TUSSOCK GRASSLANDS AND MOUNTAIN LANDS INSTITUTE

REVIEW

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Weaning Glen Lyon and Huxley Gorge calves. Photo: G. Wigley.

This photo is from the Institute's *Beef Cattle on Tussock Country.* See page 51 and 52 for further details.

"Whether the physical inability of forest trees to walk off the hills to the market place will cripple the country that supports them . . . will take the combined effort of engineers, economists and ecologists to predict." K. F. O'Connor, Jan. 1972.

Cover sketch: The *CH - 45 Skycrane* in a futuristic role. The factor tending to make helicopter logging economic is the total harvest of a veneer-peeler-chip and pulp milling operation where multiple roading for this would be costly and damaging to the country. In this *Review* Mr J. Fitzharris, writing about the West Coast, states the case for a pulp industry there.

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February 1972

Editor—*J. Runga*

The West Coast

J. Fitzharris

Mr J. Fitzharris, who completed a nine-month term as Acting Commissioner for the West Coast on November 7, comments on the potential for the area. Mr Fitzharris was formerly Fields Director in the Lands and Survey Department and a member of the management committee of the Tussock Grasslands and Mountain Lands Institute.

"The West Coast" brings a vision of gold and rugged scenery when mentioned to the average New Zealander. Even now many "outsiders" think of the region little differently from Cook, who wrote of its wild and barren appearance, or Brunner, whose report of bush-clad mountainous country with few resources and no prospects of settlement did little to arouse interest.

Abel Tasman, however, may have been nearer the mark with his "Fair land uplifted high".

It is true it was gold that attracted the first comers to the hidden fastnesses of the West Coast. And it was gold that brought an early but short-lived prosperity and a colourful period in our country's history. It was the rugged mountains that produced the gold, and they and the forests provided the setting for so many inspiring stories of courage in hardship.

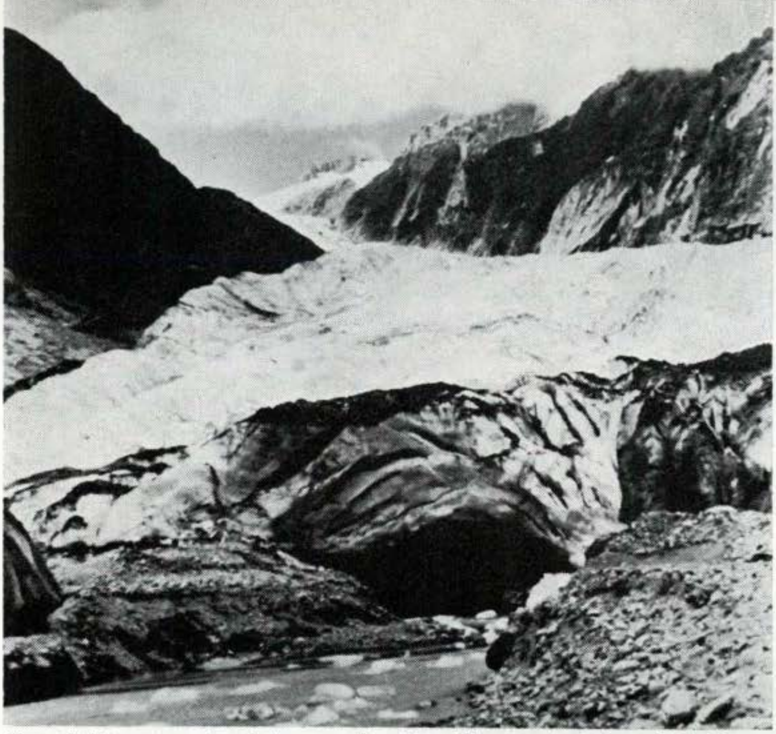
But goldfields the world over are ephemeral things, and scenery does little to console empty stomachs. A concept of the West Coast based on gold and mountains is long out of date. When the West Coast bonanzas dwindled hopes for the economic survival of the new settlement passed inevitably, as elsewhere, to the less spectacular but longer-term fields of farming, forestry, commerce and industry.

Those new industries are, in fact, rooted in the past. Even in the hectic days of the goldrushes a few enterprising men were laying the foundations for a more stable future.

Coal, discovered by Brunner, was being mined in the 1860s to be barged down river to fuel the early steamships using the Greymouth Harbour. The first store was opened by Reuben Waite in 1864. Timber mills were early on the scene to meet the needs of the rapidly growing settlements.

Perhaps the West Coast is unique in that it was settled because of goldmining and the other two great "extractive" industries, sawmilling and coalmining, rather than through pastoral development.

Wherever people gather, however, they must be fed and meat has always been the food of hard-working men. Early stock came in "on the hoof", mostly over the passes from Canterbury and down the Grey River. The open land was on the river valleys and mountain tops, and the native bush was a great wintering area.



One of the reasons tourists cross the Alps. The terminal face of the Franz Josef glacier as it was in 1956.

Photo: G. A. Dunbar from a transparency.

Land clearing progressed with time, mostly on well drained soil sites, and stock increased slowly. Dairy farms were established near the settlements. In the remote areas good foundations were laid for the first-class beef herds of today.

Stock numbers increased slowly for a long time, well behind the national average. I think this could also be said of farm management practice.

Today it is quite different. There is a thriving dairy industry based on high-producing farms. The recently built milk powder factory at Hokitika is proving a success (it is the biggest in the South Island). It also demonstrates wonderfully what amalgamating smaller factories and accepting regional industry can achieve.

West Coast beef is acknowledged to be second to none in quality. With outlets north and south the demand for good cattle is still unsatisfied, and the future is assured.

Sheep numbers are not high by national standards but are substantial. I expect sheep numbers to remain static while both beef and dairy cattle increase.

Livestock figures	1967	1969	1970	1971
Dairy stock	42,840	46,169	46,062	44,031
Beef cattle	57,540	67,845	74,507	81,844
Sheep	272,152	298,100	297,940	(not available)

Apart from farming, what of the future? I do not see any great "bonanza" looming, but I do see steady progress.

There are four great natural resources:

1. COAL. Good cokeing coal is normally in world-wide demand. Though the demand has slackened, this should be temporary. Several overseas firms are interested in the Buller fields and some exports are expected through Lyttelton. The future will be in the large-scale mechanised opencast mine, where less labour than at present will produce more coal than is produced now.

2. PULP. The West Coast beech forests are extensive and because of the prospect of a pulp industry, based on indigenous forest resources, there is considerable research to ensure that this resource is not "slaughtered". Protection forests and scenic and flora reserves will be set aside. Water and soil conservation and general environmental control will have to be maintained.

   Even after these are satisfied there will be "purists" who will make more demands. I am sure all these will be answered adequately to the economic benefit of the region, and for New Zealand generally.

3. ILMENITE. Extensive deposits of ilmenite sands on the foreshore between Greymouth and Westport may provide a stable industry in the future if the minerals recovered can be satisfactorily upgraded. A lot of money has been put into investigating this resource.

4. ELECTRIC POWER. These three industries will need large supplies of electricity. Whether this can be supplied by local coal-fired generators, local hydro generation or supplied from across the Alps by aerial cables is not yet certain.

   What is certain is that the electricity for such industries is not immediately available, and advance notice of four or five years is needed to arrange the supply.

   Whatever source is chosen the environment will be affected in some way. This may be the price of progress, but we have learnt a lot on how to control such effects.

   Winning coal and ilmenite will mean moving massive amounts of material. However, at Stockton, the coal is being mined on a hilltop which is already bare and is not in any scenic or farming area. State coalmines always rehabilitate opencast mining areas although there will be little difference at Stockton. On public lands it is mandatory to restore the topsoil after mining, and I am sure that ilmenite mining will leave the land in a condition suitable for forestry and pastoral farming again. The new Mining Bill shows the awareness existing for conservation control today.

Sketch: Franz Josef Information Centre — meeting the needs of the tourist.
—Courtesy Landscape Section of the Horticulture Department, Lincoln College.

TOURISM. Tourism has become one of the fastest growing industries in an area so wonderfully endowed with scenic beauty. The unspoilt bush, mountains and lakes, the rugged coastline and sparkling water in swift-flowing rivers combine to form a resource not surpassed in New Zealand, in which already many people live in conditions of polluted air, polluted streams and polluted harbours.

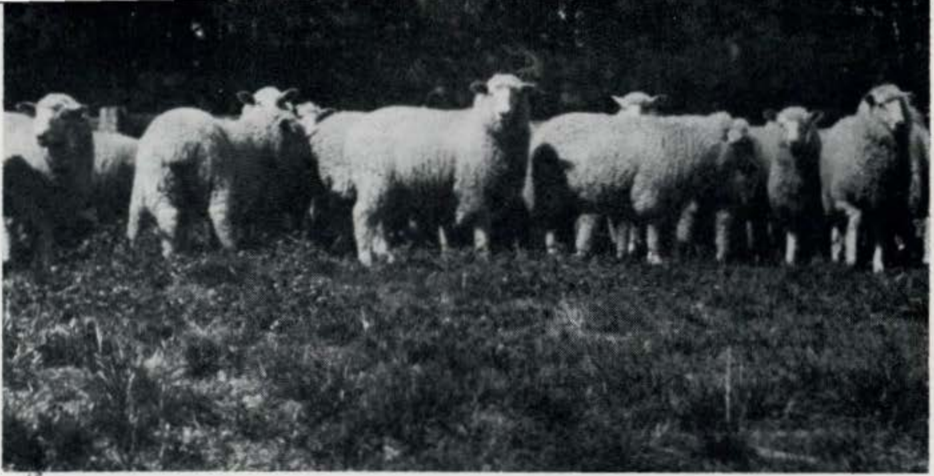
Tourism will provide new career opportunities, new techniques, new training and skills. Visitors from other places will break down resistance to change, when that change is to West Coast advantage.

Man on holiday is a great destroyer and polluter. We shall want designers with skill and imagination to plan our parking areas, "lay-by" sites and picnic grounds—all these should blend with the countryside.

Westland National Park traffic counts, on the Franz Josef access road, point to the problem ahead. In five years vehicles have quadrupled from 4,000 odd to 18,000 a year. This and other evidence points to a need for forward planning for West Coast tourism.

Although the West Coast countryside will, no doubt, change over the years, this interesting region west of the main divide of the South Island will provide an environment more like that our forefathers saw. It should retain this for many years, I think to a greater extent than any other part of New Zealand.

This precious environment will always be its charm and its greatest asset.



Good-doers: Border Leicester cross Merino lambs bred on Glenrock.
Photo: A France from a transparency.

Glenrock Demonstration Run

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Glenrock Station, near Burkes Pass in the Mackenzie Country, was established as a Department of Agriculture co-operative demonstration run in 1963 and while the project to date has not achieved the stock targets set in the original programme, it has provided a great deal of information on the development of this class of high country.

The aims of the project are:

1. To carry known techniques as far as possible and to evaluate them fully,
2. To give the lending institutions a sound demonstration of the creditworthiness of this type of development,
3. To assist in demonstrating how much can be expected from tussock country in national increases of meat and wool.

The programme for improvement was to be a co-operative effort between the runholder and the various organisations associated with work in the high country. These included the Agriculture and Lands and Survey departments, the Waitaki Catchment Commission and the Tussock Grasslands and Mountain Lands Institute.

A description of the property appeared in the September 1965 issue of the *Review* so my comments here have been restricted to a summary of development.

Background

In June 1963 there were 3,200 Merino sheep and 40 cattle on the 10,443 acre property which was divided into four main blocks.

At this stage 45 acres were in one and two-year-old lucerne and 26 acres were cultivated ready for further lucerne. About 40 acres had been oversown with red clover the previous year and a total of 100 acres of tussock had been oversown prior to this with only fair results. The feed provided in 1963 was inadequate for the wintering of all the stock and the hoggets were wintered down country. This meant that the effective carrying capacity at that stage was only 2,360 sheep and 40 cattle.

The other important aspect was the poor standard of the buildings and facilities plus the almost complete lack of vehicles and haymaking equipment.

Stocking Rates

Starting with this, the 10 year development programme allowed for an increase in stocking rate of 4,300 ewe equivalents by 1974. This included the wintering of the hoggets on the property and the mating of the 2 tooth ewes. Previously ewes went to the ram as 4 tooths.

The following table shows the movements in stock numbers and the original predictions based on the 10 year programme.

	June 1963		June 1971		Projected June 1974
Ewes	1,350		1,670		2,500
2 Tooths	350	(Not mated)	380	(Mated)	800
M.S. Hoggets	840	(Wintered down country)	1,100		1,200
M.A. Wethers	580		900		2,500
Rams, etc.	80		110		300
	3,200		4,160		7,300
Cows	—		29		80
Heifers	30		—		—
Other	10		4		2
Calves	—		2		15

Opposite: Lucerne has been established on much of the available fan soils on Glenrock. Photo: Courtesy T. H. Donaldson.

What Has Been Achieved

Cattle numbers increased initially to 70 cows but with several dry years, culminating in the 1969 drought, the cattle numbers are now back to the level at the start of the programme. Sheep numbers have shown reasonable increases from 3,200 to 4,160 but the increases fall short of the projected figure of 7,300 by 1974. Per head performance has crept up slightly but seasonal variation in feed supply has kept the average figures for wool weights and lambing percentages fairly static around the 9 lb and 90 percent levels respectively. Major changes have been in the wintering of the hoggets on the station. These have grown well and now go to the ram as 2 tooths.

Development has covered all aspects of the property and includes an increase of lucerne to 180 acres (providing an average of 30-40 bales per acre) and 50 acres of pasture plus 1,200 acres in three oversown blocks which are now producing at a high level.

Access on the higher blocks has always been a problem. This has been improved with the construction of 1½ miles of new tracks.

The original subdivision into four blocks had resulted in poor feed utilisation especially on the colder country and overgrazing in other areas. Greater efficiency has been achieved by a further 12 miles of new fences which have divided the property into nine main blocks varying in size from 300 to 1500 acres.

With subdivision, and oversowing and topdressing on some blocks, the vegetation cover on all blocks has improved significantly. Spelling of the originally severely depleted blocks is now possible and these are improving and carrying more stock each year.

Cattle proofing has also been carried out on many of the original fences and this has allowed the grazing control of roughage without the need for burning.

Opposite: One of the original stands of lucerne. Photo: T. H. Donaldson from a transparency.

Below: One of three over-sown blocks on Glenrock. Photo: A. France from a transparency.

During the eight years of the programme the buildings have been upgraded to provide adequate facilities, including three new haybarns, and last year a second house was provided. A landrover has replaced the original old truck and tractors and hay making equipment have been purchased.

To reduce stock movements a new set of yards were also built adjoining the cultivated area near the Mackenzie Pass road.

The above description covers the physical achievements of the first eight years of the programme, but does not include the intangible benefits of the programme so far. One of the major benefits is the ability to carry out diversification, if only to a minor degree — a prospect which would have been virtually impossible in the early stages. *The diversification includes the fattening of all of the Border Leicester Merino cross wether lambs on the place, the chance to take a crop of oats (80 bushel crop prior to lucerne in 1970) and also the odd catch crop of clover seed.*

Much of the development carried out has had a marked effect on the quality and value of the property, but so far the annual returns do not fully reflect the fairly large input of capital which has gone back into the property from farm surplus "plough-back", Catchment Board subsidy and Department of Agriculture grant. Obviously, the recent decline in the price of fine wool and the associated lower prices for sale stock, have been partly responsible, but the capital investment in relatively non-productive (but necessary) items, such as buildings and plant, has also added to the problem. These factors have been accentuated by the failure to maintain expected stock increases due mainly to a series of dry years and the slow response of feed production from oversowing, topdressing and subdivision.

At this stage it would be premature to examine all the financial aspects of the programme, but this will be done fully at the conclusion of the programme in 1974.

There are, however, some points which can be noted at this stage:

1. There is a three to five year delay between investment in oversowing, topdressing and subdivision, and the response in feed production sufficient to enable an economic increase in stock numbers.
2. There is a need for basic facilities (woolshed, homestead, yards) before any programme can be carried out effectively.
3. Because of the relative isolation of high country properties, there may be a need for an adequate range of cultivation and haymaking equipment and a 4-wheel drive vehicle.
4. There is almost total dependence on the weather for success of the programme, especially in an area of the high country where extremes of drought, wind, snow and heat are accepted conditions.

Economic Trends in High-Country Farming

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Christchurch.

In 1968/69 there were 33 properties in the high country class of the Economic Service sheep farm survey. These properties are located from Marlborough to Southland and are grouped to show the average level of production, financial structure, profitability and farm management practices relating to high country farming in New Zealand.

Table (a) shows the averages in the 1968/69 survey.

(a) **Physical and Production Data**	**1968/69**
Number of properties	33
Total average area	28,969
Sheep shorn	6,730
Cattle wintered	191
Sheep, cattle ratio	35:1
Ewes to ram	2,709
Lambing percent	79.7
Wool shorn per sheep	8.9
Labour units (man years)	4.0

Asset Structure

The estimated value of fixed assets plus livestock is higher for the high country class than for any of the seven other farm classes in the Economic Service classification. Land and improvements are about $17,000 higher than the average of the Fattening - Breeding farms, Class 4Se, when compared on an estimated market value basis. This comparison has not been adjusted to take into account any affect that different tenure may have on market values. Most of the survey properties in the high country class are held under pastoral lease while in the fattening-breeding class nearly all are freehold.

The value of the sheep on high country properties is more than twice that of most of the other classes. The investment in plant and cattle is very considerable and has been increasing rapidly in recent years. Table (b) shows the large increases which occurred in the market value of land, plant and stock in the high country over the ten years from 1959 to 1969.

The estimated average market value per survey property increased from $93,300 to $141,000 or about 50 percent.

For land and improvements the increase was about 55 percent over ten years. The investment in plant and machinery at estimated market value increased about 40 percent.

Cattle increased 100 percent due mainly to increased numbers, and sheep increased about 35 percent due mainly to improved quality and rising store stock values.

(b) **Asset Values — High Country Class, Average per Property**

	1959	1964	1969
	$	$	$
Land and Improvements	59,500	85,900	92,600
Plant and Machinery	4,400	4,900	6,200
Sheep	25,300	31,700	34,100
Cattle	4,100	4,000	8,200
	$93,300	$126,500	$141,100

The data in this study is derived from the Economic Service sheep farm survey. At present about 530 sheep farms situated throughout New Zealand are in the survey. These farms are picked at random and split-up into eight classes defined according to type of country, type of production and source of income. Class 1 and 2 S. is High Country, South Island, and is briefly defined as "Extensive run country located at high altitude carrying fine wool sheep, with wool as the main source of income".

The asset values expressed as a percentage for each of the eight classes are shown in table (c). These show the difference between classes and between the North and South Islands in type of country and type of farm production. The proportion invested in livestock is greatest in the high country and hill country of both Islands. As the class of farming becomes more intensive the value of the land and improvements is more significant. The larger part played by cattle in the North Island is clearly shown, as is the North Island farmers' very small investment in plant and machinery.

(c) **Asset Values — Percentage Composition — 1968/69**

South Island

Class	High Country	Foot-hills	Fattening Breeding	Intensive Fattening	Mixed Fattening
Land and Improvements	66	69	74	76	81
Plant and Machinery	4	5	6	6	9
Sheep	24	18	16	16	9
Cattle	6	8	4	2	1
	100	100	100	100	100

North Island

Class	Hard Hill	Hill	Intensive Fattening
Land and Improvements	58	67	78
Plant and Machinery	3	3	3
Sheep	20	18	12
Cattle	19	12	7
	100	100	100

Gross Income Patterns

Gross income patterns between farm classes indicates the importance of the different sources of income. They show the result of a change in price for a main commodity and the effects of a diversification policy, such as the current move towards more cattle.

(d) **Gross Income Percentage Patterns**

South Island Farm Classes

%	High Country		Foothills		Fattening-Breeding		Mixed-Fattening	
Gross Income	59/60	68/9	59/60	68/9	59/60	68/9	59/60	68/9
— Wool	78	71	57	43	45	32	28	17
— Sheep & Lambs	14	19	32	37	38	45	27	28
— Cattle	6	8	7	16	5	10	3	3
— Other	2	2	4	4	12	13	42	52
	100	100	100	100	100	100	100	100

The importance of wool in the high country is clearly seen in these patterns. With the exception of the Mixed Fattening properties where income from crops is the major item, income from wool and sheep sales contributes 80 percent to 90 percent of total farm income. Diversification towards more cattle can be seen in these patterns and in the Foothills class income from cattle is starting to make a significant contribution.

Diversification in the High Country

During the 1950s and up until 1966 high country farming compared very favourably for profitability with other classes of New Zealand sheep farming. For most of this period the rate of return on capital invested in the High Country class was higher than for most of the other seven classes. Again no allowance is made for the effect, if any, on the rate of return in the high country due to land tenure being predominantly leasehold.

However during the 1960s for all farm classes there was a very marked increase in the level of total farm expenditure, and the price of wool fluctuated greatly at different times for different qualities and in 1971 is at a very low level, the lowest for many years for fine wool. To maintain net farm income in the face of these two economic facts sheep farmers have had to increase or diversify production. Down country, increases in production and diversification took place rapidly during this period and were successful in holding net income and in increasing it in the case of the Mixed Fattening class.

In the high country some development and diversification also took place but here it is slower and more costly and results less spectacular. Topography, altitude and climate impose a considerable handicap and the weather can cause a sudden and drastic reversal at any time as occurred in the heavy snow falls of 1967 and 1968, and the summer drought of 1970/71.

(e) **Average Expenditure Per Farm**

Class	Av. 1960-64	Av. 1965-69	Tot. % Incr.
High Country	\$16,900	\$23,700	+ 40.2
Foothills	10,600	15,900	+ 50.0
Fattening-Breeding	9,600	13,400	+ 39.6
Mixed-Fattening	10,100	14,000	+ 38.6

(f) **Average Net Income Per Farm**

Class	1960-64	1965-69	Tot. % Incr.
High Country	\$8,585	\$6,700	— 21.9
Foothills	5,420	5,540	+ 2.2
Fattening-Breeding	5,890	5,660	— 3.9
Mixed-Fattening	5,470	6,150	+ 12.4

Tables (e) and (f) shows how expenditure and income for the high country class during 1960s compares with the other South Island classes. Total farm expenditure has risen at much the same rate in the high country as in other classes but high country net income has declined considerably from an average \$8,585 per farm per year from 1960 to 1964, down to an average \$6,700 per farm per year from 1965 to 1969, a fall of nearly 22 percent.

This reversal is substantial and is certain to be greater still in 1970 and 1971 with further falls in fine wool and store sheep prices and greatly increased farm costs.

The marked decline in profitability of the high country class during the 1960s compared with the other South Island farm classes (Table (f)), highlights the difficulty in high-country farming of increasing production and gross income at a rate fast enough to keep abreast of increasing farm expenditure and inflation.

In the high country the results from expenditure on development are in most instances much slower to be achieved than down country. The larger the lag between the expenditure on development and the receipts of proceeds from the increased production, then the greater is the disadvantage to the high country farmer during periods of high inflation such as occurred during the 1960s.

The high rate of inflation in recent years has been a major factor in increasing total farm expenditure. The high country property with its high labour content has suffered higher inflation increases than other sheep farm classes. Average total expenditure per farm in the high country increased 40.2 percent during the 1960s (Table (e)). From 1960 to 1969 the increase in on-farm expenditure items on high country properties due to inflation was 21.7 percent. From 1969 to 1970 the rate of inflation was 3.3 percent and from 1970 to 1971 it was 6.6 percent. The cumulative result of inflation on high country expenditure items from 1960 to 1971 has been an increase of 34 percent. In other words, the quantity of goods and services which could be purchased by high country farmers for $100 in 1961 required $134 for the same goods and services in 1971.

The rate of increase forecast in farm expenditure items due to inflation in the current period from 1971 to 1972 is about 6 percent.

The fall in average net income per farm in the high country (Table (f)), must also be viewed in the light of inflation of prices for consumer goods and services. For example, a net income per farm of $8,500 in *1960* required $12,800 per farm of *1971* dollars for the purchasing power of the net income to have been maintained over the period. We know that the actual level of average net farm income in the high country this year was nowhere near $12,800 and was probably about $5,000.

Therefore coming on top of low wool prices the recent high rate of inflation has hit hardest at the high country farmer in his activities both on his property and off it.

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Matched Sample Comparison

In all the tables so far, we have been looking at class averages which are representative of a type of farming as defined by the class. The number and content of each class varies from year to year as there is a small annual turnover in properties under survey. For a more detailed look at what has been happening on a type of high country property, within the high country class, two matched samples will be analysed and compared.

The two groups to be compared, A and B, are as similar as possible from a topography point of view. The properties in both groups are of medium size, no large 60,000 acre plus properties are included, neither are any of the smaller runs on the easier high country. All the properties in both groups have a limited area of winter country which includes some flat to undulating terraces and fans.

These terraces and fans are mostly in depleted native tussock and pastures are difficult to establish on them because of droughtiness, very cold winters and the low nutrient status of the soil. Each group is a matched sample, that is, the properties in each group remain the same throughout the period of the survey. For this study the survey period is six years from 1964/65 to 1969/70.

(g) **Production, 1954/65 to 1969/70**

Average per property, per Group:

Group	A	B
Average total area	29,000ac.	28,400ac.
Total sheep shorn	5,050	4,358
Wethers shorn	2,317	1,431
Percent wethers to total sheep shorn	46%	33%
Wool shorn per head	8.9 lb	8.4 lb
Average net price per lb	37.7c	35.7c
Cattle wintered (Av. June '64 to June '70)	34	126
Sheep to cattle ratio	149:1	34:1
Lambs tailed	1,014	1,114
Ewes to ram	1,467	1,611
Lambing percent	69.1%	69.1%

Group A *maintained the conventional management policy which had been used on these properties for the past twenty or thirty years — Minimum ewe flock, buying some replacements most years, all fine combing Merinos, very little hay made, and used only for the rams and a few cows and heifers. No cultivation, topdressing or oversowing, only an odd 40 to 50 acres sod-seeded. No planned development policy.*

Group B *had been conventional high country grazing properties but during this six year period moved into a development programme. The fan and terrace country and front hills were being subdivided with cattle proof fences and existing fences were cattle proofed. Water supply was improved, tracks put in, and a start made in the topdressing and oversowing of this country. Hay paddocks were developed and a large quantity of hay made in favourable seasons. The odd paddock of winter feed was sown and hoggets, two-tooths and cattle, and later ewes, were being winter fed. The ewe flock was being increased at the expense of wethers, and cattle numbers were being increased as quickly as was possible. More emphasis was being placed on sale sheep and with this in view Halfbred and Corriedale rams were replacing the Merino, and wool quality was becoming coarser.*

By the end of 1969/70 Group B properties were well committed to their new management policy. A large amount of money had been invested in their development to this stage and this was obvious in the changed appearance of the front country — more fences, tracks, etc. Production, however, was only starting to get underway by June 1970 and therefore it must be remembered that this analysis only compares the results at a very early stage.

From table (g) the end results of the two different sheep policies can be detected. The percentage of wethers to total sheep shorn is 13 percent lower in Group B than in Group A and this is directly evident in the lower shorn wool weights per head in Group B. Or conversely, in Group B, 37 percent of the sheep shorn are breeding ewes as compared with 29 percent in Group A. This is an 8 percent difference in the proportion of breeding ewes in the flocks for a 0.5 lb difference in wool shorn per head.

In Group B the average wool price for the six year period was nearly two cents per lb lower than the average price received by Group A. This is most likely a result of the strengthening of the wool clip by Group B properties.

Lambing percentages were the same and several properties in both groups suffered very heavy lamb losses in the November 1967 snow storm.

The main difference between the two groups is in the cattle numbers. Group A had an average 34 cattle per property over the period and a sheep to cattle ratio of 149 to 1. There was an increase during the period from 18 cattle per property in June 1964 to 59 in June 1970.

Group B had an average 126 cattle per property over the period and a sheep to cattle ratio of 34 to 1. The increase over the period was from 75 to 194.

(h) **Capital Involved**

June 30th	1964				1970			
Group	A		B		A		B	
	$	%	$	%	$	%	$	%
Land and Improvements (CV)	60,800	61	52,200	60	89,000	62	84,000	5[illegible]
Livestock	26,100	26	22,700	26	36,000	25	45,500	3[illegible]
Plant	6,300	6	5,700	7	8,500	6	7,500	[illegible]
	93,200	93	80,600	93	133,500	93	137,000	9[illegible]
Working Capital	7,500	7	6,400	7	9,500	7	10,000	[illegible]
Total Farm Capital	100,700	100	87,000	100	143,000	100	147,000	100
Total per sheep shorn	20.26		22.42		26.27		30.75	
Total per Stock Unit	21.56		21.44		27.70		25.88	

The total capital involved and the composition of this capital has changed considerably, between and within the two groups, over the six years from 1964 to 1970 (Table (h)). The increase in total capital, including working capital, was 42 percent for Group A, while in Group B the increase was 69 percent. The land development undertaken by Group B properties is evidenced by an increase of 61 percent in the value of land and improvements, compared with a 46 percent increase in Group A. Group B properties achieved a 40 percent increase in stock units wintered over the six years and with an increasing ratio of cattle to sheep the total investment in livestock doubled. Group A increased stock units by 11 percent and the investment in livestock rose 38 percent.

Working capital, calculated at half the annual cash expenditure plus wages of management, makes up a constant 7 percent of total farm capital. The ratio of land to stock to plant made little change in Group A over the period to 1970. In Group B this ratio changed significantly and in line with the increase in stock numbers and diversification of income.

A comparison of the gross income patterns (Table (i) (1) and (2))for the two groups shows clearly the results of their different management policies. Both groups remain very dependent on wool and wool prices, but whereas Group A is almost solely dependent on wool, Group B has achieved a significant degree of diversification as seen by comparing the change in percentage patterns from 1965 to 1970 for the two groups.

(i) **Gross Income Patterns**

(1) **Group A**

Gross ex	1964/5		1965/6	1966/7	1967/8	1968/9	1969/70	
Sheep	2,747	17%	1,015	1,684	– 252	– 627	3,416	17%
Cattle	—	—	—	781	– 111	– 262	388	2%
Wool	13,463	83%	17,777	17,034	18,185	18,863	16,695	81%
Other	7	—	319	215	133	—	146	—
Total Gross $	16,217	100%	19,111	19,714	17,955	17,974	20,645	100%

(2) **Group B**

Gross ex	1964/5		1965/6	1966/7	1967/8	1968/9	1969/70	
Sheep	2,157	15%	3,684	2,153	1,229	3,378	3,067	14%
Cattle	1,243	9%	1,067	1,356	2,573	2,184	3,484	16%
Wool	10,306	71%	11,875	12,556	12,475	16,551	13,866	64%
Other	794	5%	230	664	305	509	1,182	6%
Total Gross $	14,500	100%	16,856	16,729	16,582	22,622	21,599	100%

Both groups were affected by the snow and severe cold spells of 1967 and 1968, but Group A properties incomes much more so than Group B. *In Group A sheep and cattle accounts were in deficit for two years as a result of the losses and the additional purchases required to make-up numbers.* In Group B there was an immediate effect on the sheep account as the number of surplus stock was less, but due to better hay reserves, closer management with more paddocks, and a larger percentage of replacements bred, these properties *recovered quicker* and the drop in income was short-lived.

There was also a considerable difference in the effect of this severe climatic period on the wool production and wool revenue of the two groups, Group A being much harder hit. The number of sheep shorn in 1968 was down by 570 per property in Group A and by 155 per property in Group B. This was a 12 percent drop in Group A compared with 3 percent in Group B properties. Wool weights per head fell 0.7 lb in Group A, while Group B weights increased 0.5 lb per head. Total wool sold per property in Group A fell nearly 8,000 lb or 17 percent while in Group B total wool sold maintained its previous year's level. Further to this, fine wool prices in 1968/69 reached their highest level of the six year period being up by 6 to 8 cents per lb on the 1967/68 year. The net result was that Group B properties gained considerably more from the increase in price than Group A. Group B total wool income increased 30 percent or $3,800 per property while Group A decreased 7 percent or $1,300 per property.

The advantage was with Group B properties throughout this severe climatic period mainly because of their improved ability to feed their stock well during the winter of 1968, remembering that the summer and autumn feed supply in the high country after the November 1967 snow was very good indeed.

(j) **Pattern of Expenditure — Per Farm Group Average**

Group	A			B		
Av. 1964/65 to 1969/70	$ Total	$ c per Stock Unit	%	$ Total	$ c per Stock Unit	%
Wages and Shearing	5,650	1.11	40.2	4,269	0.79	30.0
Manure and Seeds	247	0.05	1.7	829	0.16	5.8
Repairs and Maintenance	966	0.18	6.9	1,092	0.20	7.7
Development Expenses	—	—	—	1,028	0.19	7.2
Truck and Tractor Expenses	1,347	0.26	9.6	882	0.16	6.2
Interest	206	0.04	1.5	1,453	0.27	10.2
Rent	442	0.09	3.1	376	0.07	2.6
Depreciation	1,241	0.24	8.8	1,588	0.30	11.1
Other Expenses	3,957	0.78	28.2	2,739	0.51	19.2
Total Expenditure	14,056	2.75	100.0	14,256	2.65	100.0
Average Stock Units	5,095			5,380		

The average total farm expenditure per year over the six year period is nearly the same for both groups while the percentage composition of this expenditure is very different and reflects the different management polices. (Refer Table (j)).

"Wages and shearing" which includes only remuneration to employees, plus their rations, and does not include wages of management, is the largest expense item in both groups being 40.2 percent of average total expenditure on Group A farms and 30 percent on Group B farms. *Group B with a policy of development and diversification into cattle has had a lower wage bill both in total and per stock unit. Seventy-nine cents per stock unit, compared with $1.11 per stock unit in Group A.*

"Manure and seeds," "Development" and "Interest" are all related, as also is some portion of "Repairs and Maintenance", and these items show what has been happening on the Group B properties as they implemented a change in stock policy and land development. In total these items amount to 31 percent of total expenditure in Group B compared with 10 percent in Group A, or, 82 cents per stock unit compared with 27 cents.

Group B properties had $19,800 of borrowed capital per property in 1964 with approximately 2/3 in term loans and 1/3 in short term advances. By 1970 indebtedness had risen to $27,500 with the same proportion between term loans and advances.

Group A properties had no term mortgage liability throughout the six year period, and their total indebteness was confined to short term advances which fluctuated according to wool prices and stock losses. The average level of advance over the period was $3,500 per property.

"Other Expenses" is a total of expenditure items either not relevant in this comparison of policies or not able to be itemised due to differences in account classification and composition between farms.

The comparison of "Total Expenditure" shows Group B higher by $200 per year per farm and lower by ten cents per stock unit than Group A. From this there is little to judge so far except that increased production and diversification has been achieved by Group B up to 1969/70 at a lower cost per stock unit than the conventional policy of Group A properties. *Whether this small expenditure advantage can be improved on or even maintained under the high rate of inflation going on at present is another question.* In achieving diversification Group B has taken on a pattern of expenditure which is less flexible than Group A and on which production is more directly dependent.

However Group B is increasing production and this is the only way to fight the effects of inflation on net income particularly during the present period with depressed wool prices.

(k) **Net Income Patterns**

	1964/65	65/6	66/7	67/8	68/9	69/70	6yr Av.
Group A	$3,797	5,466	5.544	3,955	3,744	4,762	4,545
Group B	$3,653	5,485	1,869	1,276	6,856	4,192	3,890

The net income pattern of both groups before tax and before any wages of management deduction is shown in Table (k). Group A net incomes have maintained a steadier course during the period than Group B and on average over the six years Group A has been higher by $655 per year.

The fluctuation of net income in Group B follows directly the fluctuation in gross income as total per farm expenditure steadily rose by 3 percent to 4 percent per year until 1969, and then by 10 percent from 1969 to 1970. In Group A expenditure, under a conventional pattern, followed gross income and when total gross fell in 1967/68 and 1968/69 so also did expenditure, then increased when total gross increased in 1969/70. This is evidence of the less flexible expenditure pattern of Group B compared with Group A.

Group B properties are still in the early stages of development and diversification and the time lag between the expenditure on development and increased stock numbers, and the increase in production and income, is evident in this analysis and must be considered when comparing the results. For example, cattle are only just starting to make a significant contribution to gross income in 1969/70, the final year of this analysis. Based on opening cattle numbers and prices during the past season, gross income from cattle in Group B in 1970/71 will have doubled in two years.

The properties in both groups have similar topographic and climatic problems and the limitations imposed are considerable. The risk factor is great in the high country and the conventional management policy as practised by Group A has stood the test of time well. This policy is very dependent on wool and is built on a large wether flock which results in minimum surplus stock for sale. By good management flock performance has been increased to a high standard but now that the value of the main product has slumped and inflation is rapidly eating up what is left some alternative policies must be searched for.

Group B properties have provided an example of an alternative, namely development of winter country, increasing the cattle to sheep ratio and sale stock output, and increasing the proportion of income from other than wool sources. On a net income basis Group A has done slightly better during the period from 1964 to 1970, but Group B has achieved a gross income pattern better able to cope with present and likely future problems and at an expenditure level which was ten cents per stock unit below Group A.

Summary

1. High country management is achieving higher levels of per head production than before. In the past twenty years wool weights have risen from 7½ lb per head to 9 lb, and lambing percentages have risen from the 60s to the 80s. Topography and climate continued to influence production but management has been adapted to minimise their effect.
2. During the 1960s the relative position of the high country farm class deteriorated considerably when compared with other classes of sheep farming. Total farm expenditure increased for all classes and while production increases maintained net profit in the down country classes, this was not possible in the high country.
3. The value of the assets of a high country property is high. Under today's economic conditions with wool prices low it is inevitable that alternative uses for this land are being turned to at present.
4. There is a very real move towards more cattle and improved winter country as shown in the matched sample analysis. There were advantages to be seen in the policies of both groups but the results achieved by Group B, without being spectacular, were the results of an alternative policy better suited to cope with present economic problems.
5. The hardness of the country, the severity of the 1967-68 storms, and the early stage in the development of Group B properties were important limiting factors in the period studied.
6. In the high country the alternatives available in farm management policies have always been very limited, and for the type of property analysed in this study there would appear to be little alternative but to develop, improve the winter country, and diversify stock production and income.

Photosensitivity from Swamp Fever

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Swamp fever is a form of photosensitivity common in the Mackenzie Basin.

The term swamp fever is really a misnomer as in the uncomplicated form of the disease there is no pyrexia or any other signs of fever. It is a primary form of photosensitisation, the aetiology of which is unknown.

W. Vance in his book 'High Endeavour', reports that soon after James Preston took over Ben Ohau Station in 1892 he accidently dropped some rock salt. As the sheep relished it he put more out for them and noticed an immediate improvement to an eczematous condition similar to facial eczema. This is the first record of the disease I can find.

It was reported in the early 1900s as occuring in sheep on the original Benmore Station and was consequently called 'Benmore Disease'. As the original block where the condition was prevalent was swampy and as subsequent outbreaks appeared to be associated with swampy areas with tarns or lagoons it came to be known as swamp fever, the term still used.

The next reports appear in the thirties, a botanical survey being carried out by Mr H. H. Allan in 1935. Further botanical surveys were done by A. J. Healy in 1957, 64 and 66. By this time the condition was reported from many different stations where swampy lagoons occurred.

In 1936 C. S. M. Hopkirk, in the New Zealand Journal of Agriculture, mentions a condition of photosensitivity in the South Island high country in an article called 'Facial Eczema in Sheep'.

The disease appears to be confined to the Mackenzie Basin and affects Merino and Halfbred sheep at the time when the tarns are drying up and the exposed vegetation there is being grazed. This can be as early as November but is usually about December/January. The disease can appear as late as April and has been confirmed as occurring in July. It usually abates late summer or autumn when the rains come.

Above and below: The effects of photosensitivity resulting from the disease called swamp fever. The cause is unknown but toxic plants are suspected. Symptoms are sunburn, nuzzling, and congregating in shade.

Photos: G. Schwarz, from transparencies.

The incidence of the disease varies year by year but is usually low at about one or two percent and may be as high as 25 percent. It has been reported that where ewes and lambs were exposed the majority of the cases appeared in the ewes.

Cause Unknown

The cause is unknown and may be due to a photosensitising agent in plants growing at the edge of tarns or in aquatic plants or algae.

It has been suggested that the condition is caused by St John's wort, *Hypericum perforatum*. This plant does cause photosensitivity, usually in the spring when the rapidly growing plant is more toxic, the typical symptoms of photosensitivity occurring and the sheep tending to show a marked aversion to water. In all botanical surveys of affected areas a dominant feature has been the absence of *H. perforatum*. However, the dwarf hypericum — *H. japonicum* (swamp hypericum) has been found in the areas in varying amounts but its involvement is not proven as it has often been in small quantities and has not shown evidence of being grazed. A feeding experiment with the dried plant material has proved negative.

A further trial with the fresh plant would be of interest.

No other known photosensitising plants have been found on the affected blocks but species of *Mentha* and *Stackhousia* different from those found on the blocks, have caused photosensitivity in Australia. In Australia a species of algae was found to be toxic when eaten by sheep and one of the symptoms was photosensitivity.

Plant composition of the tarns in the Mackenzie has not been investigated and it may be that certain pond weeds or algae could be involved.

Symptoms

The incubation period, the intensity of light and quantity of light required are all unknown. Affected animals become photophobic and one report mentions an aversion to water. An eczematous condition occurs on areas exposed to the light and commences as a red oedematous swelling of ears, eyelids, nose, lips and face — causing the ears to droop and the animals to have difficulty in eating and seeing.

Moving sheep to shaded areas during an onset of swamp fever would help to minimise sunburn. T.G.M.L.I. photo.

This is followed by necrosis of the skin. A secondary infection often intervenes and there is under running the dead skin a foul-smelling pus. The dead skin finally sloughs off exposing the raw tissue which finally heals. The resulting scar tissue leaves areas of skin denuded of hair, and misshapen ears and eyelids. The back in extreme cases is affected, particularly in recently shorn sheep or where there is a parting of the wool. The animal loses condition rapidly but mortality is low, however recovered animals appear to have their constitution weakened and frequently succumb to the rigors of climate.

Only that part of the skin not protected by pigment or wool and exposed to the light is affected but there is no internal pathalogical changes as in facial eczema where the liver is damaged. Thus it is a true primary photosensitising condition, the toxic principle going direct from the source to the skin.

Treatment

Treatment consists of removing the sheep from swampy areas, providing shade from the sun and ensuring that food and water are available. The sheep should be treated to prevent secondary infections and fly strike, particular attention being paid to the eyelids to prevent the eyes becoming infected and secondary blindness occurring. The only form of control that can be recommended is removal of sheep from suspected blocks just prior to the tarns drying up. In some cases large lagoons have been fenced off with good results. Removal may cause some inconvenience to runholders but it would be preferable to the painful and long-lasting effects upon that uncomplaining aristocrat of the Mackenzie, the Merino.

New Zealand Timberlines

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What is Timberline?

Timberline, or bush line as we usually call it, is a conspicuous feature on high mountains of New Zealand which still carry their original forest, and occurs at the altitude where the climate becomes too cold for the growth of trees. There are two distinct kinds. In one, beech trees form a dense forest up to their limit, and more often than not one can step from the forest to the snow tussock without being impeded by scrubby vegetation (Fig. 1). The other kind of timberline is found in areas such as Stewart Island, central Westland and Mt Egmont, where beeches are absent. Here mixed forest of totara, kaikawaka, rata and kamahi becomes lower growing, and merges into stunted forest or very dense scrub of olearias, senecios, dracophyllums, koromikos and dwarf native conifers (Fig. 2). With increasing altitude, this in turn becomes shorter and more discontinuous and passes gradually into the snow tussock of the tops.

The altitudes at which tall shrubs and trees cease is the same in both kinds of timberline, and depend mainly on latitude; thus timberline is about 5,000 ft on Mt Ruapehu, and 3,000 ft in southern Fiordland.

Reafforestation in the High Country

On the mountains most familiar to readers of this journal, however, there is little forest and no obvious timberline. This was not always so. Scorched logs, buried charcoal in the soil, and scattered remnants of forest show that nearly all the high country once supported forest, even in Central Otago on mid-slopes which receive more rain and snow than the semi-arid valleys. Radio-carbon dates indicate that these forests were destroyed mainly during the first few centuries of Maori settlement (see the article by Dr B. P. J. Molloy in *Review* No. 19).

Fig. 1 above: Mountain beech forest usually forms an abrupt timberline against the snow tussock. Here the figure of the author is providing scale.
Photo: A. P. Underhill (from N.Z. Jl Bot.)

Fig. 2 below: In areas where beeches are absent, there is a belt of tall, dense scrub above the forest.

Photo: P. Wardle (from N.Z. Jl Bot.)

The ability of the high country to grow trees again is a question of considerable interest, especially in relation to control of erosion. Nearly all tree planting carried out so far, experimental or otherwise, has been with introduced species, especially pines. There have been two good reasons for this.

One is that there are numerous species available from the Northern Hemisphere, and the silviculture techniques are fairly well understood. *This may be contrasted with the very limited number of hardy native trees, and the paucity of information as how to grow them.*

The second reason lies in the fact that timberlines are obviously much higher at comparable latitudes in Europe and North America. It has therefore been assumed that the timberline trees native to those parts must be hardier than the New Zealand species, although, as I shall point out shortly, there is another more important cause of the differences in altitude of timberline.

Much of the introduction of trees into New Zealand has been of the "trial and error" variety, and as *Pinus radiata* has proved, this can be very successful. Where trees are being introduced to high altitudes, however, such spectacular success can scarcely be expected, and work in afforestation will be better based if it includes studies of the basic factors which limit growth of plants under difficult conditions. I have been interested in learning what determines the absolute limits of tree growth.

The Causes of Timberline

Some of the factors governing timberline are already known. The most obvious—on reflection, but not at first sight—is that *timberlines are determined by conditions during summer, not during winter*. If the altitudes of timberlines are compared with temperature records, it will be seen that *places with the warmest summers have the highest timberlines*. Throughout the world, timberlines coincide quite well with a mean temperature of 10°C during the warmest month of the year, which is January or February in New Zealand. Herein lies the main reason for the high timberlines in North America and Europe. Thus, trees grow at 12,000 ft at lat. 40°N in Colorado, but even the hardiest pine would find life difficult at the same altitude in New Zealand.

There are two ways in which to look at the reasons for this dependence of timberline on summer conditions. One is in terms of *assimilation,* i.e., formation of carbohydrate molecules from carbon dioxide and water by photosynthesis. Some

Fig. 3 opposite: At nearly 12,000 ft on the San Miguel Range of Colorado, spire-like trees of Engelmann spruce form the timberline on a sheltered mountain side. Photo: P. Wardle.

of these carbohydrates are converted into cellulose, lignin, etc., which build up the body of the plant, some are used almost immediately to fuel the living processes, and some are stored to sustain the plant through its winter dormancy. The limits of vegetation at high altitudes have been explained in terms of the growing season being too short and too cold for plants to assimilate enough carbohydrate to carry out these three processes.

Trees have lower altitudinal limits than herbs, grasses or dwarf shrubs, and it has been suggested that this is because so much carbohydrate is used in forming a massive woody trunk that there is not enough left over for other purposes.

The other approach is to consider whether the growing season is long enough for plants to complete their annual cycle of growth and development. For trees, this comprises bud-break or flush in the spring, rapid growth of the shoots during the early part of the summer, growth in thickness and development of new buds during the rest of the summer, and hardening of the tissues during autumn. The last is a process, not yet fully understood, whereby a plant which in summer might be damaged by 2-3°C of frost, gradually becomes inured to very cold temperatures and dry winter winds. According to Austrian scientists the following factors influence the growing season at timberline:—

(1) Day-time temperatures must rise above about 10°C to permit active assimilation and growth.

(2) During winter, snow protects the seedlings, but it can lie late into the spring and prevent plants from growing when the air temperatures are already suitable. Therefore, trees tend to be absent from gullies and deep hollows.

(3) Severe frosts reduce the efficiency of photosynthesis for a few days afterwards, and the growing season ceases to all intents and purposes once frosts of —6°C to —8°C set in during the autumn. Spring frosts kill the new foliage of many species, although pines are very hardy in this respect.

Fig. 4 above: On a wind-swept ridge, Engelmann spruce is reduced to low bushes, dependent on the protection of the winter snow.
Photo: P. Wardle.

Fig. 5 below: In very exposed places, beech foliage survives only where it is protected by the winter snow, and the plant is reduced to a low, spreading shrub.
Photo: P. Wardle.

Although winter conditions are not the basic cause of timberline, they have their influence. The effects of snow avalanches are obvious, and one can distinguish regular avalanche tracks, occupied by herbaceous vegetation or tough, springy shrubs, from areas of wrecked forest which are struck once in a lifetime, after unusually heavy falls of snow. In regions subject to very cold, dry winter winds, exposed foliage is apt to be dried out, particularly when the soil is frozen, so that water lost from the leaves cannot be replenished through the roots. Under these circumstances, shoots formed during summer die back during winter, and one gets belts of stunted, twisted trees.

In the Rocky Mountains, the 100 ft-tall Engelmann spruce tree can be stunted into a prostrate shrub a few inches tall in exposed places, where its shoots are killed wherever they have grown above the level of the winter snow pack (Figs. 3, 4). The same effect can also be seen in red, dried-out leaves of stunted beech trees at the bush edge in New Zealand (Fig. 5).

Experiments on Mountain Beech in the Craigieburn Range

While there have been many general observations on timberlines, and some detailed laboratory experiments, there are few records of anyone having carried out the rather obvious experiment of growing tree seedlings at different altitudes and comparing their growth and survival. In 1961, I therefore set up a series of "gardens" at 600 ft intervals on Mt Cockayne. This area has the advantages that it is treeless above 3,600 ft (i.e. 600 ft below timberline), it slopes uniformly to the north-east, and it has landrover access to 5,700 ft.

The first trials were all but ruined by hungry mountain grasshoppers, and subsequently seedlings were protected by "bully" netting, which is cotton netting that passes about 80 percent of the light falling on it.

Different tree species differ in their response to light and shade, and therefore appropriate spacing of wooden laths was used to provide three levels of shading, which were about 27 percent, 54 percent and 80 percent of full light (Fig. 6). Since soil fertility differs from altitude to altitude, and since different tree species differ in their fertility requirements, soil conditions were reduced to a common denominator by using a uniformly fertile potting mix. Seedlings were grown in paper

Fig. 6 opposite: An experimental "garden" at 3,600 ft showing frames giving different degrees of shading, and protected by grasshopper-proof netting. Photo: J. S. Cocks (from N.Z. Jl Bot.)

pots, which decayed by the time seedlings became too big for them. Finally, crushed road metal was sprinkled around seedlings in autumn to protect them from winter frost-lift.

The bulk of the work was done on native mountain beech (*Nothofagus solandri* var. *cliffortioides*.) Seeds were sown in autumn, which satisfied the requirements for *vernalisation* or chilling of the seed to ensure germination. Germination occurred mainly during October and November at 3,600 ft, and during December at 5,400 ft, thus showing a lag of about six weeks over 1,800 ft (Fig. 7). The newly germinated seedlings grew for about the same length of time at each altitude, with the result that in the autumn growth ceased six weeks later at 5,400 than at 3,600 ft. Below timberline, seedlings had ample time to complete the next phases of the annual cycle; i.e. they were able to harden their tissues and to form properly developed resting buds, so that over-winter survival was good. Above timberline, cold temperatures set in earlier in the autumn than at lower altitudes and caught the seedlings unprepared, because the delayed cessation of growth meant that the final phases of the annual cycle could not be completed.

The main effect of cold weather was to dry out non-hardened shoots and leaves. This had already begun to affect many seedlings by the time that the winter snow arrived, and few survived their first winter.

Beech seedlings were also transplanted from 3,600 ft to higher altitudes as they germinated. Those transplanted to 5,400 ft thereby had a growing season six weeks longer than their neighbours which had germinated at that altitude, they had longer to become hardened after growth ceased, and their survival during winter was correspondingly better. Older seedlings transplanted from below showed still better survival (Table 1).

TABLE 1.

Altitude of germination (in feet)	Age when transplanted to 5,400 ft	Initial No. of seedlings	% dead by end of 1st winter at 5,400 ft	% dead by end of 3rd winter at 5,400 ft
5,400	—	10	60	100
5,400	—	81	40	89
3,600	Less than 1 month	9	22	78
3,600	Less than 2 months	33	3	58
3,600	About 6 months	12	17	58
3,600	About 12 months	15	0	60
3,600	Several years	8	0	0

Table 1: Shows that the survival of beech seedlings at 5,400 ft is better among transplants than among seedlings germinated at that altitude and also that the older the seedlings at the time of transplanting, the better their survival.

Performance of seedlings was also assessed in terms of growth, which reflects the efficiency of photosynthesis. To measure the increase in weight, seedlings were dug up and dried at 95°C. Weight correlated inversely with altitude (Table 2), mainly because of the difference in length of the growing season.

However even at 5,400 ft, seedlings increased in weight much faster than most seedlings occurring naturally on the forest floor below timberline, yet their survival was much poorer.

TABLE 2.

Altitude in feet	**1st Year**	**2nd Year**	
		M	**NM**
5,400	21	58	31
4,800	27	42	44
4,200	30	81	46
3,600	31	155	72

Table 2: Shows the average dry weights in milligrams of seedlings grown at different altitudes. For seedlings in their second year, M indicates seedlings with distinct mycorrhizas, and NM indicates seedlings with no distinct mycorrhizas.

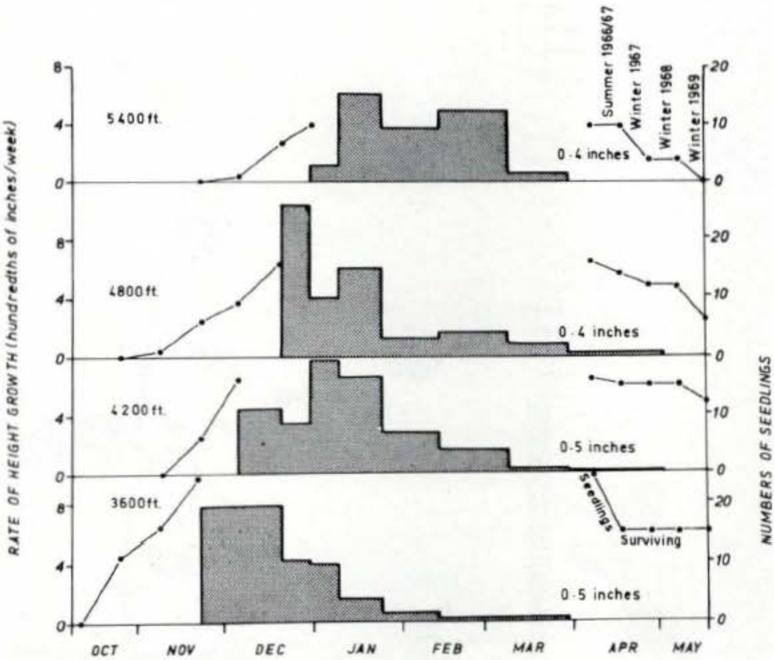

Fig. 7: RATE OF HEIGHT GROWTH OF MOUNTAIN BEECH SEEDLINGS DURING THEIR FIRST SUMMER.

The sloping lines on the left show the progress of germination in the spring, and those on the right show survival during the next 2½ years.

The left-hand column of figures shows the altitudes of the gardens, and the right hand column shows the average total height of growth during the summer. (from N.Z. Jl Bot.)

Growth in height showed little difference between altitudes during the first year (Fig. 7). This is because length of shoot in newly germinated seedlings is largely predetermined in the seed, while in older seedlings, it is likewise predetermined by the number of minute leaves and nodes which are laid down in the bud during the preceding autumn. After the first year, however, shoot growth also shows a good relationship to altitude because the lower the altitude, the bigger and better developed are the buds.

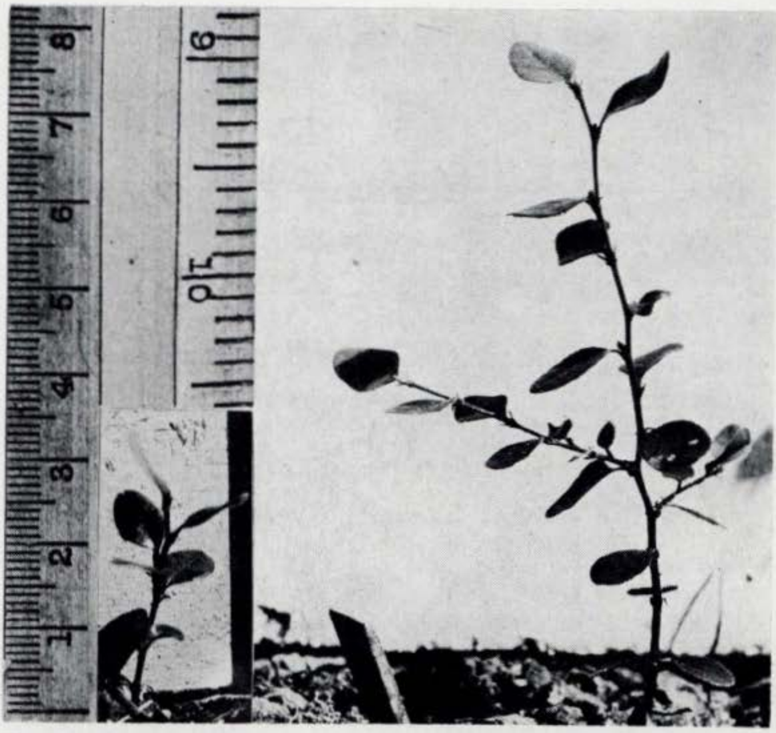

Fig. 8: Three-year-old beech seedlings at 5,400 ft (left) and 4,200 ft (right), photographed at the same scale. Photo: P. Wardle.

This is shown in Fig. 8, and the following results from one experiment:—

Altitude	3,600	4,200	4,800	5,400 ft
Average shoot growth	1.9	0.9	0.4	0.2 inches

These results refer mainly to seedlings grown under 27 percent light. Under stronger light, seedlings above timberline did not survive through their first summer. Below timberline, survival was poor at first but seedlings grew vigorously once they became established.

Some tests were carried out in the unfertilised soil of the locality, since the use of potting mix could be expected to give results somewhat better than those in nature. Plants taken to Lincoln grew much better in potting mix, but first-year seedlings on Mt Cockayne showed little difference between treatments.

This suggests that at altitudes where growth is strongly limited by climate, there is less opportunity for the effects of soil fertility to be manifested.

By the second year, growth was influenced less by soil fertility than by whether or not mycorrhizas were present (Table 2). Mycorrhizas are roots infected by fungi which assist the trees to take up phosphates and possibly other minerals. Such fungi are necessary for healthy growth in nearly all trees, once the minerals stored in the seed have been used up.

The results of these experiments indicate that the altitude of mountain beech timberlines depends on whether the growing season is long enough for seedlings to complete their annual cycle of development, rather than on the amount of assimilation and growth that is possible. The delayed germination at high altitudes leads to a corresponding delay in hardening of tissues at the end of the growing season, so that newly-germinated seedlings are especially likely to dry out when the cold autumn weather sets in. A notable feature of the mountain beech timberline is its compact nature, and the absence of stunted trees above it. This seems mainly due to the inability of seedlings to survive in the open at high alttudes, but competition from grasses and herbs, and the reduced chances of becoming infected by suitable mycorrhizal fungi are contributing factors.

Experiments with Introduced Trees

Several overseas timberline species were compared with mountain beech. Engelmann spruce (*Picea engelmannii*) is widely dominant at timberline in the Rocky Mountains, where the continuous forest is superseded at timberline by more open growth of wind-deformed trees, which become more sparse and more stunted with increasing altitude. Like beech, the seedlings of spruce established poorly in strong light, especially at high altitudes, but in 27 percent light seedlings are surviving well at 5,800 ft. However, annual growth during the first years is extraordinarily limited, averaging only 2 or 3 tenths of an inch per year even in healthy plants, and it is completed in a few weeks. This means that the tissues are well and truly matured by the time cold weather returns.


0 1 2 3

Fig. 10: Some timberline species have low-growing races, which are possibly better adapted to the conditions. This prostrate seedling of a South American beech (*Nothofagus antarctica*) is growing at Lincoln.
Photo: J. Miles (from N.Z. Jl Bot.)

Spruce seedlings are therefore hardier than those of beech, but it is doubtful if they could be used to extend the timberline more than 200-300 ft above the natural one. Eventually, the seedlings would attain a height where their shoots would be in an entirely different climate, where plant temperatures at daytime are usually 5-10°C cooler than those close to the ground. These shoots would therefore experience, in effect, a growing season that is shorter and cooler, and during the winter they would be outside the protecting blanket of winter snow, and exposed to drying winds.

Three species of pine were also tested. Lodgepole pine (*Pinus contorta*) germinated freely at all altitudes, and survival has been good. Growth was best under the least shaded treatments, and even at 5,800 ft, the seedlings show the robustness that one has come to expect of this species in the high country.

Fig. 9 opposite: When seedlings of different geographic origin are grown together under good conditions, their growth rates can differ strikingly, but such differences are less apparent at high altitudes. These four-year-old Engelmann spruce seedlings were grown at Lincoln. Left: seed from State of Washington; right: from New Mexico.
Photo: J. Miles (from N.Z. Jl Bot.)

In its native North America, however, lodgepole pine does not grow within a thousand feet of timberline expect for occasional plants crippled by the severe winters. Doubtless, their fast growth proves to be their undoing under these conditions. Even allowing for our mild winters, I anticipate that in New Zealand too, winter conditions will prevent this pine from reaching tree-size above 5,000 ft.

Limber pine (*Pinus flexilis*) comes from the same region, but it is much hardier, and massive trees occur at timberline among stunted scrub of spruce and alpine fir (*Abies lasiocarpa*). I have raised very few seedlings of limber pine but these, like spruce, show very limited annual growth and unlike spruce they benefit from strong light.

The third is *Pinus hartwegii*, which forms timberline at over 13,000 ft in the tropics of Mexico. Despite the absence of well-defined seasons and persisting snow in its native country, the species has adapted to New Zealand conditions surprisingly well, and there are some very vigorous seedlings at 4,200 ft. At 5,400 ft, however, it seems unable to mature its shoots sufficiently to withstand winter conditions. Photographs which I took of this pine in Mexico show burnt seedlings resprouting from the root collar—a property which could make it useful here.

Finally, three species of eucalypts were tried, these being Australian snow gum (*Eucalyptus niphophila*), Tasmanian snow gum (*E. coccifera*), and another hardy Tasmanian, *E. gunnii*. Since the seeds are minute, the seedlings are also very small at first, but up to 4,200 ft all the species become very vigorous after 3-4 years, with shoot growth of more than 30 inches annually. Above timberline, eucalypts were inferior to mountain beech, their weakness being that they formed more growth than they could mature before winter.

Inverted Timberlines

Another aspect of the Mt Cockayne experiments has concerned *inverted timberline,* where forest on mountain slopes meets treeless valley flats. Such flats experience very low temperatures on winter nights, lower even than the mountain sides 2,000-3,000 ft higher up, and for plants, there is not even the benefit of a continuous winter cover of snow. One of my gardens was on such a flat at 3,000 ft. Small seedlings of mountain beech proved unable to establish themselves in this garden, although larger transplanted seedlings did become established provided they were shaded. It seems that the frequent freeze-thaw cycles dry out seedlings, and this is made worse by severe frost-lifting. Seedlings of pine and spruce, however, are quite hardy on this flat.

Practical Conclusions

While my experiments were designed to give basic information about the causes of timberline, several points emerge which are relevant to revegetation at high altitudes. These are listed below. On the whole, they complement the conclusions drawn by Mr J. T. Holloway in his article in *Review* No. 18 which describes results from the Forest and Range Experiment Station. The main difference is that my results, which are described in full on pages 371-402 of Volume 9 of the New Zealand Journal of Botany, emphasize the overriding importance of climate at high altitudes, rather than soil fertility or geographic origin of introduced species (Figs. 9, 10).

1. In severe habitats at high altitudes, the advantage in survival is to plants forming a small amount of annual growth, which is completed in a short burst so that there is time for the shoots to mature before the winter.

2. Tree species are inherently unpromising at high altitudes, because their form of growth carries their shoots to a height above the ground where conditions are unfavourable for survival.

3. Although several species of exotic conifers are obviously hardier than the native beech, it is unlikely that this leads to any practical possibility of raising the timberline more than a few hundred feet, because timberline represents a fundamental climatic barrier.

4. Above about 5,000 ft, emphasis should be on plants which can form a large amount of growth despite a very short growing season. If these are to be woody plants, they would need to be low-growing, and either inoculated with mycorrhizal fungi or other microbes necessary for their growth, or fertilized at intervals. However, it is open to doubt whether there is any woody plant which would grow quickly enough to be useful for artificial revegetation, except perhaps on very favourable sites, since woody plants, on the whole, have inherently slower growth than herbaceous species native to similar habitats.

5. Immediately below timberline, many tree species can succeed, and these show a wide range in growth rates and site requirements. For afforestation, there is a choice between trees such as pines which benefit from strong light and are therefore suitable for introducing on to bare ground, and trees with seedlings which establish best under shade, such as mountain beech. The latter should be useful for planting into existing cover.

A CONCEPT IN FOREST RESEARCH

The work of Dr Wardle of D.S.I.R., described in the foregoing article, indicates that we can expect but slow progress in any endeavour to grow trees above timberline. The indigenous species have attained their altitudinal limits and the exotic species falter under these conditions, although in some instances they perform better. It is significant that his studies are concerned with the causes for timberline rather than an all-out attempt to extend it. But the results show promise of getting a few hundred feet more in forestry which, to a land hungry nation, should be encouraging.

In this study there is a need for persistence with imports of seeds and stock, hybridisation, poleplanting, transplanting, and international research, to ensure that the remotest possibilities are not overlooked.

We should hope that for the benefit of future New Zealanders this work will be done, and that it is given adequate priority.

Mr J. T. Holloway, director of F.R.E.S., has said that there is a danger of research becoming academic in these fields and it is important to concentrate on aspects assured of quick economic return for effort and funds.

This is prudent use of *public* money, yet the success of forestry in this country was not all accidental, hence the question of whether the country is already indebted to the forest industry and its research cadre and can fully bear the cost of forest research in all priorities. Should there be any doubt of this, then there is left the alternative of the corporate funding of research.

There could be only straw-splitting reasons why the various research cadre should not possess their own production forests to back research. If they had them, then instead of research being subject solely to vote funding or assessed in terms of a percentage of G.N.P., which is hardly good for morale in lean years, it would also be fixed as a percentage of a pooled cash resource brought in by the wit and zeal of the enlarged cadre.

The student body of Canterbury University have given a strong lead in foresight in establishing their own forest, even if it merely provided for their heirs a new beerhall. They have here the opportunity of experiencing the joy or anguish of forest ownership, they learn to grow trees, they add to knowledge — achievements far more profound than the end products of wood and beerhalls, or financial security.

Corporate forestry is dangerous for its competition for land, but the corporate funding of research can be beneficial for its unfettered simplicity and encouragement to research. The independence earned can do a lot for morale in this vocation where the biological frustrations of tree growing are frustrations enough.—Ed.

The Director,
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A Grower's View on Wool

M. Murchison

The Acheron, Lake Coleridge.

With so many conflicting ideas and reports being proferred on wool's future it is only natural that many growers will feel more than a little confused in these uncertain times. Some readers may not agree with the views expressed here but they may see in them a background for further discussion. The views are not necessarily those of other runholders.

Wool, as I see it, is a natural fibre of supreme quality, at present unmatched but fighting to hold its small share of the world fibre market. As the world demand for textile fibres increases due to the small contribution from wool, synthetic fibres are continually getting a bigger percentage of the world trade. This to me does not mean that wool is in any less demand, it means we have to fight harder to retain our share. When one considers that any major synthetic organisation is bigger than the whole wool world it makes one realise how very small we are.

It is hard to reconcile the price growers are receiving with the price of finished woollen articles. Accepting the fact that wool is a great deal more costly to prepare than synthetics and the end product is more than comparably expensive, I think for all we are told that it would not be unreasonable to expect a realistic price for our product. I do not advocate the return to extremely high prices such as have occurred in the past and which in reality have caused as much harm to the wool grower as the low prices he is receiving at present.

The value of greasy wool is only a minor part of the cost of any finished article. It is interesting to note that it takes approximately 2 lb 7 oz of greasy wool to make 1 lb of yarn ready to weave, or to complete a yard of typical 14 oz men's suiting cloth, about 2 lb 4 oz of greasy wool. Thus in an average two-piece suit, using 3.5 yards, there is approximately 7lb 13 oz of greasy wool.

I feel we must be very grateful to the International Wool Secretariat and the men who work with wool for fighting to hold its position. But the excellent work of the I.W.S. may have gone astray to some degree by creating the image of wool as a luxury fibre, thus encouraging excessively high prices at the retail end. This is unfortunate and an incorrect image.

Changes

Some of us brought up in the strictest tradition of wool have seen great changes take place and many more changes must occur throughout the industry. I hope some of the ideas here will be put into effect soon, others of them may take more time but most or all are inevitable.

Traditionally we are told fine wools need to be more carefully skirted and classed to a far finer degree than crossbred wool. Up until now there has been very little doubt that this is correct, but with the change of thinking toward less skirting of crossbred wool and the making of broader lines, I think this may be over emphasised. I am quite sure many clips are over-classed and over-skirted. It would be interesting to know just how broad a great many blends used by the trade are. When one considers the big variation in fibre diameter in one fleece and the blends which takes place after sale I feel some growers are wasting time classing at all.

With the large stockpiles of fine wools in the world at present it seems that fine wool needs more promotion than crossbred wool which in some instances is being used where fine wools were used in the past.

One feature against fine wools in modern industry is the speed at which modern machinery handles fibres, fine wool not being as easy or as fast to process as its synthetic counterpart or the longer and stronger-fibred crossbred wool. It is evident that greater emphasis must be given to research aimed at developing high speed processing machines which could more readily handle fine wools. It is impossible to alter the character of wool but it is quite feasible to adapt machines to get the best out of these characteristics.

I think the argument that synthetic fibres are easier to use is only a limited one. To me wool has a place, and a manufacturer, providing he is making a profit and can obtain supplies, will use it. I feel this continual argument that wool has so many disadvantages to synthetic is over emphasised by too many people to the detriment of wool. Granted wool is of irregular length, strength and diameter—this is basic and cannot be changed, but let us live with this aspect and not continually decry wool because of its dissimilarity with synthetic fibres. If change is needed surely men can devise machinery to process wool as readily as any synthetic fibres.

Brand Names

Most runholders like myself market their clip under their own brand name. In the past this has often paid premiums but with more sophisticated means of measuring wool than visual, the fibre diameter in clips is found to vary considerably from year to year depending entirely on feed conditions which in most instances are naturally associated with the weather. So today I think the brand name is not the value it was. There is no doubt that a brand name to some buyers means a clip is a high or low yielder or is finer or stronger in fibre than someone else's. On the other hand it may have a lot of moit or a higher than average content of tender wool so the brand name becomes as great a disadvantage as an advantage. There are a few instances when top speciality wools are marketed that the brand name is still important. With more accurate measurement of wool this too will get less important.

Autonomy of Sale

In the future, whether growers want it or not, except possibly for a limited number of speciality wools, they will no longer have any autonomy of sale. Individually growers are so small in the overall picture of wool that their small lines are creating a great deal more fragmentation than is necessary in practice. However, whatever the future policy, a grower must have the individual right to appeal if he considers a value put on his wool inequitable. At no stage can the grower possibly lose this right to appeal if he considers the value for a type of wool unreasonable.

Shed Classing

Shed classing, I feel, will ultimately go out. At present a great many sheds are ill-equipped to handle wool. The light is very often bad and handling facilities poorly laid out. I consider there are very few good fine-wool classers available, and even fewer where Merino wool is concerned. Aspects of shed classing also to be considered are the number of sheep being shorn in the flock per day. I suggest the economics of shed classing of a tally less than 600 sheep a day very doubtful. In some instances where wool weights are light and there is a considerable amount of reclass wool the number could be a great deal higher. The value of a shed classer also depends on what he is doing. Is he replacing one man on the table and sorting necks and pieces as well?

I think many runholders could look at the cost of shed classing. One of the biggest problems in shed handling of wool is that some wool rollers are inefficient, inexperienced and disinterested. Unfortunately our relatively short season does not allow more people to take this job more seriously—to a degree where it could be possible for them to be registered as in Australia. A point in the get up of a clip is that very rarely is a badly skirted clip discounted. Mostly it is very hard to tell once the wool is pressed up how badly or how well a clip is skirted. *I feel that in the future skirting, if necessary, will be done at a scour where the wool is being pulled or sorted thus saving two lots of handling.*

I think sheep's back classing may well be considered more in the future, especially if more and more wool store or scour handling of wool is taking place. This practice is carried out in Australia and I am told in South America. It must obviously reduce the broadness of reclassing and make handling of wool considerably simpler to a point where in some flocks very little if any reclassing would be necessary.

Store Classing

I think store classing as we now know it at present will change to a degree with specified stores handling specified wools, thus ensuring a continuity of regular classing, large lines, and making use of and training men in exactly what lines to set for various types of wool. This must get away from many small lots of wool which could easily be blended. I do not think a central complex for handling wool is economically justified at present, maybe in the future this picture could change. When wool is directed to specified handling centres I suggest the number of New Zealand standard types could be reduced from 1400 at present to say 200 or less by producing straight types and blends suitable for the trade. A grower's share of a blend could be based on weight and yield, the yield of his wool being tested on arrival at the centre, thus assuring that the grower of high-yielding wool is not being penalised by blending with a similar quality but of a lower yield. The advantage of a large line for sale is that it can be more accurately tested to give an overall guaranteed average micron and yield. The practice now is one bale in 24 is on show, this bale being guaranteed typical of the line with the average micron and yield shown. This must save considerable handling costs.

I think bulk classing will continue and grow more efficient. The practice of handling at scours, especially for mixed lines or wools with heavy skirtings could well increase in the future. I envisage this increasing in conjunction with the classing in wool stores.

Objective Measurement

I think objective measurement is essential in the future for wool. If at present it has nothing else it has shown how irregular visual appraisal on **small** lines can be. Over a large number of lines visual appraisal averages out to a high degree of accuracy. Objective measurement is a mechanical method of determining the average fibre diameter of a line of wool. While at present there are problems and inaccuracies, I suggest that for all these inaccuracies it is far more accurate than visual judgement is on occasions. I see no reason why some percentage degree of inaccuracy cannot be accepted at this stage and endeavours made to improve this percentage with use. The big drawback to objective measurement is that the traditional term "handle" is not measured. I would like to be sure that this is an important feature but have doubts about it. Today it seems to me that with shrink proofing and other processes it is very simple to change the feel or handle of wool in the finished article, thus destroying the value of our traditional "handle" of wool in the grease. I think all fine wool growers must want objective measurement accepted, especially when acquistion of our clips eventuates. There are too few fine wool clips compared with crossbred for any assessor to be able to continually accurately assess them. This is in no way being derogatory. To me it is impossible for men to assess a type of wool accurately if they are not handling a reasonable quantity of it and are not getting reports back from the processors on the individual lines of wool.

In conclusion I would like to comment briefly on the wool marketing corporation which is being set up. From a fine wool point of view there does not seem much in it for fine wool growers at present. From the report, which appeared very Americanised, and full of grey areas leaving a great deal unsaid, one must rightly hope that the corporation can get established in the U.S.A. The main thing in its favour is that at present New Zealand carpet wools are unsurpassed in the world and may be more readily saleable than comparable types. Whatever happens, and I am sure only good can come from it, let us hope that something learnt from this may help us with our fine wools, although we are very small fine wool producers when one considers the vast amounts of fine wool stockpiled in Australia and South Africa.

It is interesting to note the wool producing countries which are members of the I.W.S. are at long last talking of acting more as one body, this to me is long overdue. Whether we are crossbred or fine wool producers a strong co-ordinated marketing concept must be of great value to us all.

Do not let us decry wool, let us have confidence in it and in its ability to prove itself against synthetics in the future at a price economic to producers.
November 1971.

STAPLES FOR BALES — A QUESTION OF ECONOMICS AND PREFERENCE

An article in *The Press* of 3rd December gives the advantages of hooked staples for the clipping of bales as practiced in Australia. It is just a year ago that the Wool Board demeritted the adoption of the Australian system of farm-baling on the costs of converting New Zealand farm presses to the Australian type, the extra costs of the bales, the difficulty in displaying this bale, and the need for a new machine for re-baling after display.

Store baling was seen as a key factor in determining how farm packaging in this country should develop. Mr M. J. Slessor, the Wool Board's shipping manager, advised this Institute that dense baling if adopted would alter the methods of pressing scoured and binned wools. With dense baling there is no need for dumping. The bale contains 600-700 lb of wool compressed to medium density of 30 lb per cubic foot. It is wrapped with a piece of woven fabric, jute or synthetic, then banded.

A farm-pressed bale is about 12 lb per cubic foot. Dense baling on the farm would not be practicable nor necessary.

It seems that stapled versus twined bales is a question of economics, preference and follow the leader, if leader there be. Bales are more quickly stapled than they are twined but few farmers will change for small benefit, especially if direct scouring may dominate over direct binning, in which case on-the-farm baling may go out on properties with larger woolsheds, in favour of fleece-elevators and the truck-tray compressors. Such an idea for the bulk handling of fleecewool from the farm to the scour has yet to be designed and developed but it is a matter of urgency that the industry's leaders have this investigated since it will have a big influence on how growers' wool is classed, weighed, valued and purchased.

—Ed.

Income Variability and Farm Taxation

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Introduction

Research on farm taxation got under way at Lincoln College in those halcyon days of the Agricultural Production Conference. Farmers urged the Government to change the taxation rules to give them greater incentive. As few of the proposals were backed by serious research some of us at Lincoln started using the computer to investigate the proposals which were being kicked about at the time. Most of our results seem much less useful now that farmers' terms of trade have lost their former glory. But our research on income equalisation schemes and methods of taxation has some relevance for runholders whose incomes fluctuate so widely.

We have developed methods for calculating the extra tax farmers pay because their incomes fluctuate, and worked out rules for getting the most out of the income equalisation scheme. Finally we have recommendations on how to pay tax to reduce income variability and to keep income as stable as possible.

Estimating Variability

Understanding how to measure income variability is the first step in coming to grips with the implications of taxation for farmers whose income fluctuates. It is usual to use the **standard deviation** to measure variability. The larger the standard deviation the bigger the variation. If the standard deviation of income is zero, then future income can be predicted with certainty like the salary of a public servant.

Standard deviation is calculated from the deviation of each figure from the average. These deviations are squared as part of the calculation. I won't give the details of how to calculate the standard deviation of your income over the past few years because this historical figure will not be needed.

Now in working out budgets which involve taxation it is not much use applying historical figures to the future. For instance, taking the average wool price for the last 20 years and saying "that's what it can be expected to be in the next five years" is likely to be met with remarks like, "come on, be realistic". Likewise if the farm has been improved over recent years, historical lambing percentages may only be a partial guide to future lambing percentage. A guesstimate of a "likely figure to work on" will often be a better guide than an historical average because this average will reflect conditions which may not apply in the future. A method of guesstimating expected future income and its standard deviation over the next few years ahead is given below: (1)

1. Pick an extremely optimistic income. This income would assume a wool boom like the one in the mid '60s, coupled with high wool weights and a high lambing percentage. Call this **OPT.** There should only be a very slim chance of such an optimistic income — you would bet something less than one chance in 100 of such a high income occuring in any one year.

2. Pick an extremely pessimistic income — even lower wool prices than today, together with effects of a blizzard on the run in November. Call this **PESS**. There should be only one chance in 100 of such an extremely pessimistic figure occurring in any one year.

3. Now work out the most likely income — the figure you use in your normal budgeting. Call this **LIKE.**

The standard deviation for future income can then be calculated by taking one-sixth of the difference between optimistic and pessimistic.

$$\textbf{Standard deviation of income} = \frac{(\text{OPT} - \text{PESS})}{6} \text{ (approx.)}$$

Expected income as it is called is calculated by:

$$\text{Expected income} = \frac{(\text{OPT} + 4 \times \text{LIKE} + \text{PESS})}{6} \text{ (approx.)}$$

(1) Malcolm D. G., *et. al.* Application of a technique for research and development programme evaluation, *Operations Research*, 7 (5) p. 646, 1959.

Thus supposing we have guesstimated that:

OPT (most optimistic income) = \$20,000
LIKE (most likely income) = \$5,000
PESS (most pessimistic income) = —\$5,000

then the standard deviation of income is:

$$\text{Standard deviation} = \frac{(20{,}000 - (-5{,}000))}{6} = \$4{,}166$$

or roughly \$4,000; and the expected income is:

$$\text{Expected} = \frac{(20{,}000 + 4 \times 5{,}000 + (-5{,}000))}{6} = \$5{,}833$$

or roughly \$6,000

While we are all quite familiar with the idea of an expected income, the estimation of variability through the use of the standard deviation is foreign to all farmers and most advisers. Yet this measure is almost essential for rational planning for the risky and variable conditions under which runholders have to operate. Before reading further the reader should think of a run he knows well and estimate its expected income and its standard deviation using the simple method just outlined to make sure he has grasped it.

Extra Tax Because of a Fluctuating Income

Everyone knows that you pay more tax if your income jiggers up and down compared with a public servant on the same expected income but whose income is stable from year to year. This is because the Government grabs a greater proportion of your income as it rises. An above average income attracts a higher proportion as tax than a below average income. The swings do not counter balance the roundabouts.

Now there is a rough and ready formula which tells you how much extra tax you can expect to pay each year with a fluctuating income of a certain standard deviation ([2]). Standard deviation of income is represented by the greek symbol σ.

([2]) McArthur, A. T. G. Extra Tax Resulting from Income Variation with Particular Reference to New Zealand. Australian Journal of Agricultural Economics 13 (1) p 68, 1969.

$$\text{Extra tax annually} = \frac{1.42\,\sigma^2}{100{,}000} \quad \text{(approx.)}$$

Thus a runholder whose standard deviation of income (σ) is \$4,000 can expect to pay annually $\frac{1.42 \times 4{,}000^2}{100{,}000} = \$227.$

He can expect to pay \$227 each year extra as compared with a public servant on a guaranteed fixed income of the same average level. This \$227 per year would go a long way to educating one runholder's child at boarding school and is a sizeable amount. By comparison, a dairy farmer's income is nothing like so variable. A standard deviation of \$1,000 could be a typical figure. The extra tax annually for a dairy farmer would only be $\frac{1.42 \times 1{,}000^2}{100{,}000} = \$14$ which is scarcely worth grumbling about.

Now if runholders should point out their inequitable position to the Inland Revenue Department they will probably be told to make use of the income equalisation fund to smooth out the bumps in their income and hence reduce the extra tax they have to pay. We look at the income equalisation scheme in the next section.

The Income Equalisation Scheme

Under the income equalisation scheme a farmer can pay up to 25 percent of his pre-tax income into the local tax office. He can leave it there for up to five years. He can uplift his deposit in years of lower income to bolster it up, and hence smooth the fluctuations in taxable income from year to year. One of the snags with this scheme is that while the tax office is holding your money it is not paying you any interest.

Now the income equalisation scheme can be a real benefit to a runholder with a wildly fluctuating income, especially if he can tell what his income is going to be in the years ahead.

For instance over the last 13 years the pre-tax income on Lincoln College's Ashley Dene farm has varied widely with a standard deviation of about $4,000. A handy mathematical method called dynamic programming can be used to find the best way to use the income equalisation fund given you know what future incomes will be. I have applied this method to the Ashley Dene data. The best plan for Ashley Dene in terms of deposits and withdrawals in the fund are shown in Table 1.

Table 1 — **Optimal use of Equalisation Fund — Ashley Dene Incomes $**

Year	Pre-tax Income	Deposit (plus) Withdrawal (minus)	Level of Equalisation Fund
1958	—1,310	0	0
1959	5,520	+1,000	1,000
1960	— 728	—1,000	0
1961	1,114	0	0
1962	4,200	0	0
1963	6,878	0	0
1964	7,688	0	0
1965	6,150	0	0
1966	5,616	0	0
1967	12,168	+3,000	3,000
1968	4,138	0	3,000
1969	6,509	+1,600	4,600
1970	—1,285	—4,600	0

The deposits and withdrawals in the equalisation fund shown in Table 1 result in an equivalent annual saving of $99.

Unfortunately even Lincoln College doesn't have perfect foreknowledge of its income so it is not usually possible to make as much as this out of using the income equalisation scheme. However, intuitively, a runholder might think it worthwhile to put something into the equalisation fund after an excellent year and withdraw from his fund in a bad year. I have used dynamic programming to work out the best rules for operating under these conditions of uncertainty, an income equalisation scheme which assumes that expected income and its standard deviation in the years ahead can be estimated. These rules are shown in Table 2.

Table 2—RULES FOR OPTIMUM USE OF INCOME EQUALISATION FUND
VALUES IN TABLE ARE OPTIMUM AMOUNTS TO BE IN THE FUND AT THE END OF THE YEAR, GIVEN THE PRE-TAX INCOME PLUS DEPOSIT IN THE FUND AT THE BEGINNING OF THE YEAR AND AN INTEREST RATE OF 7½%.

Pre-Tax Income & Deposit in Fund	Average Income = $3000			Average Income = $4000			Average Income = $5000			Average Income = $6000			Average Income = $7000		
	σ= $2000	σ= $3000	σ= $4000	σ= $2000	σ= $3000	σ= $4000	σ= $2000	σ= $3000	σ= $4000	σ= $2000	σ= $3000	σ= $4000	σ= $2000	σ= $3000	σ= $4000
3,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
3,400	0	400	400	0	0	0	0	0	0	0	0	0	0	0	
3,800	400	400	800	0	0	200	0	0	0	0	0	0	0	0	
4,200	600	800	800	0	200	200	0	0	0	0	0	0	0	0	
4,600	600	1,000	1,200	200	600	600	0	0	200	0	0	0	0	0	
5,000	1,000	1,200	1,400	400	600	1,000	0	0	400	0	0	0	0	0	
5,400	1,400	1,400	1,600	600	1,000	1,200	0	400	800	0	0	0	0	0	
5,800	1,400	1,800	1,800	800	1,200	1,400	200	600	800	0	0	400	0	0	
6,200	1,800	2,000	2,200	1,200	1,400	1,600	400	800	1,200	0	200	600	0	0	
6,600	1,800	2,200	2,600	1,200	1,600	2,000	600	1,000	1,400	0	400	600	0	0	200
7,000	1,800	2,400	2,800	1,400	2,000	2,200	800	1,200	1,600	200	600	1,000	0	0	400
7,400	1,800	2,800	3,000	1,800	2,000	2,400	1,000	1,400	1,800	400	800	1,400	0	200	800
7,800	1,800	2,800	3,200	1,800	2,200	2,800	1,200	1,800	2,000	600	1,000	1,400	0	200	800
8,200	1,800	2,800	3,600	1,800	2,600	2,800	1,600	1,800	2,200	600	1,200	1,800	0	200	1,200
8,600	1,800	2,800	3,800	1,800	2,600	3,200	1,600	2,200	2,600	600	1,600	2,000	0	600	1,200
9,000	1,800	2,800	3,800	1,800	2,800	3,400	1,800	2,400	2,800	1,000	1,600	2,200	0	600	1,200
9,400		2,800	3,800	1,800	2,800	3,600	1,800	2,600	3,000	1,000	1,600	2,400	400	600	1,400
9,800		2,800	3,800	1,800	2,800	3,800	1,800	2,800	3,400	1,000	1,800	2,800	400	800	1,000
10,200		2,800	3,800		2,800	3,800	1,800	2,800	3,600	1,200	2,000	2,800	400	1,200	1,000
10,600		2,800	3,800		2,800	3,800	1,800	2,800	3,800	1,600	2,000	2,800	400	1,200	1,800
11,000		2,800	3,800		2,600	3,800	1,800	2,800	3,800	1,600	2,000	3,000	400	1,200	2,000
11,400		2,800	3,800		2,800	3,800		2,800	3,800	1,600	2,400	3,200	400	1,200	2,400
11,800		2,800	3,800		2,800	3,800		2,800	3,800	1,600	2,600	3,200	800	1,200	2,400
12,200			3,800		2,800	3,800		2,800	3,800	1,600	2,600	3,200	800	1,200	2,400
12,600			3,800		2,800	3,800		2,800	3,800	1,600	2,600	3,600		1,600	2,400
13,000			3,800		2,800	3,800		2,800	3,800		2,600	3,800		1,800	2,400
13,400			3,800			3,800		2,800	3,800		2,600	3,800		1,800	2,600
13,800			3,800			3,800		2,800	3,800		2,800	3,800		1,800	2,800
14,200			3,800			3,800			3,800		2,800	3,800		1,800	3,000
14,600			3,800			3,800			3,800		2,800	3,800		1,800	3,000
15,000			3,800			3,800			3,800		2,800	3,800		2,000	3,000
15,400						3,800			3,800			3,800		2,400	3,000
15,800									3,800			3,800		2,600	3,000
16,200									3,800			3,800		2,600	3,200
16,600									3,800			3,800			3,600
17,000									3,800			3,800			3,800

An example is probably the best way of showing how to use Table 2. Suppose you expect your income to average \$6,000 over the next few years and that the standard deviation will be about \$4,000. These are the estimates we made as an example previously. Now suppose also that we already have \$2,000 in the income equalisation fund and this year's income will amount to \$9,000, giving a "pre-tax income plus deposit in fund" of \$11,000. Find the value \$11,000 in the lefthand column. Under "average income = \$6,000" and " σ = \$4,000" you will find the figure \$3,000. This is the amount which you should have in the equalisation fund at the end of the financial year. This means that you should increase your equalisation fund which now stands at \$2,000 and bring it up by \$1,000* to \$3,000, reducing your pre-tax income to \$5,000 for the year.

Table 3 shows the expected equivalent annual gain using the income equalisation fund in the best possible way under the realistic conditions just described.

Table 3 — **Annual Gain from using the Income Equalisation Fund Optimally**

Expected Pre-tax Income	**Standard Deviation** \$2,000	\$3,000	\$4,000
\$3,000	\$20	\$54	\$98
\$4,000	\$14	\$43	\$84
\$5,000	\$8	\$30	\$66
\$6,000	\$3	\$15	\$42
\$7,000	\$0	\$4	\$21

First note the rather humble gains given in Table 3; then see that you need a highly variable income with a large standard deviation before much can be gained from using the income equalisation fund. This is what you would expect. Further, those with a low expected income can expect to make most from its use.

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* This set of rules was worked out assuming that taxation exemptions amount to \$1,000. If your exemptions are vastly different from this then you will need to modify Table 2 by reducing the "Average Income" by \$1,000 and labelling the columns "Taxable Income". The rules also assume that the going rate of interest is 7½%. This implies that if you put \$1,000 in the fund for a year your overdraft will cost you an extra \$75 or you will lose \$75 from not lending the \$1,000 to someone else. Space does not permit the publication of optimum rules for other rates of interest. However, the rules are fairly insensitive to shifts of interest rate within the range of 5% to 10%.

We are now in a position to reply to the taxation authorities who tell runholders to use the income equalisation scheme to overcome their inequitable position because their income fluctuates. Thus a runholder with an expected income of $6,000 which fluctuates such that it has a standard deviation of $4,000 can expect to gain only $42 a year from using the income equalisation fund as compared with not using it. See Table 3. This does not compensate the runholder for the expected extra tax of $227 annually he has to pay above a public servant on a fixed income of $6,000. The meagre $42 annually only covers one-sixth of the extra tax burden he has to carry.

All this does not mean that the income equalisation scheme is so useless that it should be removd from the Statute book. Following a boom year it may be unwise to increase tax deductable farm investment beyond the rate at which stock numbers can be built up to exploit the invesment. Holding some of a boom year's income in the fund until there is the opportunity to use it on the farm is likely to help those runholders who believe that investment on the run is a profitable venture. All we need is a boom year!

So far I have been discussing average gains and losses but the decrease of variation of income is also important to farmers and this is the topic of the last section.

Method of Taxation and Income Variability

Income variability itself is one of the serious disadvantages of high country farming. It makes it difficult to organise run development wisely and upsets the family's standard of living. **In the past there have been boom years when runholders have spent wastefully to prevent windfall gains being lost to the farm in taxation.** In years of low farm income it may be difficult to carry on a development plan started in better times and thus exploit past investment. Moreover few farming families have the liquid reserves to see them over bad seasons and it is customary for banks and stock and station agents to carry their clients over bad seasons. Runholders have to "draw their horns in" too. Development ceases, holidays are foregone, and teenage children may be brought home from boarding school following a difficult season.

Now the way in which a farmer chooses to pay his tax makes a great difference to the variation he has in post-tax income. There are two ways farmers can use to pay their tax at the moment.

(a) **The normal system** — Under this system provisional tax is based solely on the income in the previous year. On top of this there is terminal tax which is the difference between last year's provisional tax and the tax due on last year's income. This system has a highly de-stabilising effect on post-tax income.

(b) **The pay-as-you-earn system** — Provisional tax is based on an estimate of income for the year. If the estimate is accurate there is no terminal tax the following year. This has a highly stabilising effect on post-tax income.

In Table 4, I have calculated the approximate standard deviation of post-tax income for various situations using these two systems of paying tax. ([3])

Table 4 — **Standard Deviation of Post-tax Income. Normal System Versus PAYE System**

	Standard Deviation of Pre-tax Income			
Expected	**$2,000**		**$4,000**	
Pre-tax Income	**Normal**	**PAYE**	**Normal**	**PAYE**
$4,000	$2,474	$1,346	$4,948	$2,692
$6,000	$2,632	$1,232	$5,264	$2,464
$8,000	$2,804	$1,120	$5,608	$2,240

From Table 4 take the example of $6,000 expected income with a $4,000 standard deviation — the example we have used before. If the runholder uses the "normal" method of paying tax he will inflate his post-tax income standard deviation to $5,264. He can halve this variation by using the PAYE system — by estimating his income for the year accurately and paying provisional tax accordingly. This method reduces post-tax income variability to a standard deviation of only $2,464.

This year may be a good moment to move onto the PAYE system because incomes are expected to be down from last year so that this will reduce provisional tax payments. Paying tax as you go on an accurate estimate requires more homework but it has a marked effect on income variability as Table 4 shows. This is particularly true as expected pre-tax income rises.

([3]) McArthur, A. T. G. The Effect of Taxation Method on Post Tax Income Variability. A.E.R.U. Technical Publication No. 13, 1970.

Summary

Runholders with a wide variation in income pay considerably more tax than farmers with more stable incomes or salaried people on the same average income. The income equalisation fund can be used optimally by following rules derived from dynamic programming developed in this research. Although this is worthwhile it is insufficient to compensate for the tax cost of a fluctuating income.

Runholders can halve their post-tax income variability by paying their provisional tax on an accurate estimate of their income for the year.

Landscape Conservation a runholder's viewpoint

Bernard Pinney
Dunrobin Station,
Mossburn.

It seems a fact of life that wherever man treads he affects his environment in some small way. In New Zealand, man has made immense changes to landscape in the last century, much of it to his own and his country's good, but equally as much to his country's detriment.

There is no room for the runholder passing the buck and blaming his predecessors or the others in the community, whilst continuing the process himself. He must open his eyes to what he is doing to his landscape, and learn from past mistakes, including his own, then look ahead to see how best he can marry sound farming practice to conservation of his whole environment.

Tracks and Roads

Tracks to remote areas of farms and runs are a feature of the early stages of a development programme. They serve a valuable function in providing speedy access for men, dogs, fencing materials, stock, and even fertilizers. Their design and siting in too many cases shows a lack of vision on the part of the landowner. He under-estimates the need for the gradient to be correct. If over 1 in 8 there can be immediate problems in scouring. He economises on culverts or cutouts for the watertable and finds his track unsafe, and an eyesore for posterity. He finds the track becomes a breeding ground for barley grass or thistles because he has been reluctant to sow down the disturbance he has caused with some seed and fertilizers.

The wise siting of tracks so they blend into the landscape should always be considered.

The foothills of South Canterbury in particular and many other attractive places in the South Island, have been mutilated by the zig-zags of the bulldozer, and scarred forever. In some situations this has been inevitable but in many others the tracks could have been led up and along gentle spurs, gullies, through bush or scrub, or behind ridges *out of sight from the normal viewing points.* In this way they would have become nearly invisible and access would still have been achieved.

On Dunrobin Station great pains are taken to camouflage tracks in this way. Many hours are spent studying alternative routes and looking for small fault lines or terraces on the hills which are so effective at disguising tracks. The aerial photographs readily available from the Lands and Survey are invaluable for such work.

The Wallace County has recently constructed a road up the Aparima Valley and taken pains to level off the mounds of rock and earth left by their formation work, and also by the draglines which were used to deepen the watercourses running across the road.

This finishing off only took a few hours but meant the difference between permanent untidiness and a finished job.

Opposite: A well sited track. The track is camouflaged by scrub. It was sited in this particular place in preference to many other possibilities, and is almost invisible from all angles. Photo: B. Pinney.

Think hard before he is let loose. This new track meanders amost invisibly up this valley and opens up more than 2,000 acres to vehicles.
Photo: B. Pinney.

Buildings

How often do people really give thought to the sound design and siting of new buildings so that they blend in with their full environment? *The pitch of a roof should harmonize with the surrounding hills, and the materials and paints used complement the local colours. Buildings should be in harmony with one another.* Little points superficially perhaps, but very important when living and working with them for years on end. In parts of Britain local committees are responsible for preserving the character of a district. In some areas, for example, a farmer might wish to erect a grain dryer or a new haybarn. He is compelled to erect it in such a way that it becomes unnoticeable. He may have to site it in a hollow, close to another substantial building, or near trees which effectively break an unsightly silhouette. New Zealand could learn from their experience.

There are not many examples of such design consciousness in New Zealand. The township of Arthur's Pass, parts of Arrowtown, Cottesbrook Station, Bushey Park, Mt. Peel Station and Kelvin Heights, near Queenstown, would be a few. There are many examples of a total lack of feeling for design especially in many of our city suburbs. Tinwald, in Canterbury, all of the Te Anau township with the exception of the waterfront, and most of our country towns. Must this go on forever?

Planting

Intelligent use of trees can cover up a multitude of design lapses. Many of the early New Zealand homesteads show great imagination in their planting, especially those in Canterbury, Hawke's Bay, the Wairarapa, and parts of Nelson. The relative absence of trees in Scotland in comparison with England may in some ways have been responsible for the scarcity of early plantings in Otago and Southland, which are settled predominantly by Scots.

There is an awakened interest in farm forestry. Plantations have a marked effect on a landscape but do not always enhance it, particularly where only one species to the exclusion of all others is chosen. In many plantations springing up in Northern Southland, it is good to see them *following the contours of the land, and having their monotonous edges broken with different species to give a variety of colour and form.* Hence we are planting several varieties of hybrid poplars in clumps of wetter ground along the edges of our radiata stands. Such an approach to forestry, besides beautifying the landscape, is also capable of diversifying the enterprise.

If foot and mouth disease ever struck New Zealand, forestry could be all that is left for the hill-country farmer. Whether it does or not, it is a field which deserves a much closer look by runholders, as the economic prospects of forestry appear particularly good, and the aesthetics even better if planting is approached creatively.

It is stimulating to do a tour of the trees of Central Otago taking in the orchards of the Clutha Valley, the Lombardy poplars above Roxburgh, or the spectacular autumn colours between Arrowtown and Queenstown. They all enhance the landscape of the region.

The marina on Lake Benmore near Otematata. This was formed and planted out by the Ministry of Works. Photo: T.G.M.L.I.

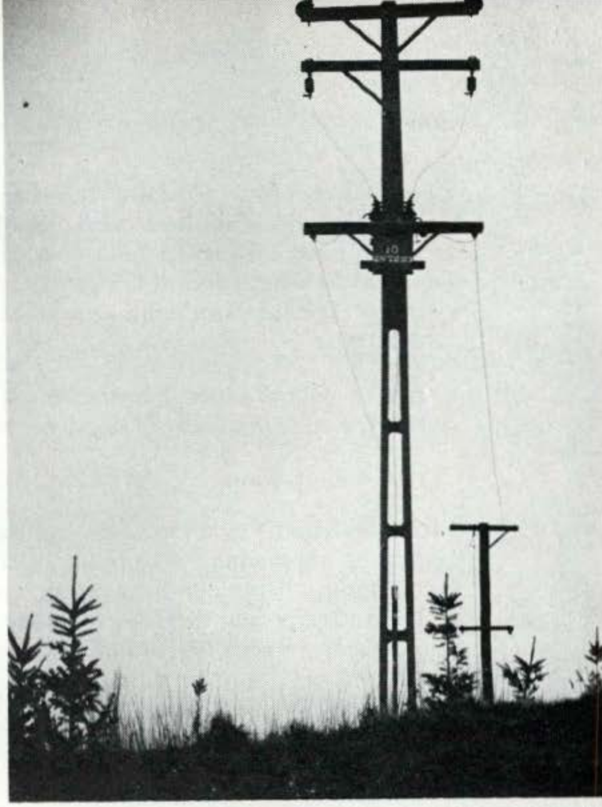
The value of trees has been realised round the new Lakes Aviemore and Benmore. Credit must be given to the Landscape and the Hydro Construction Sections of Ministry of Works and to the Electricity Department for their co-operation in landscaping the lake edges.

Pylons and Poles

These eyesores constitute one of the worst features of our landscape. What used to be one of the most beautiful drives of the world, from Tarras through to Fairlie is being systematically ruined. The Lindis Pass is now a mess of pylons, wires and scarred by bulldozer tracks which have been formed to aid their laying. The road from the Ahuriri River northwards is lined with a mass of huge gravel pits formed by the roadbuilders, who appear to be giving little thought to replacing their topsoil or hiding the scars with trees.

Near Twizel the pylons have tastelessly been erected on the Southern Alps side of the road spoiling the panorama for miles. Until recently the drive into Lake Pukaki township was ruined by a shanty town of huts and wires that could have been designed and sited much better than they were. Newly-formed sections of the highway between Simons Pass and Lake Pukaki are now bordered by a mass of thistles brought in by the machines, and include the dangerous nodding thistle.

Tekapo township is perfectly situated as a potential tourist resort with its skating, skiing, mountaineering, camping, fishing, and boating. It is not too early to make a start in burying all the overhead wiring, but one learns of a shortsighted expediency here which may take years to undo, to the undoubted detriment of the town in the meantime.



POWER POLES. Was it considered to bury the wires? Though it will take time, these young Oregans will disguise them.

Photo: B. Pinney.

SCHOOL BUS SHELTER AND FOUR MAILBOXES have been combined to give a much tidier and more functional effect than the typical water tank on its side and a rough mailbox nailed onto a post.

Photo: B. Pinney.

Mining

Fortunately New Zealand has been spared much of the damage caused by mining. One suspects that the danger is not far away especially when one looks around possible areas like Glenorchy. The Dipton limeworks are starting to alter the skyline of one of Southland's most attractive landscapes near Castle Downs.

One of Otago's best-known landmarks, Saddle Hill, near Dunedin, is systematically being demolished by the roadbuilders.

What can be done?

It is vital that the landowners and the public are made aware of what is happening, as a result of their actions and apathy. A continuous campaign is needed, giving examples of abuse of the landscape on the one hand, and constructive thoughts as to how to remedy the situation on the other.

There is only a small group of offenders. These include ourselves — the runholders and farmers — the Ministry of Works, the Electricity Department, the roadbuilders, the Forest Service, skiing and mining interests. The healing efforts of landscape men in Ministry of Works will be of little value unless the landscape is safeguarded in the prior design of major works.

There are a few individuals who must be prepared to take greater responsibility. For example the Commissioners of Crown Land and their subordinates who administer the pastoral leases, are responsible for giving prior approval for any improvements to the pastoral runs. They are responsible for seeing the lands are not overstocked, or unsound cultivation undertaken. They are well-placed to encourage conservation of the scenic attractions in their care, though one must recognise they only administer land belonging to the Crown.

The catchment boards likewise are in a strong position to help in this landscape conservation, as they are generally in close contact with the runholders, and especially so in those situations where Conservation Run Plans are in action.

Local farm forestry associations are helping the landscaping of some districts. They have the experience and enthusiasm for trees which should be made more use of.

City councils could concern themselves much more. In particular in the setting and supervising of design standards to prevent our country towns taking on even more of a shanty appearance.

Especially in tourist areas they must make a start in burying all overhead wiring. They have a great responsibility to prevent urban sprawl and the fragmentation of farming land by the opportunist land speculators. The move towards 50-acre subdivisions in the Lakes County is to be commended. It failed.

There would be merit in the taking over of specific areas of great beauty such as the Speargrass Flat-Lake Hayes-Lake Johnson region near Queenstown under the 1953 Scenic Reserves and Domains Act, in order to prevent them being ruined by new roads and buildings forever. Other areas for consideration could include portions of the coastline between Taiaroa Heads and St Clair near Dunedin and the Takitimu Mountains in Northern Southland. Areas such as these should be gazetted as scenic or forest reserves.

Local bodies have powers to zone what land will be industrial, residential, and rural in their district plans. They appear to be constantly juggling such areas. They should encourage likewise the zoning of many more scenic reserves at the other end of the scale. It does not require much vision to see the benefits to the local way of life and even on tourist traffic that this would generate in the future.

These would, in time, relieve some of the pressure on our national parks. Once gazetted as a scenic reserve or a national park such regions should become immune from undue interference for all time. This means bringing pressure on our politicians to repeal the several clauses in the Scenic Reserves and Domains Act, 1953, the National Parks Act, 1952, and the Public Works Act, 1928, which are making the first two acts mentioned so ineffective. The clauses concern mining, electricity production, bush preservation and access. Those interested should study the United States and Canadian national parks systems and those of the Nature Conservancy of Great Britain, noting how much less compromising they are in comparison with ours in New Zealand.

Near the Lindis Pass — a mess caused by the bulldozer. Were all or any of these tracks necessary?

Opposite: Here the Pass is unblemished. Photos: B. Pinney.

All landowners have a particular responsibility in protecting their landscape. Farm advisors, the Department of Agriculture, and rural lending institutions, must consider these aspects when dispensing funds and advice, and not just consider the economic aspects to the exclusion of all else.

Whether we like it or not, an increasingly mobile and leisured public is demanding greater access for recreation on the land. They have a right to ask this, and landholders have a responsibility to see that they leave their properties not only in good heart, but with the landscape as unspoilt as is humanly possible, for the enjoyment of all, both now, and in the future.

Insect Pests and Management: Why Study Population Numbers?

Dr E. G. White

Tussock Grasslands and Mountain Lands Institute.

Sound management practice for any plant-feeding animal species depends on a knowledge of animal numbers, the carrying capacity of the vegetation, and when to increase or decrease numbers. Such practice applies regardless of whether the animals are domestic stock, game species or noxious animals, except that in the case of noxious animals it is not the carrying capacity but the *economic threshold* that concerns the manager. The economic threshold can be defined as the level above which it is economic to introduce control measures to conserve vegetation for some alternative use. Above this threshold a noxious animal can be regarded as an economic pest.

Insect pests belong to the noxious animals category in which it is control rather than animal production which is the objective. In order to assess the economics of control it is usually necessary to establish the pest status or otherwise of the insect species. Hence studies may be established to census population numbers and to determine the densities at which the species becomes a pest of economic importance.

Insect Numbers

Insect numbers can change rapidly from one generation to the next and throughout the stages of any one generation. This is particularly evident in years of higher than usual abundance, and points to the high fecundity (the large number of eggs laid) of many insects.

The potential for rapid changes in numbers *from one generation to the next* is perhaps best illustrated with some arithmetic as follows:

If each female moth in a population lays 100 eggs and equal numbers of male and female progeny are produced, then the population size will remain the same in the next generation if only one male and female progeny survive to adulthood and reproduce. If, however, two males and two females survive, the population size *doubles* in the next generation. Yet this represents only a *2 percent* increase in survival! Clearly an 8 percent or 10 percent increase in survival can lead to dramatic population increases.

We need to know whether such population changes occur in order to establish whether a suspect species is continuously a pest, occasionally a pest or never a pest. Therefore a study of numbers needs to be conducted for more than one generation and preferably over several generations. Since many insect species pass through only one generation per year, the need to appreciate such changes in population size may call for a considerable period of study.

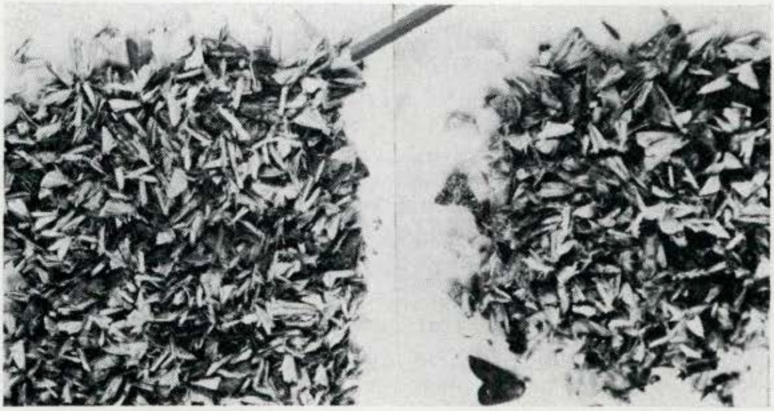
It may also be important to establish change in numbers *within a generation.* Returning to the arithmetic example above:

If 90 percent of the progeny are parasitised as eggs, only 10 percent are left to feed on the vegetation, whereas if 90 percent are parasitised as larvae when they have completed feeding, very much more vegetation is consumed and damaged. Such a difference may be highly significant in determining the pest status of the species and therefore a knowledge of trends in numbers and of the changing population structure during a season is important.

Carrying Capacity and Economic Threshold

Carrying capacity is always defined in relation to the preservation of a resource. Hence, if the management of domestic stock is in question, the manager makes his decisions with a view to the preservation of vegetation productivity. If, however, the management relates to a pest species, the preservation may concern *either* vegetation productivity itself *or* the requirement that the vegetation productivity be preserved for utilisation in alternative ways such as for grazing stock.

Where preservation concerns vegetation productivity per se, the economic threshold may be equated with the carrying capacity. For example, if land is retired from grazing for the purpose of halting erosion, then insects assume pest status if insect damage causes a further decline in the productivity of the vegetation. In other words, insect grazing has exceeded the carrying capacity and thereby has become economically



Tussock Grassland moths caught in two light traps during a three-hour period. Several thousand moths are present but sound management requires more than a knowledge of numbers.

Photo: Dr E. G. White, from a transparency.

significant in the long-term view of erosion control. Studies of insect grazing might in this situation aim to determine which components of the vegetation are most vulnerable to over-grazing and erosion loss, together with the grazing tolerance of these plant species.

In the second case above *where there is direct use made of vegetation productivity,* the economic threshold is lower than the carrying capacity rather than equal to it. Let us use the example of erosion control again. If the purpose of retiring land is not simply to halt erosion but to reduce the extent of erosion by providing opportunity for a natural increase in ground cover, then insect grazing becomes economically significant at the level where it unduly slows natural revegetation. In contrast, a level of grazing that permits a natural increase in the vegetation cover is obviously lower than the carrying capacity.

Similarly, when the vegetation is used for cropping or for grazing stock, the economic threshold for insects is exceeded when it is more economic to control the insects than suffer the losses in crop or stock productivity. Again, the definition of this threshold level requires a determination of the effects of insect grazing pressure on the productivity of the vegetation and can be most precisely expressed when a firm cash value can be placed on the direct use of the plant productivity.

When to Manage Insect Numbers

A knowledge of insect numbers by themselves does not help the manager make a sound management decision. For example, the same density of aphids on a brassica crop has more deterimental consequences for the crop during early growth than at maturity. Management decisions can be fully profitable only if their timing is appropriate, and therefore a knowledge is required of species biologies and natural trends in population numbers.

Species biologies may often be exploited to afford control at minimum cost. For example different stages in an insect life cycle are likely to respond differently to management practices, some stages less favourably than others, and so the timing of a control measure may significantly influence its effectiveness. Furthermore, the economics of a control measure are improved by proper timing relative to the stages in the life cycle which do most damage. Studies of insect biology are therefore relevant to pest control and their study may help avoid the cost of ineffective management.

Natural trends in population numbers may also be exploited to minimise management effort and cost. The trend in aphid numbers on the mature brassica crops above will not continue to rise because aphids cease to favour brassica plants after maturity. Efforts to control the aphids at this stage might therefore be wasted whereas control at an earlier stage of plant growth could be fully justified at the same (or even lower) aphid densities. A knowledge of patterns in the trend of insect numbers within and between seasons can therefore make a further contribution to considerable savings in control efforts and costs.

Institute Research

Entomological research in the Tussock Grasslands and Mountain Lands Institute has so far been directed at determining whether or not some of our tussock grassland insects are pests. In other words, do population numbers of suspect species reach the economic threshold for any classes of land use?

Three groups of insects have been studied over the past four years—grasshoppers, cicadas and a seed-feeding moth. Grasshopper numbers have been estimated using a painted code mark on every individual caught and by noting the proportion of marked and unmarked animals in weekly samples taken from a study area of three acres. Cicada numbers have been estimated by searching in nine plots for the empty skins left on the vegetation when the adults first emerge and fly off. Moth numbers have been indirectly assessed by investigating the percentages of damaged ovaries in snow tussock flowers. During the population censussing of these three insect groups, it has been possible to also derive considerable information on species biologies and population movements, especially in the case of the individually coded grasshoppers. Thus, within the framework of population density investigations it has at the same time been possible to obtain much of the basic information required for management practice.

The results of these studies are now in the process of being evaluated to provide an assessment of the likely pest status (if any) of each of the groups. Should it be found that some are indeed economic pests under given conditions, the next step would be to establish practical guidelines for possible management

The investigation of population numbers is not therefore to be thought of simply as a registration of births and deaths. The facts acquired along with the population figures serve to establish a fully viable relationship between the study of insect numbers and their management.

ACKNOWLEDGEMENT: Mr J. G. Hughes for his helpful criticims and comments on the original manuscript.

KEAS — Writing from Mt Aspiring Station, Mr J. C. Aspinall in December 1971 says: "Last year all forms of bounty were dropped and keas are now protected in national parks and scenic areas. Runholders have the right to take whatever steps they think necessary on their own properties. It is an interesting situation I find myself in. If a kea is in the national park, I as a national park board member am expected to report any person who shoots one and the fine is $100. If the kea flies across the boundary, be this creek, river, or bush edge, I am entitled to pay someone to shoot it." Mr Aspinall who contributed an article in *Review* **No. 12, 1967, entitled** *Some Observations on Keas* **noted that fewer attacks were then evident. In his recent letter he reflects that "Sheep have come in with healed small wounds but it was not until we began inoculating hoggets against blackleg and malignant oedema that** *large* **wounds came in." Mr Aspinall's letter will be published in full in the** *Comment* **section of our next issue.**—Ed.

Title photo: Because of their quaintness keas are highly regarded by many runholders but the odd bird becomes a killer of sheep and instrumental in the occurrence of bloodpoisoning.

Photo: T. Crowhen from a transparency.

Killer Keas Are Poison

A. Thomas
Makarora Station,
Wanaka.

It is a popular opinion in Makarora that the New Zealand mountain parrot should stay in the mountains. But in recent months there has been at least one that has turned nocturnal predator. The kea is a native of this country and as such, comes under legal protection. This is as it should be, but a case can be presented for the high-country farmer.*

* This protection is not absolute—see editor's note.—Ed.

1971 Kea Menace

On 2nd July Mr C. Pennycook and his shepherds (Makarora Station) found one dead sheep which when closely inspected had a small hole immediately behind the shoulder blades. First thoughts were that someone had been a little careless with a .22 rifle, but when another carcass was found three days later, apparently dead from the same cause, an autopsy was performed on the first carcass. This revealed that the sheep had died, not from a bullet, but from blood-poisoning.

The immediate supposition was that a killer kea was at large. Subsequent events proved this correct. In the following week, no carcasses were found, but while feeding out, several sheep were showing a flag. This means that a staple of wool has been pulled from the sheep's back so that it projects above the normal lie of the wool.

This is not conclusive proof as other things apart from kea action could be the cause, for example, wool pulled by a fence wire. But when a flag is associated with a hole in the flesh immediately under the staple this narrows the field somewhat.

Coupled with this is blood-poisoning, possibly brought about by infection on the beak of the kea, contaminating the flesh of the victim, and causing death in 24-48 hours. These three symptoms point to only one thing—a **killer kea.**

From the 9th of July to early September, Mr K. Blanc, a local farmer, was to feel the effects of kea action. His total loss was 37, and he managed to save 80-100 by injecting pencillin. Towards the end of this period the killer shifted back to Makarora Station. On 28th August the two-tooths were attacked and from then on there was trouble until 19th September. The least number of flags found in one morning during this period was 6, the most 15. The total deaths for the station were 68. Some 180-200 others were saved by penicillin injections. On 22nd September, the menace moved on to the farm of Mr W. Cameron and continued there until 18th October when it was shot by Mr Cameron. On this farm 44 sheep were struck, all were treated with penicillin, but a total of 23 died.

A kea, fearless in his mountain setting.

Photo: T. Crowhen from a transparency.

On glancing at the above figures it can be seen that a total of 128 sheep died from kea action. This represents a capital loss of at least $1,280, a fairly accurate estimate as these ewes were all in lamb at the time. Besides the direct losses are the bad effects on the remainder of the flock which had to undergo a thorough examination every morning. This consisted of herding the flock into a corner and searching for flags which over a period of time will have deterimental effects on ewes in lamb. Had this trouble extended into lambing, losses may have occurred through mis-mothering.

Efforts to save the struck sheep were largely successful because of immediate inspections and injections of triple penicillin to flagged ewes. At the height of the killing at Makarora Station, all lambing ewes were inoculated against blood-poisoning which undoubtedly saved many ewes that were flagged, but not immediately noticed. Some of these sheep were found several days later with bad flags, but showing no effects of blood-poisoning. As a safeguard, these flagged ewes were treated with penicillin as well, but the inoculation obviously carried *them through the first 24-48 hour period. It is felt that these sheep would have survived without the penicillin, the inoculation probably being sufficient to ensure their living.*

Hunting the Killer

Efforts to eradicate the killer were numerous and time consuming. Among these was an effort by Mr Blanc to poison the bird by spreading on the higher bluffs and mountain tops, by helicopter, freshly killed carcasses treated with poison. This required a permit from the Internal Affairs Department. It can only be concluded that the measure was unsuccessful since the killing continued for some time. The most common effort was all night patrols with rifles and spotlights. It is general opinion that lights will attract keas as they are known for their inquisitive natures. They are also known for their cunning — only one bird was ever spotted and shot at after being attracted by the light of a fire at 4 a.m. one morning.

Acting on this knowledge of the bird's inquisitiveness, a flashing light ringed with rabbit traps was set in a paddock, to no avail, although sheep were attacked in the same paddock on the same night. Rabbit traps set on dead sheep were likewise unsuccessful. This suggests that keas may at times have preference for live meat.

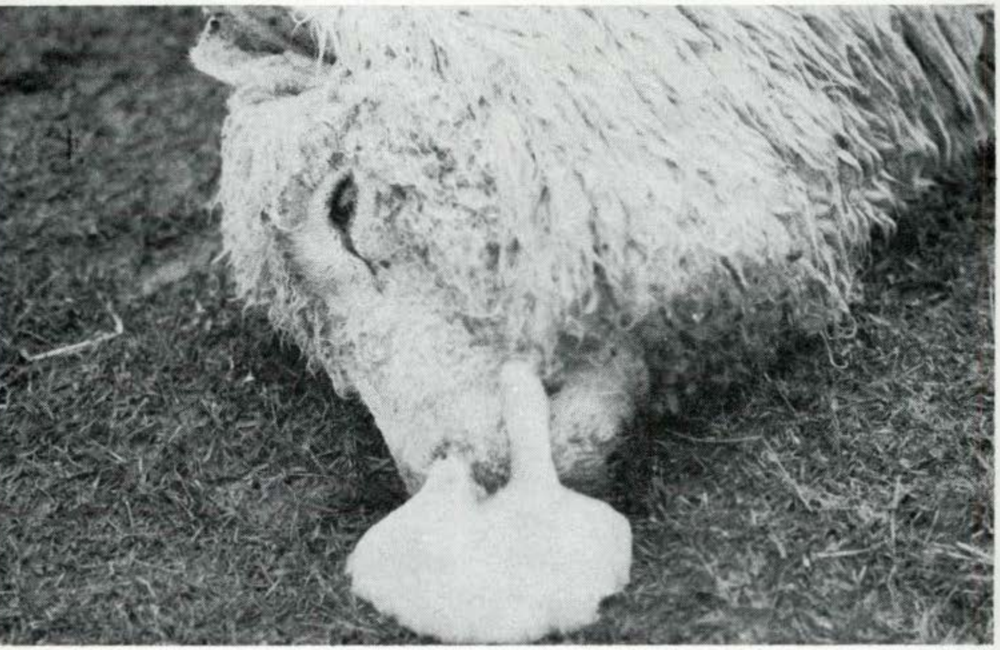
After the attacks on the two-tooths on 28th August at Makarora Station it was decided that a continuous watch be kept over the ewes at dusk and dawn. When this failed sterner measures were decided upon and the watch continued all through the night from 12th to 14th September with no results. On the nights of the 16th and 17th assistance was given by three Internal Affairs Department rangers who shot and killed one bird that answered their bird calls. This bird may have been an unfortunate victim, as the killings still continued. The cunning of this bird was by this time becoming legend, as on the night of the 13th September the watchers all fell asleep from fatigue, and it was on this night that the bird made its biggest strike by attacking 15 ewes in the same paddock.

The kea had moved from Mr Blanc's locality after being shot at and losing its tail feathers in the process, and never returned, but continued killing at Makarora Station. Increased vigilance there by stationhands and rangers evidently forced

A flagged hogget. Photo: A. Thomas.

it to move on to the property of Mr Cameron. As a result of a nightly patrol the strikes grew less and less until on the evening of 18th October, he shot a kea feasting on the back of a tethered ewe. Inspection showed that it was growing a complete new tail, the feathers being approximately $2\frac{1}{2}$ inches long. There is therefore a strong possibility that this was the same bird which had its tail feathers shot off by Mr Blanc six weeks earlier. Since this bird was killed, a month ago, no further attacks have occurred in the valley.

Bloodpoisoned. Photo: A. Thomas.



Above — The kea beak penetrated deeply here.

Below — The gelatinous exudation and the relative absence of gas bubbles is indicative of malignant œdema. The reverse is indicative of blackleg.

Photos: A. Thomas.

Mention must be made that three attacks were witnessed—myself (Makarora Station), Mr K. Blanc, and Mr W. Cameron—where a kea rode on the back of a ewe, scattering wool and tearing at the flesh savagely, while the ewe ran around blindly in panic.

Theories on What Makes a Killer

Two theories are currently popular as to how a kea graduates from being a fun-loving bird to becoming a vicious killer. In his book *New Zealand Birds*, W. R. B. Oliver advances the suggestion that keas develop a taste for meat (mainly mutton) through having ready access to raw offal. From this it is an easy step to attacking weak and helpless sheep, and finally, healthy animals. If this is the case, then the remedy is obviously a simple one.

The second theory, and one more widely held, is that the kea, well-known as "the clown of the mountains", develops a taste for mutton by accident. Sitting on a sheep's back, it pulls a little wool, thus causing the sheep to run and giving it a ride. After some time the sheep becomes exhausted—slowing or stopping. To make it move again the kea digs deeper and pulls harder with its beak, eventually breaking the skin and exposing the flesh. From this, it may develop a taste for the meat. Unlike theory one there is little that can be done to prevent this.

It is obvious that killer keas do exist. This is now an established fact. What is not conclusively known is why or how this occurs. This knowledge can only be determined by experts and it is to be hoped that this information is sought diligently, as the high-country farmer can do little about this problem at present. Observations by farmers will, of course, help, but until this bird's habits have been established, cases such as this one will inevitably occur. This is a problem which badly needs a solution if protection of these birds is to continue. Needless slaughter of innocent birds is obviously wrong, but so is the apparently needless slaughter of innocent sheep.

Heritability and Reproduction

A. M. Day
Ashburton Veterinary Club Inc.

Stud breeders, whether of sheep, cattle, dogs or whatever are continually attempting to breed into or out of their herd, flock or pack, certain characteristics which will, they hope, make their animals more acceptable to potential purchasers. Consciously or not they are dabbling in the science of genetics and the rate at which they progress depends on, amongst other things, the heritability of the characteristics that they are seeking to change in their stud stock. Heritability refers to the average effects of the genes determining the characteristics, and many experiments the world over have allowed geneticists to list characteristics according to the degree or percentage of heritability.

To take calf weaning weight as an example, it has a heritability of 30%. If a large herd had an average weaning weight of 400 lb, and the animals selected for breeding averaged 440 lb at weaning, then the amount of selection applied was 40 lb and their progeny could be expected to increase the weaning weight over the herd average by 30% of 40lb, that is, by 12 lb to 412 lb. Had there been no selection applied weaning weight would have remained at 400 lb subject to the same conditions of feed and management being employed.

Some characters, such as carcass quality, rib-eye area, for example, tenderness, fat cover and so on have heritabilities of up to 60% which means relatively rapid progress can be made in the improvement of these particular factors, but in cattle the female's fertility has a figure of 0-10%, depending on which aspect of fertility is referred to .

With this in mind there can be no reason for a breeder with a 70-80% calf drop having as an excuse the poor fertility which his strain of cattle has inherited. Deliberate inbreeding and similar malpractices would have to be intensively pursued for generations before a reasonable calving percentage could be dropped down to 70% of cows mated.

On the other hand we know that weight gain in early life is highly heritable — around 30 to 40%, because the weight of heifers at mating will usually decide their fertility — those at 600 lb or more will conceive earlier and in greater numbers, — it can be deduced that if breeders select for good growth rates then high and early conception rates will follow, providing that these good growth rates are utilised with good feeding.

It would follow from this that given a herd of similar cows calving to the same bull at about the same time of year, having been kept under the same conditions during the last trimester of pregnancy, one could select the heifer calves with the best breeding prospects on the day they are born, for with birth-weight, weaning weight and subsequent gain being fairly highly heritable, the better the start, that is, the heavier the new-born calf, the quicker it will reach a fertile condition. This speed of conception is of importance from many points of view not least of which is the necessity for calving heifers (and thus mating them) about three weeks before the adult herd, to afford them an extra interval between calving and their second mating, which will of course take place with the adults.

The position with sheep is rather more complex in that, while heritability of fertility is only slightly higher than in cattle, the additional factor of fecundity serves to obscure the effect.

Fecundity, or the characteristic of multiple births, is quite heritable, but it is only in recent years that shepherds have been identifying twin ewe lambs and retaining them for breeding. Previously it was more common to select on size at weaning or even as two-tooths, which often meant that the purchaser of the so-called cull two-tooths was possibly obtaining the most fecund or twin-prone of that particular mob.

Unfortunately our systems of management currently employed prevent the full realisation of this twinning potential until the ewe is a four-tooth or older because of our unwillingness to treat twin-ewe lambs better than the rest — if they could be drafted with their mothers into separate select mobs and fed well without competition from single-lambs and their semi-passenger mothers, we would have bigger and better breeding stock at an earlier age.

Sheep Farmers' Supplementary Finance Scheme

By authority of the General Manager,
State Advances Corporation of New Zealand,
Wellington.

As a result of the continuing decline in the profit of the sheep farming industry culminating in the opening lamb schedule for 1971/72 the Minister of Agriculture announced interim assistance to be known as the Sheep Farmers' Supplementary Finance Scheme.

The purpose of the Scheme is to provide immediate assistance to eligible sheep farmers who derive the majority of their total gross income from sheep. The Scheme provides for loans of up to a maximum of $3,000 and is specifically aimed at those farmers who are facing seasonal deficits, above normal advances from their seasonal financiers.

All genuine sheep farmers and mixed cropping farmers in recognised cash cropping districts who are expecting to face a seasonal deficiency in 1971/72, after maintaining their properties and meeting charges and living expenses are eligible to apply if they come within the following definitions:—

(a) **Sheep Farmer**—One who derives at least 50 percent of his *gross income from all sources* from sheep sales and wool.

(b) **Mixed Cropping Farmer**—One who derives at least 40 percent of his *gross income from all sources* from sheep sales and wool.

A farmer who does not quite meet the above requirements may have his case considered by a Regional Review Committee.

The Scheme is essentially a holding operation and will apply to the 1971/72 season only. It is expected that all applications should be lodged by the end of March. Other main points on the operation of the Scheme are set out in detail below:—

Extent of Assistance

Interest free loans of up to $3,000 will be available. The loans will be reviewed in June 1972 in the light of the season's financial results and compliance with the provisions of the Scheme.

Provided the property is not sold in the meantime, the final loan established at 30 June 1972 will remain interest free until the end of the 1973/74 season. At that stage future repayment will be determined unless the Regional Review Committee considers that some other course is more appropriate in a particular case.

How to Apply

Applications must be made to the farmer's seasonal financier, who will require an application form, detailed estimates of receipts and expenditure, or cash flow budget, for the 1971/72 season, and balance sheets and farm trading accounts for the 1970/71 season.

The financier, normally a stock firm or bank, will determine the farmer's eligibility within the following guide lines.

Guide Lines

1. It is expected that cases in the Scheme will be forecasting a deficit for 1971/72. A payment in excess of estimated final deficit but within the $3,000 limit can be made.

   However, when the results of the season's operations are known the excess amount advanced over the actual cash deficit is to be refunded by the financier.

2. Where economies have already been made in a budget it can be enlarged to provide for adequate topdressing, maintenance, and other essential outgoings which previously may have been arbitrarily reduced or deleted.

3. The total gross income for determining eligibility can be based on either actual sheep and wool income for the 1970/71 season, or the estimated sheep and wool income for the 1971/72 season.

4. *If some capital expenditure is included in the original budget, this will not in itself debar assistance, but the Review Committee reserves the right to convert the amount to an interest-bearing loan if the sum involved is substantial.*

5. Equity, or lack of it, in farming assets will not be a factor in determining eligibility, but applicants with substantial cash resources or investments would not qualify.

6. Provided other criteria are met the size of the property will not be a material factor in determining eligibility.
7. Lack of long term viability is not a reason for excluding an application.
8. Personal living allowance must not exceed $1,500 for the 1971/72 season. Such items as life insurance, school boarding fees, telephone, mail, travelling, and taxation are not included in this allowance. At the end of the season the farmer will be expected to substantiate that his living expenses have not exceeded this limit by producing farm trading accounts or other accepted evidence. This "living allowance" has caused the most questions to be asked. The allowance is for groceries and clothing and similar items of personal spending.

Partnerships

The advances to any one farmer will be restricted to a maximum of $3,000 irrespective of interests in other farming enterprises or the number of properties owned.

For multiple ownership the following rules will apply:—

Partnerships of two or more working partners are eligible, but loans will be restricted to $3,000 for the total farming enterprise.

Living allowances of $1,500 each can be allowed for each full-time working partner.

Companies and Trusts are eligible for a single loan of $3,000 only if the major shareholder or beneficiary is a genuine farmer personally responsible for working the unit and deriving his income from this source.

Applications which do not fall clearly within the guide lines, but which otherwise appear to have merit, will be referred to the Regional Review Committee for direction.

Security

No registered securities will be taken for the loans, but applicants will be required to complete a simple Acknowledgement of Debt and the debt will rank behind all other liabilities, including unsecured debts.

Regional Review Committees

Regional Review Committees have been set up in each branch district of the State Advances Corporation, with a special committee for the Gisborne district.

The chairmen of these committees have been appointed by Cabinet from nominations submitted by Federated Farmers. Senior officers of the Department of Agriculture and the State Advances Corporation have also been appointed to the committees.

The committees will determine the eligibility of a farmer if the seasonal financier is in doubt. They will also consider appeals against decisions of seasonal financiers declining assistance under the Scheme. Applicants whose appeals are upheld by the committee must then obtain a seasonal financier who is prepared to provide finance.

The Minister has since announced details of the "Stock Retention Incentive Scheme" and farmers should note that payments made under this new Scheme will be taken into account when determining eligibility under the Sheep Farmers' Supplementary Finance Scheme.

Stock Retention Incentive Scheme

Issued by authority of the
Director-General of Agriculture,
New Zealand Department of Agriculture,
Wellington

This Scheme has been introduced by Government to help preserve the productive capacity of the sheep industry. It should discourage a further decline in sheep numbers next winter, and provide extra income to enable sheep farmers to maintain their farms and the basic living standard of their families. The Department of Agriculture will administer the Scheme, and this circular outlines its main provisions.

Eligibility

Incentive payments will be made on the basis of sheep owned at 30 June 1972.

(a) Payment will be made to the legal owner of the sheep. If the owner is a trust, company or partnership, this is the body that will qualify for an incentive. Sheep leased or bailed or borrowed will qualify in the hands of the lessor, bailor, or lender. Where stock are subject to a leasing or bailment agreement it is expected that the owner will make whatever adjustment is appropriate to the agreement. No distinction will be made as to where the sheep are located, or on whose property they are grazed on the qualifying date; in all cases the legal owner will receive payment. Institutions qualify as well as private owners (but see (f) below regarding Government Departments).

(b) Sheep alive at the qualifying date will qualify, no matter what sex, age or breed. Lambs born during the season prior to 30 June 1972 will qualify if they are retained on that date.

(c) No payment is to be made on the first 250 sheep in each ownership.

(d) The qualifying date is 30 June 1972, and for the purpose of sheep changing hands on that date, midnight is the precise qualifying time.

(e) The effect of these provisions is that farmers may buy and sell right up to 30 June as usual, but persons holding sheep at that particular time will qualify for an incentive.

(f) Government Departments are excluded from the Scheme except where they are farming on a trust basis, e.g., Maori and Island Affairs.

Rate of Payment

	Flock Size	Incentive per Sheep
A.	Less than 250	No payment.
B.	251 - 5,000	$1 on all sheep from 251-5,000 inclusive.
C.	5,001 - 10,000	As in B above PLUS 60 cents on each sheep from 5,001-10,000 inclusive.
D.	Greater than 10,000	As in C above PLUS 20 cents on each sheep above 10,000.

Interim and Final Payments

An interim payment can be made, based on sheep numbers as at 30 June, 1971. This is merely an advance and payment will be made at two-thirds of the rates quoted above.

The procedure for calculating the final payment will be:

(a) Determine the total amount due by taking sheep numbers as at 30 June, 1972, and multiplying by the appropriate rates as given above.

(b) Deduct the interim payment previously made.

If a credit balance remains this will be paid out. If a debit balance remains (usually because of a decline in sheep numbers), this will be recovered from the farmer.

Interim Payment

Payment will be based on sheep numbers as stated in Sheep Returns submitted to the Department by farmers as at 30 June, 1971, and will be made to a farmer's bank account or to the bank account of his seasonal financier.

(a) A letter and application form will be sent to every farmer who completed a sheep return at 30 June, 1971, and then owned more than 250 sheep. It is expected that these will all be mailed by the end of January.

(b) The farmer will be asked to nominate a bank, or seasonal financier through whom payment is to be made. If he chooses to arrange payment through a bank, he will enter his bank account number on the form or preferably provide a blank encoded deposit slip and return it to the local office of the Department of Agriculture.

(c) If he wishes to authorise payment to his seasonal financier he will take the application form to the nominated financier to arrange for its completion and submission to the Department. The financier will allocate each such client a separate client reference number of up to four digits. This reference and the financier's trading bank account number for the branch office concerned are to be entered on the form. A separate series of client reference numbers may be established for each trading bank account on which the seasonal financier operates. It is important that the full number for each client (i.e. bank account number and client reference) is unique. When the application form has been completed by the farmer and his seasonal financier, the latter is to arrange for its return to the Department in the envelope provided. There is no need for seasonal financiers to accumulate or schedule applications.

(d) The Department of Agriculture, through its local offices will then process the applications, entering on each form the total number of sheep as stated in the 1971 sheep returns.

(e) Payment will be arranged through the trading bank system to the account number shown on the form, and appear on the bank statement with the notation STOCK RETN INCENTIVE. Where payment is made to the account of a seasonal financier, his client's reference number will appear alongside the payment entry, and this will enable him to identify the client concerned.

(f) *In the application form, which must be signed by the farmer himself or by an authorised agent, the farmer will be required to undertake to repay any part of the advance payment which exceeds his entitlement in the final calculation as at 30 June, 1972.*

(g) In those few cases where payment to a farmer's trading bank account or to a seasonal financier is not suitable, the farmer concerned should get in touch with the office of the Department.

(h) In some cases, more than one sheep return is lodged by a single farmer. In such cases he will receive more than one application form. Farmers will be asked to send in the application forms relating to all their sheep together, so that their total holding of sheep can be assessed.

(i) Farmers who did not send in a sheep return at 30 June, 1971, or who have become sheep owners since that date will be able to claim for an advance incentive payment by submitting a statutory declaration to this effect. They should approach the Department of Agriculture to obtain the appropriate forms.

Final Payment

The final payment will be made on the basis of a statutory declaration by the farmer of the number of sheep owned at 30th June, 1972.

(a) A form will be sent out with the 1972 sheep return forms. The farmer will complete the statutory declaration and return it through the same channel as he sent the application for his advance payment (i.e. direct to the Department, or through his seasonal financier).

(b) The Department of Agriculture will receive the application form, and after checking procedures have been carried out, will compute the payment due. If a credit balance remains, it will be paid in the same way as the advance payment.

(c) In the event of a debit balance occurring in the final calculation, the Department of Agriculture will send the farmer an account for the amount outstanding.

(d) Any farmer who fails to submit a final return as at 30 June, 1972, will if due reminder does not bring forth a return, be required to repay all his advance.

Checking Procedures

As a condition of the payments, farmers will be required to satisfy the Department that sheep numbers supplied are accurate. Where there is any doubt, the onus will be on the farmer to establish the accuracy of his stated return, by production of appropriate evidence.

Application forms for final payment will indicate this requirement.

Where contrived ownership changes have been made in order to increase incentive payments, the Director-General of Agriculture will have discretionary powers to disregard the changes made. Assessments made in these terms would be subject to appeal.

Appeals

An appeal system will be established to review, *inter alia,* cases falling under para. 8 above.

Effect on Supplementary Finance Scheme

Incentives paid under this scheme will be treated as normal farm income for the purposes of determining cash deficits and assistance under the Supplementary Finance Scheme. Thus any assistance granted will reduce the requirement under the Supplementary Finance Scheme. Financiers should therefore include Stock Retention payments in revisions of their clients budgets, regardless of whether or not advance payments are claimed before 30 June, 1972.

Taxation

Incentive payments will be included in gross farm income when determining assessable income. A schedule of payments made under the scheme will be supplied by the Department of Agriculture to the Inland Revenue Department.

Payment System

The computer system to handle payments under this scheme relies on both the advance and the final payment being made to the same account reference (i.e. farmer's bank account or seasonal financier's account and client reference number). It is therefore important that every care be taken to ensure that the account reference is the same for both payments.

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Hey, boss — better order that book on beef!!

IN THIS REVIEW