss from the body to a certain extent by reducing blood flow to the extremities, i.e., ears and legs, once conditions become exceedingly cold the animal must try to stop these extremities from freezing, i.e., frostbite. It does this by allowing short bursts of increased blood flow through the exterior blood vessels of these extremities to raise their temperature periodically.

**EFFECT OF CLIMATE ON THE TOTAL INSULATION OF FLEECE AND HAIR COATS**

(a) Wind plays an important role in destroying the insulative properties of the fleece. A relatively mild wind of 10 m.p.h.
will destroy about half the insulative value of a fleece. The effect of body position in relation to wind direction is most marked and depends on the animal’s fleece length. In one experiment, newly-shorn sheep with \( \frac{1}{4} \) inch of wool had external insulation values of 4.3 when the right side faced the wind and 4.2 units when the hindquarters faced the wind. When, however, the fleece length was 1\( \frac{1}{2} \) inches, the insulation value of the fleece for hindquarters facing the wind was 25 per cent greater than for side exposure.

The importance of wind in the survival of Merino lambs has been shown in experiments, where, when the wind speed rose from 0.2 m.p.h. to 12.5 m.p.h., the insulation value of the coat dropped by two-thirds.

(b) Rain, particularly with wind, can cause a severe drop in coat insulation. This is shown in Figure 3. The effect of wind alone and of rain alone was greatest on sheep with short fleeces. Wind and rain together had almost an additive effect. Although rain can reduce coat insulation this is not always the case. Fine rain can increase coat insulation in a mild breeze by cementing the individual fibres together and stopping wind penetration.

(c) Sunshine under cold conditions can reduce the stress on an animal. At our latitudes the heat on the surface of a sheep can be some four times its inner heat production. Even under completely overcast conditions, with the sun just above the horizon, the heat load on the skin is never less than 10 per cent of the inner heat production. Even sheep under snow conditions can still receive great benefits from sunshine due to reflection of the sun’s warmth from the snow.

![Figure 3](image-url)

Figure 3—Increase of heat production in sheep due to rain and wind (compared to a sheep with half-inch of wool, in little wind and no rain).
EFFECT OF CLIMATE AND SHEARING ON MAINTENANCE REQUIREMENTS

When the intake of grazing sheep is compared to those of sheep fed similar cut pasture indoors, the maintenance requirements of the grazing sheep may be higher by from 24 per cent to 275 per cent, or from a quarter to nearly three times more. The average increase is 80-90 per cent or approaching twice as much. Part of this increase is due to the effort of walking and climbing, and part is due to the effort of grazing the herbage instead of being fed cut material. However, even when these two factors are allowed for, a big part of the increased maintenance requirement still remains. Probably a large part of this is the drain of the climate on the sheep’s energy.

When sheep are shorn, the heat loss from the body increases and the animal tries to eat more to provide more body fuel. Sheep can eat up to half as much again right after shearing. As expected, the appetite will depend on how cold the weather is. In a sheep affected by cold after shearing, more food energy is used for maintaining body temperature and less for productive purposes. The balance between the two will depend on both the level of feeding and the degree
of cold stress. Under severe conditions the feed intake alone will not be enough to maintain body temperature, and the animal must use up body fat for fuel and hence loses weight.

I question the economics of out-of-season shearing because of the increased heat losses and thus greater maintenance requirement. It seems to me that shearing should be done during the warmer months when climatic stress is least. The sheep appears to be fairly well protected against the environment by its fleece except right after shearing. It is then that adequate feed and shelter, either natural or artificial, is vitally important.

SHELTER

The usefulness of shelter is difficult to assess. Obviously shelter reduces wind velocity and prevents exposure to driving rain. Under hot conditions it provides shade. A shelter belt reduces wind speeds near the ground for a down-wind distance of about 30 times its height and is most efficient for about one-third of this. Similarly there is some “up-wind” shelter from shelter belts. Provided that there is enough food, natural ground shelter will probably be sufficient to limit the exposure of sheep and cattle to extreme environmental conditions.

There are no new answers for fighting the effect of cold on sheep and cattle. The practical solution lies in good farm management, that is, providing enough food and shelter, especially during shearing, lambing or calving or when the animal is young. Even this is difficult to do when there are sudden, unpredictable and catastrophic weather changes.

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A SIGN OF THE TIMES

Extract from a Runholder’s Invoices


2 500’s Penicillin
1 Pocket Knife
1 Earmarker
1 Foster Milk
2 Foster Ewe
2 Save-a-Lamb
1 Big Ben Alarm Clock
CORRIEDALES IN THE HIGH COUNTRY
By P. C. Ensor, Double Hill Station

In this, the third article of this series on sheep breeds in the high-country I do not propose to go in detail into the early history of the Corriedale. It is the same as that of the Halfbred, already ably described by Mr Cran.

EARLY BREEDERS

Not only was the history similar but also many of the same breeders were involved. The subsequent development of the Corriedale was more a question of evolution than revolution.

The history of the Corriedale as a distinctive breed goes back to the latter part of last century. Some far-sighted breeders, seeing the lack of uniformity when extremes in breeds were crossed, set about in-breeding the Halfbred to stabilise its desirable features.

The first man in New Zealand to cross a longwool ram on the Merino ewe and then inbreed the halfbreds to secure a new breed of sheep was Mr James Little.

At that time, about 1866 to 1868, Little was employed by Dr. Webster in Otago and he mated Romney rams with Merino ewes. The results of his early in-breeding appear to have been very successful. Unfortunately, on the death of Dr. Webster, the flock was dispersed and as far as is known there are no Corriedale descendants of this original cross.

James Little then moved to North Canterbury and in 1878 started breeding again on his own account, this time crossing the Lincoln ram on the Merino ewe. The care and selection that went into this early breeding is shown by the fact that from the progeny of 4,000 ewes only 20 rams were retained for stud purposes.

In 1874 the New Zealand and Australian Land Company started breeding Corriedales at the Levels Estate near Timaru and the progeny of their flock are thus the oldest-established Corriedales.

Other breeders to establish flocks from an original cross up to the turn of the century were—1879, D. G. Greenwood; 1889, Charles Ensor; 1890, Leonard White and Sir Charles Campbell; 1901, Owen Evans.

There appear to have been few, if any, original crosses made after this date, and all were Lincoln-Merino cross with the exception of Ensor, who used English Leicester rams on fine-combing Merino ewes.
These early breeders saw the need for a true dual-purpose sheep to meet New Zealand conditions and, in the words of Mr Little, his ideal all the time was to get the solid, well-shaped carcase of the Shropshire or Southdown well covered with a good staple of the best-quality halfbred wool. He also recognised that to make the breed worthwhile it must be a sheep that would be able to fight for itself and not need coddling, and further that there would be no genetical improvement by the continued use of a first cross.

That these objectives have been achieved is shown by the fact that the Corriedale is now the second largest breed of pure-bred sheep in the world—the Merino is the largest.

As the Corriedale was originally evolved for hill country, one can perhaps wonder why it has not been used more extensively on the high country too. Part of the answer to this difficult question is probably that, once the Corriedale became established, its popularity on the easier hills and low country increased very rapidly. Stud breeding was naturally aimed at this large existing and potential market, thus tending to produce a type not necessarily so suitable for the more exacting demands of the high country.

On the other hand, the Merino did well under these high-country conditions. Where an alternative was desired it was quite easy to breed the halfbred.

**FEATURES OF THE BREED**

During the past 50 years there have been Corriedale flocks established throughout the high country. These breeders have recognised the advantages of working with a pure-bred animal against continual cross-breeding, or believed that a change from the Merino was desirable. There are sufficient of these flocks under varying conditions in the high country to show that the Corriedale will thrive and be profitable.

At the 1951 Lincoln College Farmers’ Conference the writer gave a paper on “Corriedales in the High Country”. At that time accurate figures of production on high-country runs were almost non-existent. However, since then the Economic Service of the Meat and Wool Boards has carried out extensive surveys, and a Bulletin published in 1960 more than justifies any claims made on behalf of the Corriedale in 1951. Of the 42 high-country runs under survey, three Corriedale flocks show wool weights of more than 1 lb per head higher than the average of all runs (only three others were significantly higher), sales of surplus sheep run 10 per
cent higher, lambing 10 per cent up and death rate average to well below average.

From the financial angle, again only three runs show a better net return per head of sheep, and only one a greater gross return.

With the development now taking place in the high country, it is inevitable that some change will take place in the breeding policy of runholders. It is here that the future of the Corriedale as a high-country sheep lies. By saying this, I do not mean that all will change their breed—nothing could be more undesirable. The Merino's place in the high country cannot be denied and better feeding conditions do not necessarily mean that it must be replaced by some other breed.

On the other hand, some country could show a better economic return from the use of a breed with a more diversified production than the Merino. One factor which could influence this is better access to markets allowing a quicker turnover of stock. The personal preference of a breeder must also be taken into account.

THE RESULTS OF CROSSING

When a change is made or contemplated, it must be a well-planned one — selecting rams of a desirable type and as
far as possible ensuring a continuous supply of the chosen strain of rams. Any sudden change of breeding policy in the high country can be full of pitfalls and one great proven advantage that the Corriedale sire has, is that it can be gradually introduced into either a Merino or Halfbred flock without causing a drastic and undesirable variation of type. This allows time to assess the change and gain experience in producing the right type of sheep.

In the case of the Halfbred an evening-up of the type and quality of both wool and carcass can be expected. One of the major reasons for the use of the first-cross halfbred is hybrid vigour—but the advantages must be weighed against the inevitable disadvantages of continued cross-breeding. There are sufficient statistical records available to show that any alleged loss of hybrid vigour in the Corriedale is often illusory when it comes to economic production.

The figures I have already quoted should prove this as no animal lacking in vigour could give results well above average, and this on country up to 7,000 feet with almost none of the summer country being below 3,000 feet.

Used on a Merino flock, there will of course, be a lowering of wool count but quality and weight can largely be maintained whilst developing a carcass more acceptable on the market. When a large proportion of dry sheep are run, the Merino usually shows to advantage in wool-weight per head but as the proportion of breeding ewes and young sheep rises, this advantage tends to disappear.

Selecting the right type for the high country cannot be emphasised too often and, linked with management, is probably the most important factor for success with the Corriedale in this environment. The word 'type' rather than 'strain' is used as it appears to me that strains are evolved through continued selection to a desired type and even then it is necessary to select to a type to maintain the desired standard of the strain. On the other hand, for commercial buying, it is probably first necessary to decide where an acceptable strain can be bought and then select for preferred type within that strain.

The writer has a decided preference for the Corriedale from the English Leicester cross, for the same reasons as Mr Cran advocates this cross in the Halfbred, namely, hardiness, ability to recover from a check, and quality of wool. The Lincoln cross originally produced a heavier type of wool, but in the high country one must be careful not to try to produce a
weight of wool that cannot be sustained on the feed resources available.

**SELECTION**

Carcass—As constitution is all important in the high country, a quality carcass must be the aim. The setting of the rib in the backbone is vital — incorrectly set the sheep will soon appear slab-sided under adverse conditions. A thick or heavy shoulder should be avoided and good length of carcass maintained. Quality of carcass is more important than size. Provided the quality and constitution are up to standard, size is basically a matter of feeding.

Wool—For the high country, wool finer than the usual commercial Corriedale is required and for most conditions a good quality 58-58/60’s is best, provided sufficient staple length is maintained — a short 58-60’s wool is to be avoided at all costs as it will inevitably result in a loss of weight. As a point of interest, this season I checked my own and some other high-country Corriedale clips in the wool-store and according to the broker’s assessment the hogget wool was 58/60’s to straight 58’s. Over two-thirds of other Corriedale fleece wool was 58’s, one-third was 56’s and about 2 per cent below 56’s.

To attempt to breed to a 56’s under high-country conditions means that the lower end of the clip will be too strong for the country.

In the past the Corriedale was at times criticised for a tendency to wool-blindness — a serious fault in any breed and not confined solely to the Corriedale. It can be overcome by careful breeding and selection of sires without going to the other extreme and producing an ugly bare-headed animal, probably also weak in the points and belly and altogether a light clipper.

**THE CORRIEDALE IN THE FUTURE**

After nearly 40 years’ experience with the Corriedale in high country ranging from the days when any sort of improved pasture or winter feeding was virtually unknown, to the development of the present time, I am satisfied that the Corriedale is adaptable enough to give more than satisfactory results on most classes of high country.

The development taking place in the high country will give even more scope for the full exploitation of the all-round productive ability of the Corriedale — a point well illustrated in the Economic Service’s survey when, for the period under review, the average gross returns per head of sheep for three
Corriedale flocks ranged from $5.14 to $5.41 as against the average for 42 runs of $4.25.

As a sheep to handle on the high country I believe that they are but little inferior to the Merino — not quite so fast but tracking and keeping together well.

My own ewes are probably one of the last mobs to be driven nearly 40 miles to their annual ewe-fair yet can still sell in the top bracket.

The decision as to what class of sheep to run on any particular place is in general the personal preference of the owner within the limits set by the country. Without denying the Merino its special place in the high country, I believe that the productive value of the Corriedale will assure it of an increasing percentage of high-country sheep.

This ability as an all-round producer makes it less vulnerable to a fall in fine-wool prices than the Merino and the quality of its surplus stock, and heavier wool clip, gives the Corriedale an advantage over a Halfbred flock which needs a much higher culling rate.

RESIGNATION

Dr. S. N. Adams, Director of the Tussock Grasslands and Mountain Lands Institute since 1965, has resigned.

He has accepted appointment as Principal Scientific Officer in the Chemical and Animal Nutrition Division, Northern Ireland Ministry of Agriculture, and will be stationed at Queen’s University, Belfast.

Dr. Adams has left behind him a reputation for independent thought. He expressed his opinions fearlessly and although some of them ran counter to established views, the fact that he spoke up may well have caused others to re-examine their arguments.

In an age when scientists are often reminded of their duty to communicate clearly with the public which supports them, Dr. Adams had a particular ability to write simple prose. He insisted that any article must be easily understood by those for whom it was written. His editing shook the confidence of many a writer but the result was always readable.

We feel sure that his critical ability will stand him in good stead in a "land of fable and fairies."
MOLESWORTH — THE ECONOMIC RECORD

By R. W. M. Johnson, Agricultural Economics Research Unit, Lincoln College

It is fortunate that the Department of Lands and Survey has kept very good financial records of progress at Molesworth. When these figures are viewed over the whole period since 1940, a most favourable picture emerges of good management, satisfactory economic returns, and soil control. This short article discusses a recent analysis of the Molesworth accounts,* and sets out some of the reasons why the results have been so good.

As is well known, the lessee of Molesworth surrendered his lease to the Crown in 1938, after a losing battle with low wool prices, rabbits and snow losses of sheep. In those days, Molesworth station included the runs of Molesworth, Tarndale and Rainbow. Rainbow was re-leased in 1939, and the Lands and Survey Department first re-stocked the remaining two runs with cattle in 1940. In 1949, the lessee of St. Helens station—which included the St. Helens and Dillon runs—also surrendered his lease, and these two blocks were added to the above to give the present-day station area of 450,000 acres.

In 1949, cattle numbers had reached 2,500, and with the absorption of St. Helens the herd increased to 4,800. Numbers have slowly built up, and since 1959, the winter carrying capacity has fluctuated between 7,500 and 9,000 head of cattle. Further increases in numbers are limited by the need to provide adequate winter feed.

The main source of revenue to the station is the sale of two- and three-year-old steers in the Addington market. Prices have varied from $80 to $90 per head in recent years. In addition, the fairly steady level of herd numbers has meant that 400-600 heifers and cull cows could also be sold every year. Altogether, steers brought in a revenue of $92,000 in 1966/67, and cows and heifers brought in a revenue of $61,000 in the same season.

Molesworth is not a cheap station to run. Cattle replacements (mainly bulls) cost $15,000 per year, wages $20,000 and freight $8,000. The major item of expenditure is rabbit control, and in 1966/67 some $36,000 was spent on poisoning, aeroplanes, and rabbiter’s wages. Since Molesworth lies outside a declared Rabbit Board area, the Lands and Survey Department can claim the usual rabbit subsidy directly from Government.

In this way, some $18,000 of the above rabbiting costs are recovered. The total running costs (including the full cost of rabbit control) comes to some $130,000 per year.

On the basis of present revenues and expenditure, the station has an annual surplus of about $50,000. This is the sum available each year for further capital expenditure. Interest has to be paid on money borrowed from the Treasury, but no allowance is deducted from the surplus for interest on the total capital worth of the property.

There are two measures of profitability which are worth calculating in the case of Molesworth:
(a) the rate of return on all money spent,
(b) the current rate of return on capital.

The first measure treats the enterprise rather like a Post Office savings account which allows withdrawals on overdraft as well as deposits. All current and capital expenditure is drawn out of the account, and all revenues are paid back in. As the enterprise develops, these revenues are expected to exceed the earlier costs of development. The question is, what rate of interest would these extra returns allow to be paid on earlier outgoings? The appropriate calculation shows that this rate of returns is 14.8 per cent, that is, the true rate of annual capital appreciation in the case of Molesworth has been nearly 15 per cent. per year.

The second calculation shows present annual surpluses as a percentage of the total capital investment in 1966/67. This ignores the pattern of income and expenditure in the past and merely takes the present as a yardstick. If all development expenditure is deleted from the annual budget, it can be estimated that the true surplus as a going concern is about $60,000 per annum. The capital employed to generate this surplus is difficult to measure exactly, but on the basis of past capital expenditure of $200,000 and the present value of the cattle herd of $511,502, the capital employed is approximately $710,000. Alternatively, the Valuation Department's assessment of the value of land and buildings is $353,830, which gives a total of $865,332. These respective estimates give the following current rates of return:

On capital improvements at cost plus stock ...... 8.4 per cent
On capital improvements at valuation plus stock  6.9 per cent

It can therefore be seen that the current rate of return in relation to capital employed is not spectacular, but nevertheless quite satisfactory for such a difficult type of enterprise. The
previous estimate of a return of 15 per cent reflects the fact that surpluses were probably higher in relation to the capital employed earlier in the development programme for Molesworth.

This satisfactory result must be examined in the light of the history of the take-over of Molesworth by the Crown. In the conditions of the early forties, it was not at all clear that cattle could be made to pay on the high country; the decision to run cattle was made on soil conservation grounds as a possible answer to the depredations caused by rabbits. In conjunction with rabbit control, the improvement of the surface cover has been achieved by these means, and the decision has been proved a correct one. Indeed, over the intervening years a number of stations in the same area have now changed to an all-cattle policy.

The success of the cattle programme is also due to the high degree of adaptability of cattle to the high country. In comparison with the excessive snow losses of sheep on Molesworth and St. Helens over the years the loss from deaths of cattle over the last 27 years have been quite low (4.3 per cent). Apart
from disease problems, the occupier's capital is not therefore periodically wiped out by factors beyond his control. The uncertainty associated with high-country grazing has been reduced.

A second factor contributing to the success of cattle on Molesworth is recent trends in world demand for beef. Over the years, beef meat has been in more demand than sheep meat, and fattening stock from Molesworth have received the benefit of this. In addition the Molesworth stock have a reputation for doing well and quiet handling. Both factors have contributed to the economic success of the experiment with cattle in the high country.

The recovery of the surface cover has not been without its problems. The growth of sweet brier is one of these. Apparently cattle are more fastidious than sheep or rabbits and will not nibble the young brier shoots down. At some stage control of brier could be quite expensive.

The skilled management of Molesworth has played its part. Mr Chisholm has built up a tremendous knowledge of the problems associated with high-country grazing with cattle, and the results so far outlined together with the excellent lines of steers seen in the Addington saleyards are good testimony of this.

Under the circumstances, it seems unlikely that these results could have been achieved by private run-holders. The role of the State has been to provide a large amount of capital in a period when the economic future was uncertain, and the particular success of cattle as a grazing animal in the high country was unknown. The soil conservation objectives of the experiment are being achieved. It is the value that the community places on these objectives that will determine the future role of the State in the high country. If the technical needs of soil conservation are rated high enough by the community, then large-scale destocking of the high country of sheep may be necessary. In this case, a great deal of re-organisation will be needed in boundaries, fences, buildings and finance. It is likely that the State would then have to step in, in a paternal and beneficial way, to ease the many difficulties of the transition and change to a full soil conservation programme.

* Mr Johnson is the author of the recently published “High Country Development on Molesworth,” a 35-page economic survey of the property, Publication No. 40 of the Agricultural Economics Research Unit, Lincoln College.
This book is more than a collection of pictures by a well-known mountain artist. The author tells also in the text the simple unaffected story of his career and aspirations.

Austen Deans is a Canterbury man of the very earliest lineage, his forebears having been established at Riccarton long before the “First Four Ships.” He has become one of our best-known mountain painters and his pictures are familiar to most high-country men. He was twice winner of the Kellihier Art Award.

A wide selection is reproduced here including a number which are not of mountain subjects. There are 20 colour plates including three portraits and innumerable drawings tracing his progress through youth and war and family life. The reproductions are good on the whole, though those of the Peel Forest bush have lost some of the delicate contrasts of light and shade which makes the originals so delightful.

Seeing them collected together I feel that Austen Deans is at his best when he brings the viewer right into the stark magnificence of peak and valley and rock and scree. The familiar distant pictures of the Rangitata Gorge which have proved so popular do not display the forceful realism of which he is capable. His versatility is demonstrated by the portraits and one cannot help thinking that if fate had placed him in a different environment he might have been a portrait painter of distinction.

He says himself that his once cherished ambition to become a true modern failed before the lure of New Zealand loveliness and the inexorable force of economics. Perhaps we should be grateful that it did.

Many will enjoy this book of lovely pictures and learn something from his own lips of the simple kindly man who painted them.

D. McL.
LYMPHO OR CASEOUS LYMPHADENITIS OF SHEEP

A Review by M. C. Armstrong, Livestock Superintendent, Department of Agriculture, Christchurch

Lympho or Caseous Lymphadenitis is a disease of sheep and goats in which slowly developing, cold, cheese-like abscesses occur mainly in the superficial lymph glands of the body when wounds are infected by bacteria called Corynebacterium ovis. In the live animal there is little sign of any adverse effect on health. However, the disease is important because of the condemnations of meat and rejections of carcasses for export when lympho abscesses are found at meat inspection.

Economic loss from this disease varies from one flock to another, depending on the degree of condemnations and rejections of carcasses at slaughter. Lympho commonly occurs in sheep-raising areas of Australia, New Zealand, European countries, North and South America but rarely in Great Britain. It is more common in the wrinkly, angular breeds of sheep prone to shear cuts and in the less intensive, dry, pastoral areas where the chance of soil and dust contamination of wounds is greatest.

The causal bacillus is capable of living and multiplying outside the animal in the surface soil under shade and a little moisture for as long as two years. It has been found to be present in the dung of both infected and healthy sheep. Therefore it may exist as a parasite in the intestines and be passed out in the dung for the infection of recent wounds. The bacillus is common in sheep camps—especially those in damp, shady areas. Disinfectants readily destroy it.

MODE OF INFECTION

The commonest route of infection is the inoculation or contamination of cuts and wounds inflicted at shearing, crutching and lamb-marking. Wound infection probably occurs most frequently in and around the shearing shed, in the yards and sheep camps from contaminated dust, dirt and soil. The shearing board, chutes and counting-out pens are especially suspect. Shears and machine handpieces may become contaminated from a discharging or ruptured superficial abscess and then inoculate wounds as shearing or crutching progresses. Any other factors causing wounds, such as dog bites, may be significant in a flock in which the disease occurs. The incidence increases with the age of the sheep—doubtless due to more chances for wound
infection. The disease seems to be more common in angular, lean, wrinkly flocks, especially some Merino strains, in which there may be a greater chance of wounds at shearing. Rough shearing and machine shearing affect the degree of wound infliction.

SYMPTOMS AND POST MORTEM APPEARANCES

In the live animal the only sign of infection may be enlargement of one or more of the superficial lymph glands of the shoulder, flank, thigh and groin or perhaps a discharging abscess from the body surface. Abscesses in the lymph glands contain a greenish coloured pus of cheese-like consistency. Many of these abscesses tend to point and burst to contaminate the environment with a chronic discharge of pus. The superficial lymph glands most commonly affected are those of the shoulder, flank, thigh and groin. Careful palpation of the superficial lymph glands soon after shearing may detect up to 70% of infected sheep. In severe cases, abscesses may be found in the lungs and other internal organs.

TREATMENT

There is no successful treatment known apart from the surgical removal of abscessed glands. This may be considered for valuable animals.

PREVENTION AND LINES OF CONTROL

Attempts to reduce the incidence of lympho must be along three lines of attack, that is prevention of unnecessary wounds, prevention of wound infection and reduction of the source of infection.

1. PREVENTION OF UNNECESSARY WOUNDS

This brings to mind clean shearing instead of fast, rough shearing. There is also the opinion that blades inflict fewer wounds on Merinos than machines—also that machines tend to cut through an abscess and are harder to disinfect than blades. Some runholders believe that they have reduced the incidence of lympho by returning to blade shearing instead of machines. Decisions like this depend on economic and management considerations. Plain-bodied Merinos may be selected before wrinkly strains. Dog biting must stop.

2. PREVENTION OF WOUND INFECTION

Shearing and shed hygiene are important, with the highest possible degree of cleanliness and disinfection in the shearing shed. Special attention should be given to the shearing board and all places where freshly-shorn sheep with shear cuts are
handled—particularly chutes and counting-out pens. Wound dressings are advocated—the most convenient may be a disinfectant in pressure atomiser form. A dry powder dressing of equal parts sulphanilamide and boric acid applied by shaker is useful for protecting and healing wounds.

Freshly shorn sheep should be turned out quickly on to clean grass areas if such are available.

At lamb-marking a high degree of hygiene and regular disinfection of instruments is necessary. This should be done in temporary yards in clean, spelled areas, and the lambs dropped into a spelled grassy paddock.

3. REDUCTION OF THE SOURCE OF WOUND CONTAMINATION

Sheep with burst discharging abscesses are a potent source of infection at shearing and crutching. It is obviously important to keep a close watch for these and cull them aside both before and after shearing. As young sheep have fewer mature and ruptured abscesses, shear them first if possible.

It is wise to reduce the amount of dust contamination of wounds in the vicinity of the shearing shed. This means more concrete in pens and yards and water spraying to reduce dust. Shifting newly-shorn sheep quickly from yards is worth emphasising again. On some properties it may be possible to clean up sheep camps by either fencing and spelling the concentrated area for two years or by cultivation and seeding.

Plunge dipping off-shears before wounds are healed is not recommended as the chances of wound infection are higher.

Attention to the cleanliness of shearers’ clothing is also relevant to the prevention of wound infection.

RESEARCH AND INVESTIGATION

In Australia there has been research effort to produce and test a vaccine. Unfortunately, the results were most discouraging. It seems that it is impossible to prevent infection by vaccination. Australian research also tried to find a diagnostic test similar to a tuberculin test for detecting infected sheep. But its efficiency was too low to be of any practical value.

In New Zealand the Department of Agriculture has made several attempts to control lympho by palpating the superficial lymph glands and culling sheep with enlarged infected glands. It is easier to detect in recently shorn sheep. Much skill and labour is required for individual palpation. It was found that

Grossly Enlarged Lymph Glands Infected with Corynebacterium Ovis

*Photos: M. C. Armstrong.*
this method alone is not enough for eradication owing to its failure to detect a worthwhile proportion of sheep in the early stages of infection.

As the causative bacillus is sensitive to penicillin, the New Zealand Department of Agriculture conducted trials to test the use of penicillin injections at shearing time for prevention of wound infection. The results showed little control for the high costs involved.

One runholder in New Zealand has advocated the use of a disinfectant dipping spray straight off-shears—claiming that a dramatic reduction of lympho incidence over recent years has followed this addition to his strict attention to hygiene.

Although it has been tested on one property by the Department of Agriculture with doubtful results, it appears that a more critical evaluation of this method is necessary.

The following important factors for control should be constantly practised:

1. Cull obviously infected sheep both before and after shearing and crutching.
2. Observe the highest degree of cleanliness, disinfection and decontamination at shearing, crutching and lamb-marking.
3. Do everything possible to prevent unnecessary wounds at shearing time.

Several runholders in New Zealand seem to have reduced lympho to negligible proportions by strict attention to these factors.

GODLEY PEAKS STATION’S EXPERIENCE WITH LYMPHO

By John Scott

We took delivery in May, 1937: 10,000 Merino sheep—2,000 flock ewes, 3,000 hoggets and two-tooths and the balance flock wethers.

At the Tekapo sale in March, 1938, we sold 1,000 cast-for-age wethers at 2/6 each and 600 cast-for-age ewes at 7d. It was obvious that selling surplus stock at such prices was not going to get us very far, so we put in hand a fencing programme, which had as its object the reserving of several areas of river flats.

These, then, were to be used for our cast-for-age mobs to give them a build-up in condition, to bring them up to freezing-work’s standard. We were successful in this, and 1,200 wethers killed out at excellent weights; but with a 36% lympho rejection!
I took my problem to the then Government veterinarian in Timaru, Mr Lukey. His solution was cleanliness—inside the shed, outside the shed, and in any pens or yards used for immediate off-shears sheep. And as important as any of the foregoing—keep dust down.

Our woolshed was an old one and like all old ones the shearing board was a medley of cracks and crevices where the tongue and groove had broken away. Bad to work on and impossible to keep efficiently clean. We solved this problem by screeding the whole surface off to a depth of $\frac{1}{2}$in. - $\frac{3}{4}$in. with an emulsified bitumen-sand-cement mixture, and then surfacing with $\frac{3}{16}$th in. hardboard, painted with a floor paint for protection and waterproofing.

This floor is still in excellent order today, and I see no reason why it should not give many more years of service. Count-out pens were concreted and a first-class piped water supply installed.

The basis of our shearing management is covered by the following five points:

1. Keeping the shed clean and free of litter at all times (out of the shearing season as well as in).
2. During shearing the board and count-out pens are washed out every day and nearby yards wetted down.
3. All water pots are emptied every day and recharged with fresh disinfectant solution. (We blade shear.)
4. New clean oil rags are given to the shearers every day and disinfectants added to the shear oil.
5. We keep vegetative cover in off-shears' yards as vigorous as possible to keep down dust.

I gave you the 1939 figures of 36% rejection. From 1940 to 1949 we put into the works about 500 ewes (kept dry for one year) and 1,200 wethers annually. In the first three years lympho reduction was slow, but thereafter spectacular, until in 1947 we recorded our first clean sheet and this was repeated in 1948.

I must make it clear, that during the years quoted our cast-for-age sheep had also been getting steadily younger, the bulk being round about five-year-olds.

The wethers, in particular, had at least two more years of valuable wool production left in them. It so happened that in that year John Hogg, who had been with me ten years, purchased a property in the Tasman Valley.

Until he sold out in 1962 most of our cast-for-age sheep went to him. He normally kept these two years and then fat-
tended them for the works. I have it from him that his total lympho rejection in that 12-year period amounted to under ten sheep.

Since 1962 our cast-for-age sales have gone to various buyers and we just have not been able to keep track of their performance.

In conclusion it may be of interest to follow John Hogg's experience with lympho a little further. Naturally when in Guide Hill he followed our procedure to the letter, and is repeating it in his new property on eastern Lake Tekapo. In his first year he had a 25% rejection. Last killing season he had this down to 4%, and is confident he can record a clean sheet in the not distant future.

**LYMPHO PREVENTION ON HAKATARAMEA STATION**

By C. B. Hercus, Manager

In the autumn of this year, an article was published in the Christchurch "Press" and the "Otago Daily Times" in which I told of my experience in controlling lympho. The incidence of this disease in our older sheep has dropped from 50 per cent down to 4 per cent.

This created so much interest among farmers running fine-wool sheep that I have been repeatedly asked to come out in the open about our method of control and the type of material we are using.

Just what this country loses in export earnings due to lympho is difficult to assess, but it must be a very large sum of money. In the main, lympho disease is spread in two ways and it is controlled entirely by recognising these two factors. Nearly all fine-wool sheep have the skin broken in some minor degree during machine shearing. Should a shearing comb break a lympho abscess, all subsequent sheep shorn with this gear are very likely to become infected even if the skin is only lightly broken.

The second major source of infection is due to lamb marking. The wounds from marking are very prone to pick up the infection if the lamb's mother has the disease. I have also seen sheep pick up the infection because the nostrils have come in contact with a lympho sore.

**Control:** Our method of control is to run all sheep "off shears" through a misting machine using Syvel disinfectant mixed at the rate of one gallon to 150 gallons of water. At
lamb-marking all wounds are sprayed with this same material. It is most important to disinfect all wounds while fresh.

Actually, at shearing time we mix Syvel with our dip and saturate all shorn sheep in a shower equipped with large jets, which are fed at 100 p.s.i. pressure. We have a recovery pipe back to the reservoir, but this and the suction hose must be connected through a petrol strainer to prevent the jets from blocking. The strainer must be cleaned frequently.

We have found that 100 gallons of wash will easily dip and disinfect 1,200 sheep and combining lympho control with dipping is proving most satisfactory. The race and yards are all in concrete for clean and easy working. Another important feature was the noticeable absence of dermatitis at shearing time this year. However, this could have been due to the seasonal conditions.

I would stress that this method of control is a preventative one, and will not cure sheep which already have the disease.

Some time ago we sent into the works 1,100 lambs, which included a mob which were not disinfected at lamb-marking. The rejection of Impho in this mob was 30, as against one to two per thousand which is now our usual rejection.
By Professor J. D. Stewart, Professor of Farm Management, Lincoln College

The College Council sold some of its runs in the Haka-taramea Valley in 1966 and decided to use part of the money to buy a hill-country property. The objects were to extend our experience in the management of this class of country, to evaluate the economics of development under current costs and prices, and to provide research facilities for the College staff.

A suitable property at the right price was taken over in March, 1966. It is known as "Hunua" and forms part of the old Broxton run on the Brothers Range, west of Waikari in North Canterbury.

PHYSICAL

The area is 2,282 acres, the tenure, Crown Renewable Lease, with 17 years to run at the date of purchase. The property is ill-shaped, the homestead being at one extremity where there is a narrow frontage, the access track to the back being about six miles long. The highest point is 2,300 feet, the contour is steep and often rugged. There are only about 150 acres of crawler-tractor country.

CLIMATE

The rainfall is 25in. The front end of the property is very exposed to the north-west, and dries out quite severely.
However, the aspect of two-thirds of the country is away from the north-west—and these areas will be the easiest to improve. There is no severe snow risk, although a thin covering of snow may be on the higher areas for some weeks. Blade shearing is practised.

**SOILS**

The soils are classified as Haldon steepland series, but a more detailed survey has revealed some significant variations. In particular there is an area near the front of the property with soils derived from basic greywacke, which are deep, well structured and chocolate-brown in colour. These have a high phosphate status, a high pH, but are low in sulphur. Soils derived from greywacke cover most of the property. They are shallow, moderately acid, deficient in phosphate, sulphur and probably molybdenum.

**COVER**

The cover is variable. There are areas of good silver tussock on the tops and easier slopes, the sunny country carries a poor, overgrazed cover of danthonia, while the steep dark faces carry flax, some fern, matagouri and other shrubby weeds. While there is some nasella tussock, nodding and grecian thistle, the weed situation is not out of control. There is resident clover over considerable areas.

**STOCK**

The College took over the existing stock: 1,000 Corriedale ewes and 350 replacement ewe hoggets. These were low-performing sheep, lambing less than 80%, and clipping less than 8 lbs. wool. Body weights were extremely low. In autumn, 1966, the two-tooth ewes were 73 lbs., and the mixed-age ewes averaged 88 lbs. This is due to poor nutrition, not low genetic potential, because a few ewes transferred to the College research farm soon achieved body weights of 115 lbs. average.

The very low condition of the ewes, means that they cannot be used freely in the clearing up of blocks prior to oversowing and topdressing, as they have no reserves on which to operate under any stress. This was discovered when the ewe flock had to be used a little severely in the development process. Consequently a dry-sheep mob must be built up rapidly to make possible strategic mob stocking on development blocks.

**FINANCE**

The property was purchased for $39,000 as a going concern. An approximate break-up of this would have been $8,000 for stock, $500 for plant, and $30,000 for the lessee’s interest. The current rental is $592 per annum.
DEVELOPMENT

A farmer acquiring such a property has three alternatives. One is to continue to manage the property as it is. A property of this nature can be run cheaply—no machinery expenses, no fertiliser, no seed, and no employed labour other than for shearing and crutching. (It is customary to co-operate with neighbours in mustering, tailing and dipping.) The cost structure would then be dominated by the standing charges, rent, rates, interest on any debt, insurance, and administration. Other direct running costs would include merely shearing-shed expenses, dip, some repairs and maintenance of fences, buildings and yards. Whether, a property carrying 1,000 low-producing ewes could survive today would depend upon the level of the two important items, debt servicing (interest and principal) and personal drawings.

The following is an abbreviated budget for the property, using 1967-68 prices and costs, assuming the level of production and of inputs to be those at the time of purchase.

REVENUE

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Price per Unit</th>
<th>Revenue</th>
</tr>
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<tbody>
<tr>
<td>Wool</td>
<td>10,600</td>
<td>27 cents net</td>
<td>2,860</td>
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<tr>
<td>C.F.A. Ewes</td>
<td>250</td>
<td>$4.00</td>
<td>1,000</td>
</tr>
<tr>
<td>Wether Lambs</td>
<td>400</td>
<td>$3.00</td>
<td>1,200</td>
</tr>
<tr>
<td>Cull 2nd Ewes</td>
<td>50</td>
<td>$5.00</td>
<td>250</td>
</tr>
<tr>
<td>Skins</td>
<td>30</td>
<td>$1.50</td>
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**Total Revenue:** $5,355

EXPENDITURE

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<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>Stock Purchases: Rams</td>
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<td>320</td>
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<tr>
<td>Standing Charges:</td>
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</tr>
<tr>
<td>Insurance</td>
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<tr>
<td>Rates</td>
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<td>350</td>
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<tr>
<td>Rent</td>
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<td>590</td>
</tr>
<tr>
<td>Administration:</td>
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<td>980</td>
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<td>Telephone and Mail</td>
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</tr>
<tr>
<td>Stationery</td>
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<td>10</td>
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<td>Accounting and Legal</td>
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<td>50</td>
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<tr>
<td>Wages:</td>
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<td>360</td>
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<tr>
<td>Shearing and Crutching</td>
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<td>280</td>
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<tr>
<td>Casual</td>
<td></td>
<td>80</td>
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</table>

**Total Expenditure:** $5,355
Animal Health:

Dipping, Docking, etc 120

Power:

40

Feed:

Hay 120

Car Expenses 200

Freight 30

Weeds 60

Woolshed 80

General 100

Repairs and Maintenance 280

2,790

$2,565

The budgeted surplus of $2,565 is available for debt servicing and for personal drawings including tax. This is a cash budget, the depreciation having been included. If there was no debt to service, a reasonable standard of living is possible, although there would be some tax to pay from the $2,500. But there would be little possibility of a boarding school education for any children. If there was a substantial debt servicing cost, say, $1 per ewe equivalent, or $1,200, then the standard of living or the maintenance of the farm would suffer. Further, it is doubtful whether the budgeted inputs would even maintain this level of production. While it seemed to be in a kind of ecological equilibrium there was evidence of slow deterioration of the cover and encroachment of weeds.

To conclude, such a unit can survive with 1967-68 prices and costs, if there is no substantial debt, if education of children at boarding school is not imperative and if the owner accepts a very modest standard of living and a slow but inevitable deterioration of the country.

The second and third alternatives involve development, either out of income or by borrowing.

Development out of income is more acceptable to many farmers, who are averse to the risk of going into debt. The above budget shows that, at 1967-68 prices, development out of income would be impossible on this property unless there was no significant debt, and the farmer was living at a very low level. Further, had a development programme been started before the current recession in prices, it could not have been carried on. While this kind of stop-go development is common, and acceptable to farmers, it often leads to inefficiencies and low returns on development capital.
We decided to evaluate the financial, technical and economic implications of a programme based on maximum borrowing in the first instance to trigger off development. To be realistic, certain financial assumptions have had to be made. These were:—
(a) That a $12,000 first mortgage was to be serviced.
(b) That development borrowing was not to exceed that which the State Advances Corporation would lend a private farmer on this property.
(c) That current account deficits were to be kept at a level which would not lead to a seasonal overdraft greater than $4,000.

The assessment of the maximum development loan which could be raised was $14,000 to be spent over the first 2-3 years. This assessment was supported by a group of senior farm appraisers from the State Advances Corporation who inspected and appraised the property. This money has been allocated as follows:

**Topdressing and Oversowing:**

<table>
<thead>
<tr>
<th>Year</th>
<th>Acres</th>
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</thead>
<tbody>
<tr>
<td>1966</td>
<td>135</td>
</tr>
<tr>
<td>1967</td>
<td>156</td>
</tr>
<tr>
<td>Total</td>
<td>291</td>
</tr>
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</table>

**Fencing:**

<table>
<thead>
<tr>
<th>Year</th>
<th>Chains</th>
</tr>
</thead>
<tbody>
<tr>
<td>1966</td>
<td>180</td>
</tr>
<tr>
<td>1967</td>
<td>150</td>
</tr>
<tr>
<td>Total</td>
<td>330</td>
</tr>
</tbody>
</table>

**Plant:**

- Tractor, tray, grader blade,
- Motorbike, trailer, safety cab

**Tracks and Culverts:**

<table>
<thead>
<tr>
<th>Year</th>
<th>Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1966</td>
<td>6</td>
</tr>
</tbody>
</table>

**Cultivation:**

<table>
<thead>
<tr>
<th>Year</th>
<th>Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>1966</td>
<td>50</td>
</tr>
</tbody>
</table>

**Water Supply:**

- Tank, piping, troughs

**Buildings:**

- Renovations to dwelling,
- Killing shed, kennels

**Stock:**

<table>
<thead>
<tr>
<th>Year</th>
<th>Wethers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1966-67</td>
<td>250</td>
</tr>
</tbody>
</table>

**Total Allocation:** $11,615
The remaining $2,400 of the development money will be spent in autumn 1968, on the overdrilling of 50 acres, follow-up top-dressing, and wethers.

The basic principle followed in the development process has been to topdress and oversow areas which are subdivided sufficiently for stock control—both before and after topdressing. Rates of application have been 3 cwt. Mo. superphosphate initially, following up with 1½ cwt. 400 lbs. sulphur super. Particularly good results have been obtained in two blocks of 90 and 50 acres, while response on 130 acres of sunny country has been reasonable.

The existing ewe flock is too low-conditioned for use in control work. The limited use which has been made of the ewes has done them no good. Increased stocking is therefore being achieved with dry stock. The stock carried in the second year of this programme are:

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<tbody>
<tr>
<td>Ewes</td>
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<td>1,105</td>
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<tr>
<td>Ewe hoggets</td>
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<td>417</td>
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<tr>
<td>Wether hoggets and wethers</td>
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<td>100</td>
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<tr>
<td>Rams</td>
<td></td>
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<td>24</td>
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<tr>
<td>Dry ewes</td>
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<td>186</td>
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<tr>
<td>Wethers</td>
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<td>2,077</td>
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This amounted to a 50% increase in sheep numbers, although in ewe equivalents the increase is 38%. The 50 acres of turnips were poor, which, together with the dry autumn and some management mistakes, resulted in lower stock performance than had been hoped for. This was reflected in a low lambing (70%), low wool performance, and low growth rates in the lambs. Nevertheless, total wool clip was increased by 30%. Despite this low ewe performance, it is still planned to increase sheep numbers in 1968, the presumption being that the investment cannot be made profitable, and the topdressed country fully developed and exploited, without stock numbers. However, ewes to the ram will be reduced to 900-1,000, and the dry-sheep mob increased. Special attention has been given to the 1967 hoggets which will be reasonable two-tooths. Nevertheless, it is abundantly clear that we shall secure little significant improvement in stock during the first few years of development, if we are determined to stock the topdressed blocks adequately.
FINANCIAL EFFECTS

The budget for 1967-68, fully amended as at January, 1968, excluding capital items financed from the loan money and excluding any special College administrative costs, reveals a cash surplus of $2,527 for debt servicing and management. This may be compared with the $2,565 calculated in the “status quo” budget previously. The increased wool production is balanced by lower stock sales and somewhat higher current expenses to maintain the higher asset. It suggests that the farmer gains no financial advantage in the first year of such a development programme. This is almost always so. We would not expect to see a satisfactory economic result emerging in the first three or even five years. This is unresponsive country, and much of the early development cost is of an overhead nature. There will be considerable time lags in its exploitation. But even at this early stage it is evident that current wool prices do not give a great deal of confidence as to the profitability of developing this class of country. Moreover, with the maximum development loan already used, the current revenue situation will barely permit the maintenance of the committed improvements, let alone further development. The next three years should yield an interesting insight into the economics of this class of property.

BOOK REVIEW

THE LUCERNE CROP
Edited by R. H. M. Langer
A. H. and A. W. Reed. 314 pp. $4.50.

Thirty-two scientists from New Zealand and Australia contributed papers to a symposium on lucerne, at Lincoln College in February 1967. Professor R. H. M. Langer, head of the Plant Science Department at Lincoln College was one of these scientists and in editing the papers for publication he has made a valuable contribution to agricultural science.

Each of the contributors is an expert in his field. Together they would form a substantial basis for a many-departmented agricultural college. It would be presumptuous for this reviewer to query the conclusions reached, quite apart from the extreme difficulty of being able to satisfy thirty-two authors!

In his preface Professor Langer says, “Although the choice of topics was to a certain extent determined by the availability of direct knowledge and experience in Australasia, an attempt
has made to present a reasonably continuous narrative of the lucerne plant and its role as a crop in a temperate climate." The thirty papers in the book are grouped under nine headings, physiology and ecology; genetics and plant breeding; inoculation and establishment; agronomy; lucerne-grass mixtures; flowering and seed production; plant protection; animal production from lucerne; and the place of lucerne in New Zealand. Despite the wide coverage given by the many sections there is a lack of cohesiveness which is perhaps unavoidable with such a large number of authors, and which is probably a major distinguishing feature between this type of publication, and a definitive text by one author.

This is not a book for the student looking for a simple authoritative statement on the facts of life about lucerne, or for the practical farmer making his first acquaintance with the crop and seeking clear-cut information on seed rates, seed bed preparation, fertiliser rates and hay-making techniques. Rather this is a book for the enthusiast, farmer or scientist, and one can clearly recognise that enthusiasm is a factor held in common by all those who grow, or work with, the lucerne plant.

One of the most important practical developments in lucerne management in recent years has been the growth of knowledge of how to maintain a high-producing stand under grazing. This is well covered in papers under several headings. Lucerne growers in tussock country will find particular interest in papers on establishment of lucerne on acid soils, on grazing management, sulphur nutrition, establishment and management of lucerne-grass mixtures and the place of lucerne in the farm programme. Farmers of the drier regions, where irrigation is also a possibility, will find an excellent review of factors affecting seed production.

It would be a deceit for me to claim that I have absorbed the contents of almost 300 pages of text, tables and figures. It would be the plain truth to say that this book will be a valuable reference placed within ready access for my future reading.

—G.A.D.
WINTER FEEDING TRIALS
AT TARA HILLS
By K. H. C. Lewis,
Invermay Agricultural Research Centre, Mosgiel

It is well known that we need higher stocking rates to get the full benefit from tussock grassland improvement. It is also well known that the higher stock numbers needed to control spring and summer growth cannot be wintered on standing hay alone. Some supplementary feeding is necessary, and on run country, hay is the most common. However, this is expensive and is often used extravagantly. In our work we have tried to find out more about minimum hay requirements and their effects on lamb and wool production.

Our first studies showed that the minimum maintenance requirements of 100-110 lb. pregnant Merino ewes was about 1½ lb lucerne hay per day. When we fed them 3 lb hay per day they gained weight but didn't increase their wool production or lamb survival and growth. Clearly it was worth looking more closely at the effects of minimum quantities of hay and ways in which they could best be fed.

Our objective was, for a set amount of hay per ewe per winter, to look at the effects of
1. a constant rate of feeding, or
2. an increasing rate of feeding.

To feed at an increasing rate we had to give sub-maintenance rations before the last six weeks of pregnancy so that above-maintenance rations could be given for the critical last six weeks.

In this article I would like to comment on three of the five trials which we have completed.
1. The first trial was in 1963. In this we fed two mobs the same total amount of hay for the 12 weeks before lambing. However, one group was fed at a constant daily rate, and the other at an increasing rate.
2. The second trial was in 1964 when we compared oats and hay at constant or increasing rates.
3. The third trial in 1965 compared the ways in which a given quantity of hay could be fed: either at daily or weekly intervals as either constant or increasing rations.

FEATURES OF THE STUDY
Each treatment lasted 12 to 14 weeks. We began in July and finished in early October, just before lambing. In those
trials in which rations were increased, the increases were made at 3-4 week intervals. The stock were weighed at the end of each period. Lambing was recorded as the number born and their survival to tailing, barrenness, and lamb weights at tailing and weaning. Wool production was measured at the end of winter feeding and at weaning. Lucerne hay was fed in racks with wooden floors to reduce wastage. Digestibility tests suggested that its quality was rather low in 1963 but high in 1965.

**Fig. 1**—The design for the 1963 hay feeding trial.

**Fig. 2**—The daily hay rations (lbs/head) for the 1963 trial.
1963: CONSTANT VERSUS INCREASING RATES OF FEEDING

In this trial the average daily consumption was $1\frac{1}{2}$ lb hay/day for 13 weeks. Fig. 1 shows the design of this study and Fig. 2 gives the hay feeding schedule. Fig. 3 shows that the ewes barely held their weight under either system of feeding. When you allow for the increasing weight of the uterus the rations were definitely inadequate. You will remember, however, that poor hay was used in this trial and sheep died from pregnancy toxemia in both groups.

Neither treatment influenced wool weight or quality. For five weeks after lambing half of each group were fed on lucerne grass pasture, and half were fed on $2\frac{1}{2}$ lb hay per day. All ewes were then run together until weaning. At first there were small differences in lamb weights but by tailing there was no difference between either group.

![Graph](image)

Fig. 3—Changes in ewe liveweight between July and September 1963.

1964 TRIAL: CONSTANT VERSUS INCREASING RATIONS OF OATS AND HAY

In 1962 and 1963 Hakataramea Station wintered 15,000 Corriedale ewes on grain oats. This aroused great interest and most people accepted the claims of ease of feeding and high food value. However, the economics of oat feeding can be found only if the costs of oats and alternative feeds are known, and the amounts needed of each for comparable results are also known. In this trial we fed lucerne hay and oats at arbitrary levels and although it could not be a conclusive study it was expected to produce useful results.

We estimated that the energy value of oats was 40 per
cent higher than hay, therefore the nutritive value of 100 lb oats was roughly the same as 140 lb hay. As in the 1963 trial we fed at either constant level or an increasing level according to the schedule shown by Fig. 4.

**Liveweight Changes**

In July the average ewe weight was 100 lb. This weight was maintained on 1 lb oats per day. However, if an allowance is made for the increased fluid content of the uterus, these rations were inadequate although no pregnancy toxaemia was seen. **Fig. 5 shows that in this study hay was clearly better than oats.** Hay-fed stock gained an average 6½ lb compared to those fed on oats.

Varying the level of feeding to give better nutrition in late pregnancy had no direct advantage.

![Graph showing liveweight gains and losses for hay and oats](image)

**Fig. 5**—Changes in liveweight, between July and September 1964, of ewes fed on hay and oats.
PERIOD

Fig. 6—Changes in liveweight, between July and September 1964, of ewes fed at a constant or increasing rate.

1965 TRIAL: CONSTANT OR INCREASING RATIONS AT DAILY OR WEEKLY INTERVALS

If hay could be fed once a week instead of once a day there could be a big saving in labour. This trial looked at ewe health and possible hay wastage under constant and increasing feed levels as shown in Fig. 7. Fig 8 shows the changes in liveweight for the 14 week period. The constant feeding of 1½ lb/day maintained liveweight until the late pregnancy rise. With variable feeding there was a maximum loss of about 5 lb body weight. By the end of the feeding period, however, there was no difference between treatments. Fig. 9 shows that there was no difference in liveweight between daily or weekly feeding.

Stock Health

In the last stages of the trial a few ewes (less than two

Fig. 7—Daily rations (lbs/head) for the 1965 trial.
Fig. 8—Changes in liveweight, between July and September 1965, of ewes fed at a constant or increasing rate.

Fig. 9—Changes in liveweight, between July and September 1965, of daily or weekly fed ewes.

per cent) on fixed rations died from pregnancy toxaemia. We increased their rations and no more died. No ewes died on variable feeding. Although 18 per cent of the lambs died before tailing, these deaths were not due to either treatment. Similarly there was no difference in lamb growth from lambing (October) to weaning (February).

Wool Production

Ewes were shorn of 12 months' wool at the end of the feeding trial and shorn again of a further 4 months' wool in February. At these shearings weekly fed sheep produced 0.5 lb and 0.4 lb more wool than daily fed sheep. However, this extra production of 0.9 lb was probably a chance effect as there was nothing in the pattern of liveweight changes to suggest such large differences.
CONCLUSIONS

From these trials we conclude:

1. If the total feed available is only enough for maintenance rations, it is better to increase the feed as pregnancy advances, even though ewes may lose weight in the early stages. This method of feeding does not affect lamb or wool production and should reduce the possibility of pregnancy toxaemia.

2. Weekly feeding saves labour and where rations are increased as lambing approaches there are no ill effects. However, weekly feeding of constant rations at near-maintenance levels may be risky.

3. Oats are a suitable and convenient supplement, but their food value, on a pound for pound basis, is probably only as good as lucerne hay. Hay costs less, and is therefore the better food.

THE MINERAL NUTRITION OF HIGH-COUNTRY STOCK

By Fergus Hickey

Mr Hickey is editor of the “New Zealand Agriculturist,” the review of animal health research published by Wonder Distributors Limited, and is a respected authority on the mineral nutrition of animals.

In contrast to the more favoured farming areas of New Zealand, very little is known about the nutritional quality of the 14 million acres of tussock and other native grasses that cover much of the high country. Indeed, this angle has been surprisingly neglected although much has been written about the soils of these regions, the effects of burning, or oversowing, and the factors which in the past had contributed to the deterioration of this country.

Attention has often been drawn to the excessive stocking rates of the tussock country in the early days, and the continual drain upon its natural fertility without any effort being made to replenish it.

Yet, whatever may have been the defects of the past, it is a fact that the high country has been able to carry the large number of sheep and cattle which have lived and bred there. But it is only too evident that their level of production and their rate of reproduction has been low and there is little doubt that animal performance in both respects is capable of great improvement.
NUTRITIVE VALUE OF TUSSOCK

If these large tracts are to be brought to their full potential, we clearly need to know much more about the food value of the many types of native grasses which are the basic diet of the livestock living here. This knowledge is essential if we are to correct the several obvious deficiencies which have restricted the output of animal products.

Some 15 years ago, Professor Coop, of Lincoln College (1) reported a study of the chemical composition of tussock pastures and drew attention to their generally low level of certain nutrients. However, his study did not include trace elements other than copper. Since soil surveys by the N.Z. Soil Bureau suggest that several other elements might also be deficient in the herbage, we recently collected and analysed samples from the Hakataramea, Tekapo-Pukaki, and Mt. Somers regions. These consisted of tussock and the poorer grasses such as danthonia, sweet vernal, Yorkshire fog, and browntop, with a small amount of clover and cocksfoot present in most samples.

The full results of these studies will be published elsewhere later and I will give only a very brief summary here. In general, we found adequate levels of calcium, potassium, and molybdenum; reasonably satisfactory concentrations of phosphorus and boron; but sulphur, cobalt, magnesium, zinc, iron and copper were low, and sodium and iodine extremely low. As might be expected, we found seasonal variations of all the minerals in the plants and the analyses suggested that the nutrition of breeding ewes could be critical throughout most of their pregnancy. The herbage samples collected in the above areas could well be fairly typical of much of the tussock country.

THE DETECTION OF MINERAL DEFICIENCIES

Although chemical analysis of the fodder pointed to mineral deficiencies that might affect livestock in the high-country environment, I must stress that the analytical approach can never be conclusive in this matter and the final proof rests upon the response of the animal itself. Extravagant claims are often made about the value of soil-testing and plant-analysis but landowners should not let themselves be misled. In fact, soil chemistry has proved of little help in solving problems of trace element deficiencies in grazing stock. Sometimes it has been able to give the geological reason for a deficiency but this has always been after, and not before, independent clinical or experimental proof of the lack of some mineral in the animal diet.
The situation for pasture plants is no better. For many years animal scientists have doubted the use of pasture analysis as a guide to the mineral intake of free-grazing livestock. This technique cannot allow for the fact that the mineral levels in herbage, and animal ‘requirements’ change markedly from time to time. Moreover, animals differ in the amount of each mineral they consume, and have different abilities to make use of them. After all, it is how much of a mineral an animal actually assimilates that is important, not how much, if any, there is in the soil or it gets in its fodder. In short, all chemical methods of investigation lack precision and the best we can get from them are pointers of varying dependability. Even tissue/blood analysis is not quite what it has been cracked up to be. Both in the human and animal fields I have as often been led astray as helped by such procedures, but that is a long story. When there is a conflict between clinical and laboratory findings, as so often occurs, I am old-fashioned enough to lean towards the former, and act accordingly. Fortunately, the animal itself is a reliable guide.

**ADDING MINERALS TO THE DIET**

Although only part of the tussock country can be economically topdressed, there is no doubt that the intake of minerals by grazing stock could be greatly increased, and the danger of deficiencies thus reduced, if suitable supplements were provided, particularly during pregnancy and lactation.

These supplements are needed to cover the difference between the amount of each mineral thought to be present in the fodder and the amount the animal needs. As I said before, these estimates are inexact but several reported experiments as well as practical experience have shown that if sheep and cattle are given free access to a mineral compound they usually adapt their intake to suit their needs. The benefits commonly seen from this form of treatment prove its worth. I do not see that it would be economic, or feasible, to use individual oral drenching with mineral solutions where stock are widely spread and rarely mustered, and in any case, a more regular, and preferably continuous intake is better.

In spite of the short-comings of pasture analysis as a guide to stock mineral needs the several minerals we found deficient in the high-country pasturage could well be fed in supplements to protect the animals grazed there. The role of most of these elements in animal husbandry will be fairly well known to farmers, but I will comment on three of them in particular because of their special importance and their general neglect.
ZINC

This element has lately risen to new importance in animal nutrition since the discovery of natural deficiencies in many places. Zinc is an indispensable part of a number of enzymes which have vital functions in the metabolism of animals and humans. A lack of it has most serious effects. In our experience, the most prominent symptoms of deficiency are abnormal shedding of wool or hair, severe itching especially of the anus and vulva, swollen hocks, lesions above the hooves and round the eyes, retarded growth, loss of appetite, general apathy, diminished libido, and often a very marked tendency to wool-eating.

It was, in fact, wool-eating that led to our first recognition of zinc deficiency some years ago. (2) Farmers had complained that sheep were persistently nipping wool off the backs of other sheep, which left raw eroded areas of skin upon which troublesome ulcers developed. Experimental dosing with several different trace elements later showed that zinc, and only zinc, stopped the depraved appetite for wool and rapidly healed the wounds which were causing a serious loss of condition in affected animals. The condition had resisted all previous forms of treatment. When wool was analysed it was found to be quite rich in zinc. Evidently the sheep developed this abnormal hunger for wool when the level of zinc in their diet was too low.

Over the past ten years, zinc deficiency has been found so widely among domestic animals that enrichment of their feed with zinc has become almost standard practice in many
countries overseas. A deficiency is now thought to be also very common in Man. It is clear that apart from other functions, zinc plays a special role in healing wounds. Its remarkable ability for this, first shown in farm animals, has recently inspired the same oral treatment for humans, with marked success. Its use in an increasing range of disorders has been predicted.\(^{(3)}\) and it has been hailed by eminent medical authorities as a valuable advance with great possibilities. \(^{(4)}\)

**IODINE**

More than 40 years ago a team of scientists led by Sir Charles Hercus (Otago Medical School) studied the iodine content of food and animal products in relation to goitre in New Zealand. He concluded that the whole of New Zealand was goitrous, with the mountainous regions of the South Island being very seriously affected.\(^{(5)}\) The introduction of iodised salt for domestic use has now almost eliminated human goitre. Unfortunately, much less attention has been given to livestock. They are also exposed to low levels of iodine in soils and water and thus to the ill effects of a shortage in their diet.

It is therefore astonishing that iodine, so vital for the survival of the new-born and for the maintenance of many bodily functions, has been so neglected by most runholders. Its importance in the nutrition of animals, notably in reproduction, can scarcely be exaggerated. Towards the end of pregnancy, the lamb’s thyroid gland normally develops very rapidly. It takes up iodine from the ewe’s circulation so avidly, that during the last month the iodine concentration in its thyroid reaches a level more than four times greater than that in the ewe’s gland! Should the ewe herself be short of iodine, the foetus gets too little and its thyroid enlarges, thus producing goitre. If the supply is very seriously deficient the lamb dies in the uterus and of course is still-born.

We found firm evidence of iodine-deficiency causing congenital goitre and still-birth in sheep a few years ago in the course of our six-year study of the death and reproduction rates of sheep. This involved over 83,000 breeding ewes.\(^{(6)}\) 11.6 per cent of the lambs born during this period were still-born. Since congenital goitre due to a lack of iodine in the mother’s diet seemed a possible cause of death, the sheep were given free access to a mineral compound containing iodine. This reduced the number of still-births to slightly over 3 per cent.\(^{(7)}\) This level is probably close to the irreducible minimum since other causes of still-birth, such as malpresentations, cannot be prevented.
In the case of the South Island high-country runs, the herbage analyses we did showed extremely low levels of iodine. This, combined with widespread complaints of poor lambing percentages, suggested probable iodine-deficiency. When an iodine-rich mineral supplement was therefore used on a number of these properties, there was a sharp increase in the proportion of live lambs, and a consequent rise in lambing percentages. (This result is already well known to many neighbouring run-holders. It supports the opinion of an eminent English medical authority who said that “Goitre is the easiest known disease to prevent.”)

SODIUM

The analysis of our herbage samples also showed that sodium was very low in every instance, so low indeed that it would not provide more than about one-third of the full nutritional needs of livestock. Actually, this deficiency is by no means confined to the tussock country, as Dominion-wide studies by the N.Z. Soil Bureau (8) have shown that the level of sodium in grass throughout the greater part of both Islands is extremely low. Only in areas within a few miles of the coasts exposed to sea-spray carried by westerly winds was the sodium in grass adequate.

The element sodium is highly important in the metabolism of ruminants but in recent years it has tended to be almost wholly neglected. In days gone by it was fed to stock quite freely as common salt (sodium chloride), either by spreading on hay, in mineral licks, or by direct application to pastures. But these practices have latterly fallen into disuse and widespread deficiencies are now the rule rather than the exception.

Sodium takes part in many vital functions within the animal, including the production of essential fluids such as saliva, gastric juices, and other intestinal secretions and it is present in blood-plasma in high concentration. Thus there is a high daily need. A deficiency in the animal produces a well-recognised series of symptoms. Among them are loss of appetite, decline in bodyweight, reduced milk yield, poor fleece growth, lack of energy, and deterioration in general condition. If an animal was deprived of salt, it would die.

Apart from the profound physiological importance to the animal of an ample and continuous supply of salt, there is a further factor which is of special concern to high-country run-holders. It is a long-held belief that dietary sodium gives protection against the formation of stones in the kidneys, bladder, or urethra (i.e., urinary calculi). Recent overseas
studies confirm this protective effect. This condition, once established, is rapidly fatal as there is no cure.

There is little doubt that urinary stone is the cause of many unexplained sudden deaths in sheep, although it may often escape recognition unless a post-mortem is performed. It is particularly apt to occur in areas of low rainfall where the pasturage is drier than average and drinking water is scarce, or perhaps non-existent. Such conditions are common in our tussock terrain. Run-holders, therefore, would be well advised to ensure that their animals have a good supply of salt.

SELENIUM

This metal has already been fairly fully dealt with by other writers. I have long been of the opinion that selenium itself is not the complete answer to white muscle and other ills which it is said to cure. My disbelief was recently reinforced by the evidence given at a Russian symposium showing that other trace elements are needed with the selenium for a full response. My experience with a New Zealand station suffering from white muscle disease now makes me even more sure.

SUMMARY

The picture that emerges from a study of the nutritional properties of tussock, and the several grass species that grow with it, is that the herbage falls well below the nutrient level that is desirable for breeding ewes and cattle. On the whole, it appears that calcium is unlikely to be deficient; phosphorous would rarely be a problem except possibly for a short period in winter (to the animal, that is—not necessarily to the clover plant); but on the other hand several other important mineral elements such as sodium, iodine, zinc, magnesium, copper, cobalt, and probably iron, will usually be low or borderline, particularly for pregnant and lactating animals.

It would obviously be preferable to use the correct fertilisers rather than mineral lick to protect livestock from nutritional deficiencies. There would be a higher continuous mineral intake and moreover all animals would benefit. Although top-dressing on a wide scale is seldom feasible on high-country runs, it could be worthwhile treating suitable intensive grazing areas during critical periods of the yearly cycle, for instance, pre-tupping, late pregnancy and early lactation.

If this suggestion is impracticable, the only satisfactory alternative is to provide the animals with a mineral mixture compounded to suit the animal requirements and the composition of the herbage. Specialist advice about this should be sought.
REFERENCES

(9) Hickey, F; (1967); N.Z. Agriculturist. 18: 1. 4-5.
(See for review of literature.)

MERINO OR CORRIEDALE?

Tara Hills High-Country Research Station, Omarama
By G. H. Scales,

INTRODUCTION

Since the 1850's the Merino has been the undisputed monarch of the inland tussock country area. Attempts to introduce other breeds of sheep have often resulted in a change back to Merino. Although great increases in Merino productivity have been achieved through the improvement of native vegetation by the removal of rabbits and subsequent over-sowing and topdressing, the question now arises whether another breed might be more suited to improved pastures and higher stocking rates. In 1963, an experiment was started at Tara Hills to compare the lifetime production of Merino and Corriedale sheep. Corriedales were chosen instead of half-breds mainly because of the difficulty of obtaining a representative half-bred since the choice of ram is open to either the Romney, Lincoln or English Leicester.

The Corriedale and Merino flocks are bred on the station so that both breeds can grow up and produce together, without any carryover effect from the district from which they were purchased. To obtain a good representation of each breed, ewes and rams were bought from widely differing sources in order to spread the genetic merit as much as possible.

The purpose of the introduced "foundation flocks" was to breed a line of Corriedales and Merinos from which lifetime production data could be obtained. The progeny from the foundation flocks are run together except for a six-week period at mating, and by 1969 the experimental flocks should be self-maintaining with a total of 250 ewes in each breed. By then all foundation flock ewes will be sold, having served
The purpose of establishing the two experimental flocks. Observations will be continued until 1973 when the progeny in 1969 will be cast for age as 5-year-olds. From 1969 each flock will have a normal age structure ranging from hoggets to 5-year-olds.

Two wether flocks have also been established and by 1969 each flock will be stabilised at 125.

Productive characters recorded in each breed are differences in growth rates, wool production, fertility data, ewe and lamb mortality and sale of surplus stock. It should be noted that the results to date are only interim and final figures based on complete lifetime records will not be available until 1973.

RESULTS

(1) LIVE WEIGHTS

Table 1 shows live weights of ewes and wethers of both breeds. Data are averaged over four years.

TABLE 1. EWE LIVE-WEIGHTS IN MAY

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<th>4-tooth</th>
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<tr>
<td>Corriedale</td>
<td>69lbs</td>
<td>112lbs</td>
<td>118lbs</td>
<td>112lbs</td>
</tr>
<tr>
<td>Merino</td>
<td>58lbs</td>
<td>97lbs</td>
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<td>108lbs</td>
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</table>

<table>
<thead>
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<th>WETHERS:</th>
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</thead>
<tbody>
<tr>
<td>Corriedale</td>
<td>77lbs</td>
<td>115lbs</td>
<td>126lbs</td>
<td>147lbs</td>
</tr>
<tr>
<td>Merino</td>
<td>65lbs</td>
<td>101lbs</td>
<td>114lbs</td>
<td>127lbs</td>
</tr>
</tbody>
</table>

In both sexes Corriedales are heavier than Merinos, the difference being greatest in 4-tooth ewes and 6-tooth wethers. The 2-tooth ewe weights are good in both breeds and are indicative of good hogget nutrition.

Ewes mated as 2-tooths continued to gain in weight until three years of age, which may be contrasted to Professor Coop’s work on unimproved properties, where wet ewes failed to gain live weight with increasing age.

Although abundant good-quality feed has been available on Tara Hills in recent years, Merino ewes have wintered better than Corriedales. In early winter, Merino ewes have been about 10-15 lb lighter than Corriedales but by October this difference has been reduced to 3-5 lbs. It would be expected that on unimproved properties the end-of-winter differences would be even less.

As a fat lamb proposition Corriedale wether lambs are about 10 lb heavier in March with a corresponding higher cash realisation.
(2) WOOL PRODUCTION

Table 2 shows wool production for each class of sheep. These results are for the 1967 shearing, the wool of which was sold at the December sale in Dunedin. The fleece weights include the belly but not floor sweepings. Wool quality measurements were also taken, the quality number of the Merinos being 64’s as compared with 58’s in the Corriedales. Although slightly shorter lengths were experienced in the Merinos, higher gradings were recorded in style, evenness, colour and handle.

**TABLE 2 — WOOL**
*(On December, 1967, Dunedin Sale Prices)*

<table>
<thead>
<tr>
<th>Class</th>
<th>Weight</th>
<th>Cents/lb</th>
<th>Total/head</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merino Wether</td>
<td>12.1lb</td>
<td>42.1c.</td>
<td>$5.34</td>
<td></td>
</tr>
<tr>
<td>Corriedale Wether</td>
<td>10.7lb</td>
<td>36.3c.</td>
<td>$3.88</td>
<td>$1.46</td>
</tr>
<tr>
<td>Merino Hogget</td>
<td>7.6lb</td>
<td>40.8c.</td>
<td>$3.10</td>
<td></td>
</tr>
<tr>
<td>Corriedale Hogget</td>
<td>7.7lb</td>
<td>34.9c.</td>
<td>$2.68</td>
<td>$0.42</td>
</tr>
<tr>
<td>Merino Ewe</td>
<td>11.7lb</td>
<td>41.0c.</td>
<td>$4.79</td>
<td></td>
</tr>
<tr>
<td>Corriedale Ewe</td>
<td>10.3lb</td>
<td>37.1c.</td>
<td>$3.82</td>
<td>$0.97</td>
</tr>
</tbody>
</table>

Photo: G. Scales.
Except for the hoggets, Merinos have produced more and better-priced wool than the Corriedales. The interesting feature of fleece-weight differences is that they occur in spite of higher Corriedale live-weights. Previous experiments also showed that Merinos are more efficient than Corriedales at converting feed to wool.

Although there is little difference in hogget wool weights the price superiority of the Merinos gives a gross return of $0.42 in favour of the Merino. Merino wethers clipped 2.0 lb more than Corriedales although the difference varied from 1.7 lb in 2-tooths to 2.9 lb in 6-tooths. There is a price difference of 5.8 cents/lb in wether wool which on a total return per sheep basis works out to $1.46 in favour of the Merino. The ewe wool-weight difference of 1.4 lb is similar in all age groups and totals out at a $0.97 difference per sheep or 25 per cent in favour of the Merino. When ewe, wether and hogget wool is averaged out there is a 1.1 lb difference in favour of the Merinos with an associated price superiority of 5.2 cents giving a total sheep return difference of $0.94 in favour of the Merino. Therefore, on the 1967 Dunedin December sale prices if Tara Hills replaced its 4,600 Merino sheep with Corriedales we would stand to lose $4,324 in wool revenue.

A further point to be considered is that while Merinos can out-produce Corriedales in fleece weights on a per head basis, they will also do so on a per acre basis. It is possible to work out the likely differences in relative carrying capacity between these two breeds because their maintenance feed requirements are related to their live-weights. For each 10 lb increase in live-weight, the feed requirement increases by about 7 per cent. Thus the carrying capacity per acre of each breed can be compared. Hence on a live-weight basis there is a 12 per cent difference in relative feed requirements between the average 10.5 lb Merino ewe and the average 11.7 lb Corriedale ewe.

In practical terms this means you would carry 12 per cent more Merinos per acre than Corriedales or alternatively for every Corriedale to the acre you would carry 1.12 Merinos. It is expected that this theoretical calculation will approach the value obtained in practice but this will be checked in the field.

The Merino ewe wool return per head of $4.79 multiplied by the 12 per cent higher estimated carrying capacity, works out at $5.36, which may be compared with $3.82 per
Corriedale. This is a difference of $1.54 (40 per cent) in favour of Merinos. Hence the drop in wool revenue associated with changing to Corriedales is even greater on a per acre basis.

(3) LAMBING PERFORMANCES

**TABLE 4—LAMBING PERCENTAGES**

(Lambs tailed/Ewes mated)

<table>
<thead>
<tr>
<th></th>
<th>1964</th>
<th>1965</th>
<th>1966</th>
<th>1967</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corriedale</td>
<td>91</td>
<td>94</td>
<td>103</td>
<td>81</td>
<td>92</td>
</tr>
<tr>
<td>Merino</td>
<td>79</td>
<td>92</td>
<td>82</td>
<td>92</td>
<td>86</td>
</tr>
</tbody>
</table>

Table 4 shows that over four seasons Corriedale lambing percentages are on average 6 per cent higher than Merino. The largest difference was in 1966 with a complete reversal in 1967 in favour of the Merinos. In 1967 a more detailed lambing study was made to determine the cause of lambing percentage differences. Table 5 shows the results.

**TABLE 5—1967 LAMBING PERCENTAGES**

<table>
<thead>
<tr>
<th></th>
<th>Corriedale</th>
<th>Merino</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lambs born</td>
<td>92</td>
<td>98</td>
</tr>
<tr>
<td>Lamb deaths</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>Tailed</td>
<td>81</td>
<td>92</td>
</tr>
<tr>
<td>Dry/dry</td>
<td>19</td>
<td>15</td>
</tr>
<tr>
<td>Twin bearing ewes</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

There is a 11 per cent difference in lambs tailed/ewes mated in favour of Merinos. As twinning percentages were the same the only other factors that could affect the number of lambs tailed were barrenness and lamb deaths. The percentage of barren Corriedale ewes was 4 per cent higher than Merinos. This was unexpected in view of the higher live-weights of the Corriedales. Barrenness in the Corriedales was not thought to be due to the rams since they were checked by a vet and were changed frequently. The main difference in barrenness between breeds was in the 6-tooths where 15 per cent of the Corriedales were barren compared with 5 per cent of the Merinos. The high barrenness in the Corriedale 6-tooths appeared to be influenced by high live-weight at mating, although due to the small numbers involved no satisfactory conclusions can be drawn. Corriedale ewes over 150 lb at mating had a tendency to be barren. However, the degree of fat coupled with inactivity associated with understocking, rather than weight alone, may have caused this. On run con-
ditions there shouldn't be any worry about having over-fat ewes and in view of Professor Coop's work on the influence of live-weight on fertility in high-country flocks, every attempt should be made to get live-weights up as high as possible, especially in 2-tooths.

Lamb mortality was 5 per cent higher in the Corriedales, the difference being especially pronounced in the 2-tooths where the proportion of stillborn lambs to post-lambing deaths was high. It is not known why the Corriedale lamb mortality was higher than Merino, since the birth-weights were not excessively different from the Merinos (only 0.4 lb lighter). Fifty per cent of all Corriedale lamb deaths were due to still-born lambs compared with 30 per cent in the Merinos.

In summing up it would seem that tailing percentage differences were caused by higher Corriedale barrenness and lamb deaths in the approximate ratio of 40 : 60.

(4) SALE OF SURPLUS STOCK

As no stock will be sold cast-for-age until 1969, we have no data on this. However, on present prices cull 5-year-old Corriedale ewes should fetch about $1.20 more per head than Merinos, but whether differences should be small. Cull Corriedale 2-tooth ewes are fetching about $2.00 more than Merinos, so in terms of surplus stock Corriedales are the better proposition.

SUMMARY

This experiment has been conducted in a 20 in. rainfall, and in higher rainfall districts the situation may well vary. However, it could be expected that the general trends would hold true in rainfall areas of at least up to 40 in. Although final conclusions from this trial must be awaited until 1973, the results to date show little justification for changing from the Merino to the Corriedale breed following pasture improvement. Although the Corriedales have a high lambing percentage and higher sale value, the higher wool return together with higher stocking rates of the Merinos out-weigh these advantages.
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Postal Address: Telephone:
Box 56, Halswell 8029
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