Cover: Sika deer the species already farmed on cropping land in China. They have strong herding instincts and are rapacious eaters. There are herds in the central North Island principally south and east of Taupo. Sika damage forests less than red deer as they are pasture grazers originating on the Asiatic tundra. Although red deer are the most common species there are six others which may have contributions to make in deer farming. Wapiti-red deer hybrids and sambar are the large breeds and may be preferred for their rapid growth rates. Wapiti are part protected but could one day be farmed for their antlers as well as meat. Smaller breeds such as rusa, virginia, sika and fallow are possibly more efficient at heavy stocking. In this Review Mr D. B. Rhodes examines the profitability of deer farming.
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Editor—J. Runga

December, 1972.

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acknowledged.
Part of a nucleus herd on the property of W. R. Cowie, Tarras. The farmlet is irrigated. On well managed and adequately irrigated land it is possible to run 10 ewe equivalents of deer per acre or better.

(Photo: D. B. Rhodes)

Profitability of Deer, Sheep and Cattle Compared

D. B. Rhodes
Farm Advisory Officer,
Ministry of Agriculture & Fisheries,
Alexandra.

A prospective deer farmer faces a number of uncertainties. One of his doubts will be, on what land can deer be farmed. This study of the profitability of deer indicates that with the current prices for venison and rarity values of breeding stock, red deer are competitive with sheep and cattle on even the best country.
On the other hand, deer farming is in its infancy, with no regular stock markets and a lot to be learned about deer management.

Because there are so few deer available few are being traded as store or breeding stock. Therefore the initial pattern of deer farming involves both breeding and fattening enterprises on the one unit. As with sheep and cattle, we need good growth rates from young stock to compensate for high production costs.

From the limited information available on deer I have endeavoured to assess their profitability compared to sheep and cattle enterprises on the same class of land, under a constant level of good management, and the cost structures of the Glenorchy, Queenstown area. These are my findings:

**Gross margin per stock unit**

<table>
<thead>
<tr>
<th>Stock Unit</th>
<th>Current</th>
<th>Projected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deer — meat production</td>
<td>$5.16</td>
<td>$9.03</td>
</tr>
<tr>
<td>Deer — livestock production</td>
<td>14.09</td>
<td>9.46</td>
</tr>
<tr>
<td>Wethers — (Finewool)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deaths 4%. Wool 130c/kg</td>
<td>6.90</td>
<td></td>
</tr>
<tr>
<td>Ewes — (Crossbred)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deaths 3%. Wool 100c/kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lambing 110%. Lamb $5.40 nett</td>
<td>7.70</td>
<td></td>
</tr>
<tr>
<td>Cows — Deaths 3%. Calving 90%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weaner steers sold at $80 nett</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weaner heifers sold at $70 nett</td>
<td>7.00</td>
<td></td>
</tr>
<tr>
<td>Weaner beef (Fattening country)</td>
<td>7.20</td>
<td></td>
</tr>
</tbody>
</table>

In the case of cattle, the fattening and breeding policy give nearly the same figure, which reflects a state of equilibrium. If for deer we equate meat and livestock production we end up with a margin of $9.62 per stock unit at current prices. This is a better return than for sheep or cattle but it is dependent on
price stability. Therefore I have endeavoured to estimate gross margins (projected returns) on the assumption that with a higher population of farmed deer there will be a lower commitment in capital for stock and less buoyant trading prices for livestock. It will be seen from the right hand column that equilibrium between meat and livestock production is almost reached. The differences between margins at current and projected prices are also the result of the interest payable on the different amounts involved in stock capital.

The current market values of deer tend to depress returns from meat and elevate returns from trading in livestock. As the value of livestock reaches greater parity with meat prices the returns tend to level. However, in both the current and projected estimates the returns from deer are better than for sheep or cattle provided both meat and livestock production are carried out on the same unit.

Changing prices for wool, mutton and beef can render a different result — but the above is my forecast.

Comparing these enterprises I have tried to be objective as possible. For instance I have included an extra variable cost of fencing and yards for deer — see differentials in capital development. This was an extra 32c per stock unit (at three stock units per acre) which does not alter a gross margin by much.

Differentials in Capital Developments

Assumption — Domesticated — same performance as cattle, i.e. same death rate and calving percentage and life expectancy.

Costing for “extra variable cost” of fencing, yards. No cost of woolshed therefore deduct capital outlay of woolshed to make comparable to sheep and cattle enterprise.

Example — 1,000 acres improved land, carrying capacity three stock units per acre, 800 acres of hill (upper limit bracken line) and 200 acres flat. To simplify, hill and flat together divided into six major divisions.

On horizontal — 860 chains
To fence contour = 860 + 18% = 1004, say 1000 chains
Extra marginal cost for deer fence = $15/chain.
Therefore marginal cost for deer fence = $15,000.
For deer yards, assume only $1,000 extra, over and above cattle yards.

Woolshed and storage deduction — $5,000.

Therefore total marginal capital outlay = $11,000.

Annual marginal cost in interest = $11,000 at 6% = $660

Annual marginal cost for extra repairs and maintenance for fencing = 30c/chain = $300

Total marginal cost = $960

Total marginal cost acre/year = 96c.

At three stock units per acre the extra variable cost = 32c/s.u.

Uncertainties in Deer Analysis

Because of the lack of information on deer there are several problems in evaluating a deer enterprise.

1. Stock unit conversion factors — In converting red deer to an s.u. basis I have used information on liveweights at different ages and feed conversion figures from Rowett Research Institute (Scotland), and also the liveweight gain figures from Lincoln College. I believe my conversion factors will not be too far out but if a little too high, then deer could be more profitable than shown.

2. Stag:Hind ratio — I have used 1:20 but from a recent report in Scotland it may be close to 1:7. How sophisticated their methods are is not known. It has taken 50 years to improve our mating techniques in sheep and cattle and much of this knowledge, especially in cattle, may be applied to deer.

3. Growth rates — Remembering my assumption of fattening country and standard of management, I believe the carcass killing weights can be achieved.

4. Fencing — The extra variable cost may, to some, seem low but with domestication, and cheaper internal subdivisions it may be too high.

Other estimates — productive life, calving percentage, deaths, stag life — can be looked upon with more certainty. In fact these performance figures are similar to cattle.
The ability of deer to browse tall plants and overhead vegetation presents an ecological challenge for the discovery of cheap supplementary feeds.

(Photo: D. B. Rhodes)
My estimates are based on the current venison price which to some may seem too high for the future, but I am told that if meat was inspected prior to killing as well as after, as for other domestic meats, then new markets would be opened up in Canada, America, Australia and other countries. Thus with the advent of killing houses there is no reason why venison cannot be looked upon as a competitive domestic meat in times ahead.

Of course with deer it is easy to be over enthusiastic and we should not forget their problems. Mustering and handling will be difficult, especially at mating. Stags may turn nasty. Calving date, November-December, is after the main spring growth and alters the feed demand. Shelter for fawns during the winter may be more than required for other young animals which are usually older in their first winter. To some would-be deer farmers the regulations will be a stumbling block in getting established. Even with these uncertainties I am confident that deer farming has a future.

On farmlets where the herder spends much of his time with the stock red deer can become well tamed. Some deer show a trait for tameness. Those that do not should be culled. (Photo: D. B. Rhodes)
Table 1

MEAT PRODUCTION GROSS MARGINS

(Estimates Based on Current Market Values of Capital Stock)

Productive life of hind 10 years, calving 90%, deaths 4%
Sell at 14-15 months — carcass weight 120 lb av.
Stag life three years.

<table>
<thead>
<tr>
<th>S.U.C.F.*</th>
<th>2.0</th>
<th>100 hinds</th>
<th>at $120 = $12,000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5</td>
<td>stags</td>
<td>at $100 = 500</td>
</tr>
<tr>
<td>.8</td>
<td>90</td>
<td>weaners</td>
<td>(5-6 months) at $60 = 5,400</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>s.u.</td>
<td></td>
</tr>
</tbody>
</table>

$17,900

* Stock unit conversion factors

INCOME

80 stags and hinds (120lb at 37c) = $3,550
10 c.f.a. hinds at $40 = 400
5/3 c.f.a. stags at $60 = 100

$4,050

VARIABLE COSTS

Health = $90
Freight $1/head = $91
Stags (5/3 x $100) = 166
Deaths (4%) = 716
Winter Feed = 90
Interest (7%) = 1,253

$2,406

Total gross margin = $1,644
Gross margin per s.u. = $5.48
Extra variable cost = .32
Therefore true gross margin per s.u. = $5.16
3 s.u./acre therefore gross margin per acre = $15.48
Table 2

MEAT PRODUCTION GROSS MARGINS

(Estimates Based on Projected Market Values of Capital Stock)

Productive life of hind 10 years, calving 90%, deaths 4%.
Sell at 14-15 months — carcass weight 120 lb av.
Stag life three years.

S.U.C.F.* 2.0 100 hinds at $50 = $5,000
5 stags at $50 = 250
1.0 90 weaners (5-6 months) at $30 = 2,700
300 s.u. $7,950

* Stock unit conversion factors

INCOME
80 stags and hinds (120 lb at 37c) = 3,550
10 c.f.a. hinds at $40 = 400
5/3 c.f.a. stags at $60 = 100
$4,050

VARIABLE COSTS
Health = 90
Freight $1/head = 91
Stags (5/3 x $60) = 100
Deaths (4%) = 318
Winter Feed = 90
Interest (7%) = 556
$1,245

Total gross margin = $2,805
Gross margin per s.u. = $9.35
Extra variable cost = .32
Therefore true gross margin per s.u. = $9.03
3 s.u./acre therefore gross margin per acre = $27.09
Table 3

**LIVESTOCK PRODUCTION GROSS MARGINS**

(Estimates Based on **Current** Market Values of Capital Stock)

Productive life of hinds 10 years, calving 90%, deaths 4%.
Hinds sell at 16-17 months (running with stag), conversion factor 1.0, stags for meat C.F. = 1.0, stags for sale C.F. = 1.0.

<table>
<thead>
<tr>
<th>Productive life of hinds</th>
<th>10 years, calving 90%, deaths 4%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hind sold at 16-17 months (running with stag)</td>
<td>Conversion factor 1.0, stags for meat C.F. = 1.0, stags for sale C.F. = 1.0</td>
</tr>
</tbody>
</table>

**S.U.C.F.**

<table>
<thead>
<tr>
<th>S.U.C.F.*</th>
<th>2.0</th>
<th>100 hinds</th>
<th>at $120</th>
<th>= 12,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 stags</td>
<td></td>
<td></td>
<td>at $100</td>
<td>=  500</td>
</tr>
<tr>
<td>(Livestock) 1.0</td>
<td>90 weaners</td>
<td>at $60</td>
<td>=  5,400</td>
<td></td>
</tr>
<tr>
<td></td>
<td>300 s.u.</td>
<td></td>
<td></td>
<td>$17,900</td>
</tr>
</tbody>
</table>

* Stock unit conversion factors

**INCOME**

| 35 hinds at $110 (Sold at 16-17 months) | = 3,850 |
| 5 stags at $100 (Sold at 12 months)    | =  500  |
| 40 stags at $47 (Sold at 14-16 months) | = 1,880 |
| 5/3 c.f.a. stags at $60                | =  100  |
| 10 c.f.a. hinds at $40                | =  400  |
|                                       | $6,730  |

**VARIABLE COSTS**

| Health | = 90 |
| Freight $1/head | = 91 |
| Stags (5/3 x 100) | = 166 |
| Deaths (4%) | = 716 |
| Winter Feed | = 90 |
| Interest (7%) | = 1,253 |
|           | $2,406 |

**Total gross margin**

| = $4,324 |

**Gross margin per s.u.**

| = $14.41 |

**Extra variable cost**

| = .32 |

**Therefore true gross margin per s.u.**

| = $14.09 |

**3 s.u./acre therefore gross margin per acre**

| = $42.27 |
Table 4

LIVESTOCK PRODUCTION GROSS MARGINS
(Estimates Based on Projected Market Values of Capital Stock)

Productive life of hind 10 years, calving 90%, deaths 4%.
Hinds sell at 16-17 months (running with stag), conversion factor 1.0.
Stags for meat C.F. = 1.0, stags for sale C.F. = 1.0.

<table>
<thead>
<tr>
<th>Stock unit conversion factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>INCOME</td>
</tr>
<tr>
<td>35 hind at $45 (Sold at 16-17 months) = $1,575</td>
</tr>
<tr>
<td>5 stags sold at $45 (Sold at 12 months) = 225</td>
</tr>
<tr>
<td>40 stags at $47 (Sold at 14-16 months) = 1,880</td>
</tr>
<tr>
<td>5/3 c.f.a. stags at $60 = 100</td>
</tr>
<tr>
<td>10 c.f.a. hinds at $40 = 400</td>
</tr>
<tr>
<td>$4,180</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VARIABLE COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health                       = 90</td>
</tr>
<tr>
<td>Freight                      = 91</td>
</tr>
<tr>
<td>Stags (5/3 x $60) = 100</td>
</tr>
<tr>
<td>Deaths (4%)                  = 318</td>
</tr>
<tr>
<td>Winter Feed                  = 90</td>
</tr>
<tr>
<td>Interest (7%)                = 556</td>
</tr>
<tr>
<td>$1,245</td>
</tr>
</tbody>
</table>

| Total gross margin = $2,935 |
| Gross margin per s.u. = $9.78 |
| Extra variable cost = .32 |
| Therefore true gross margin per s.u. = $9.46 |
| 3 s.u./acre therefore gross margin per acre = $28.38 |

S.U.C.F.* 2.0 100 hinds at $50 = $5,000
5 stags at $50 = 250
1.0 90 weaners (5-6 months) at $30 = 2,700
300 s.u. = $7,950

* Stock unit conversion factors
COMMENT: Proceedings Against Hunters

In the twelve months to August 1972 there have been at least three cases of legal proceedings taken against deerhunters in the Southland area and these may be of interest to farmers and runholders plagued by similar offences.

Case 1. A musterer saw a Landrover party driving from an area of run country near Waikaia, pick a gate lock and drive on after the musterer failed to glean information from them. He took the registration number of the vehicle and the owner later admitted his part in the offence.

Mr T. G. Maxwell in the Gore Magistrate’s Court commented that it was the first case of its type to come before him in Southland.

Mr M. N. H. Haggitt a Dunedin solicitor in opening his case said high country run owners are very concerned about the practice of shooting without authority on private property. Incidents of itinerant deerstalkers shooting without authority on high country farms had risen to serious proportions he said. He said that the maximum fine was $100 but the court had power to order the forfeiture of the shooter’s certificate of registration in respect of arms he was carrying at the time of the offence. The price of deer meat coupled with the increased availability of four wheel drive vehicles had helped shooters gain access to distant areas. When one considered that between $37.50 and $42.50 could be paid for an average carcass, it was easily seen why shooters were prepared to ignore locked gates and a lack of authority to shoot on properties, said Mr Haggitt.

The defendant was fined $60 and ordered to pay solicitor’s fees of $15.

Case 2. On 30 September 1971 the manager of a northern Southland station watched a helicopter land two loads of deer carcasses on one of his paddocks.

He rang the Police who advised him to contact his solicitor. The solicitor recommended uplifting the carcasses. Later on in the day a van entered the paddock to find nothing, and the station manager informed the driver to get in touch with the solicitor. In the meantime the deer were placed in a freezer in Mossburn to prevent any deterioration taking place whilst the problem was being resolved.
There ensued over a period of time a legal discussion on the interpretation of Section 9 of the NOXIOUS ANIMALS ACT 1956, which reads...

"Ownership of animals — All noxious animals shall belong to the Crown; Provided that, where any noxious animal has been lawfully taken or killed pursuant to this Act or to any regulations under this Act, it shall cease to belong to the Crown, and the animal shall be deemed to belong to the person by whom it was so taken or killed;

Provided also that nothing in this section shall have effect so as to impose any obligation or liability on the Crown in respect of damage done by any noxious animal."

Section 3 of the same Act reads "Any noxious animal may be hunted or killed by any person in any part of New Zealand... Provided that nothing in this subsection shall be deemed to confer on any person the right of entry on to any land."

It was argued in this case that the deer were not lawfully taken or killed since both the killing and dumping of the carcasses were trespasses. It was also argued that the Act mentioned did not confer on the station manager any right to convert the carcasses and decline to return them to the lawful owners.

His solicitor contended that the manager’s only justification for holding the carcasses was in satisfaction for any damages the manager might be entitled to for the unlawful entry by the company’s servants.

The matter was settled out of court when the helicopter company’s solicitors offered a considerable sum which effectively covered all legal costs plus full payment of the storage charges, in return for the carcasses.

Case 3. The same company was fined in August 1972 for shooting at animals, namely deer, within the boundaries of the Fiordland National Park, and for taking 30 deer without authority. The magistrate fined the company on each charge $50, $5 costs, $9 witnesses expenses and $15 solicitors fees.

"Pestered"

Readers of Pastoral Lands Newsletter No. 7 may have read of the amendment (of 21/2/71) to Civil Aviation Safety Order 9A setting out safety regulations for the use of firearms and tranquiliser guns in helicopters and stating that helicopter operators must have written approval from the owner, licensee, lessee or controlling authority of the land before firearms may be carried or discharged over the land for the purpose of game recovery.

The system of block allocation is presently under review by the Forest Service and the feasibility of licensing aircraft for game meat recovery and zoning country into helicopter hunting areas is being considered. — Ed.
Fertilizer Use and Grassland Improvement on Central Otago Hill and Mountain Soils

T. E. Ludecke
Senior Lecturer, Soil Science Department, Lincoln College.

M. L. Leamy
Chief Pedologist, Soil Bureau, D.S.I.R., Lower Hutt.

An address to the 1971 High Country Field Day gathering, Bendigo Station.

In this address it will be shown that the potential of the tussock country of Central Otago is tremendous, that it is highly economic to realise this potential under present day prices and costs.

The aim of tussock country improvement is two-fold.

First, to improve pastoral production both by increasing stock performances and by increasing sheep and cattle numbers. In the Wanaka district on properties which have undertaken improvement programmes it is quite common for death rates to have decreased by 8-10 per cent, lambing percentages to have increased by 15-20 per cent and for 80-90 per cent of the surplus lambs to be sold as fats. Cattle numbers have increased dramatically since 1967.

Second, to improve the lower country so that the grazing pressure can be eased on the higher snowgrass country where soil and water conservation is vital in the national interests.

Legumes

The key to improving the lowland tussock grasslands is to establish and maintain good legume growth.

The legume suited to soils in Central Otago where the rainfall is less than 20 inches per annum is lucerne.

Where the rainfall is greater than 20 inches, then white, red and alsike clovers are the legumes suited to these conditions.

The Climosequence of Soils

On the mountain ranges of Central Otago there are steep climatic gradients. As you proceed up a mountain range, precipitation increases and temperature decreases and this is reflected in a wide range of soils.
This range of soils, shown in the figure, extends from brown grey earths where the rainfall is less than 17 inches per annum and the vegetation is formerly depleted scabweed associations, through to yellow grey earths where the rainfall is 18-25 inches and the vegetation is fescue tussock grasslands, then to the yellow brown earths.

The yellow brown earths are subdivided into two groups, namely upland yellow brown earths where the rainfall is 25-35 inches and there are scattered snowgrass plants in fescue tussock grasslands, and high country yellow brown earths where the rainfall is 35-80+ inches and the vegetation is snowgrass associations or associations induced from snowgrass. It is on the high country yellow brown earths that soil and water conservation is very important.

All these soils occur on Bendigo Station. This is a complete range of the major groups of New Zealand soils and is known as the climosequence of soils, climate being the soil forming factor that is varying. It has been found that these different groups of soils differ widely in their chemical, physical and biological properties.

The yellow grey earths and the upland yellow brown earths are the soil groups which are really suited to improvement by aerial oversowing with clovers and applying the correct fertiliser.

Idealised Cross Section of the Dunstan Range
showing the Major Soil Group Pattern in Central Otago
(Rainfall in inches)
Fertiliser Requirements

Extensive use has been made of climosequences in formulating fertiliser programmes when introducing legumes into tussock grasslands in Central Otago. By carefully selecting trial sites on a climosequence basis fertiliser programmes can be formulated for hundreds of thousands of acres with a minimum of trials.

| Table 1 |

Sulphur, Molybdenum and Phosphorus Responses with Legumes in a Climosequence of Soils on the Dunstan Range

<table>
<thead>
<tr>
<th>Site No. and Soil Group</th>
<th>Sulphur Responses</th>
<th>Molybdenum Responses</th>
<th>Phosphorus Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Brown grey earths</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>2. Brown grey earths/yellow grey earths</td>
<td>Marked</td>
<td>Fair</td>
<td>Nil</td>
</tr>
<tr>
<td>3. Yellow grey earths</td>
<td>Marked</td>
<td>Marked</td>
<td>Nil</td>
</tr>
<tr>
<td>4. Upland yellow brown earths</td>
<td>Marked</td>
<td>Marked</td>
<td>Fair</td>
</tr>
<tr>
<td>5. High Country yellow brown earths</td>
<td>Marked</td>
<td>Marked</td>
<td>Marked</td>
</tr>
</tbody>
</table>

The nutrients which limit the growth of legumes in Central Otago are sulphur, molybdenum and phosphorus. This is shown in Table 1 which is data from a climosequence study on the eastern slopes of the Dunstan Range in the Matakanui district. The response indicator plants were clovers at all sites except site 1, where lucerne was the indicator plant.

These and other trials have shown that the major nutrient deficiency limiting the growth of clovers is an acute and widespread sulphur deficiency; marked responses to sulphur were obtained at all sites except site 1. It was found that 50 lb. of sulphur per acre was required to obtain maximum clover establishment and growth. On brown grey earths where the precipitation is only 15 inches or less per annum, good dry land lucerne stands can be grown without any fertilisers.

No molybdenum responses are obtained on brown grey earths; on soil transitional between brown grey earths and yellow grey earths a fair response is obtained to molybdenum; on all other soils marked responses are obtained.

No phosphate responses are obtained on any soils in Central Otago until the acute sulphur deficiency has been rectified. The soils vary widely in their phosphate requirement.
The brown grey earths and yellow grey earths have no phosphate requirement; on the upland yellow browns earths a fair phosphate response is obtained and the high-country yellow brown earths are markedly responsive. It has been shown that the Department of Agriculture’s Truong soil test for phosphorus gives a very good indication of the phosphate status of these soils.

The fertilisers which are recommended for the establishment and maintenance of vigorous clover growth are given in Table 2.

**TABLE 2**

**Fertiliser Recommendations for Yellow Grey Earths and Upland Yellow Brown Earths**

Yellow grey earths: 1½ cwt sulphur molybdic super 400 lb. mix every 3 years. Molybdenum to be used every 6 years.

Upland yellow brown earths: 2 cwt. sulphur molybdic super 200 lb. mix every 2 years. Molybdenum to be used every 6 years.

**Seed Mixtures and Seed Treatments**

The seed mixture which is recommended when oversowing yellow grey earths and upland yellow brown earths is shown in Table 3.

**TABLE 3**

**Recommended Seed Mixture for Oversowing on yellow grey earths and upland yellow brown earths**

(lb per acre)

<table>
<thead>
<tr>
<th>Seed Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Clover</td>
<td>3 lb</td>
</tr>
<tr>
<td>Alsike Clover</td>
<td>2 lb</td>
</tr>
<tr>
<td>Montgomery Red Clover</td>
<td>2 lb</td>
</tr>
<tr>
<td>Cocksfoot</td>
<td>5 lb</td>
</tr>
<tr>
<td>Perennial Ryegrass</td>
<td>5 lb</td>
</tr>
</tbody>
</table>

There is strong scientific evidence to show that within three years of oversowing fescue tussock country in Central Otago, grasses become an important component of the sward as the clovers build up the nitrogen levels. The production from resident grasses such as sweet vernal, browntop, yorkshire fog, blue wheat grass and blue tussock is markedly increased; also the introduced grasses, namely cocksfoot and perennial ryegrass begin to make an important contribution after three or four years.
Conroy sandy loam, schist loess with a pan at 9 inches and another at 30 inches. An example of a high nutrient status brown grey earth in the 15-20 inch rainfall zone, 22,000 acres in the Maniototo and Vincent Counties. Conroy hill soils cover a further 66,400 acres in the Vincent County (Otago Central). These and related soils give Central their desert appearance but are capable of improvement with lucerne which they will grow without maintenance fertilizer. This is attributed to the presence of usually ample sulphur and phosphorus at 2-4 ft depth which the lucerne reaches. There are approximately a half million acres of brown grey earths with similar properties in the Otago region.
In the foreground is a trial plot of lucerne, one mile east of Alexandra. The soil is Conroy which in this case has a high sulphur status as gypsum (CaSO$_4$.2H$_2$O). The crop was sown without fertiliser. One of the limitations to lucerne establishment on tors country is the heavy wear on machinery and implements. This may be reduced by broadcasting coated-inoculated seed and harrowing with flexible harrows.

It is considered that grasses should be included in the initial oversowing mixture and not sown later when a maintenance fertiliser dressing is made. The reason for this is that grass seedlings have a far better chance of establishing before the competition from the sward becomes too intense.

Time of oversowing trials in the Wanaka district on upland yellow brown earths have shown that the initial aerial oversowing and topdressing should be undertaken in July or August. Research work at Invermay Research Station has shown that the seed mixture should be applied independently of the fertiliser, using a spreading device on the aircraft.
In Table 4 the numbers of *Rhizobium trifolii* in the soil in the different soil groups of the climosequence described previously are given. It can be seen that with increasing leaching the numbers of *Rhizobium trifolii* decrease markedly. On the yellow grey earths there are ample rhizobia to ensure good nodulation of the clovers.

Because of the low numbers on the yellow brown earths, inoculation of the clover seed is essential.

It is considered that all farmers undertaking an improvement programme should inoculate the clover seed themselves carefully, using a good viable strain of inoculant.

Management Associated with Grassland Improvement

It has been found on improved properties in the Upper Clutha that in order to adopt proper grazing management and utilisation of improved grasslands, the blocks should not be larger than 200 acres and preferably should be approximately 100 acres. This subdivision must be carried out before the initial grassland improvement is undertaken. These small blocks enable stock management to be carried out very much more efficiently. Access tracks are also essential on improved properties.

Following the initial oversowing and topdressing of a block in July or August, a large mob of sheep should be placed in the block to tramp the seed into the surface. The block should then be spelled until November or December to enable the young clover and grass seedlings to become established. In late November or December the block should be grazed quickly with ewes and lambs at the intensity of 10 ewes and their lambs per acre. The block should then be spelled over the hot summer months and grazed again in March.
While improved grasslands produce a lot more herbage in the cold winter months than unimproved grasslands, properties which have undertaken a major improvement programme in the Upper Clutha have found it necessary to make a lot more hay in order to winter their stock properly.

For example a property in the Wanaka district in 1959 prior to improvement found that 5000 bales of hay was sufficient to winter 4000 sheep and no cattle. In 1972 this property has improved approximately 2000 acres and requires 10-12,000 bales to winter 6500 sheep and 20 head of cattle.

It has been found that in the Upped Clutha that the optimum time to apply maintenance dressing of fertiliser is in late January or February. This ensures maximum production in the autumn and also in the late winter and early spring.

Conclusion

In the unimproved state it is estimated that in Central Otago the yellow grey earths and upland yellow brown earths are carrying 1 ewe to 4 acres and these can be improved within three years, to carry 2 to 2½ ewes per acre. *Nowhere else in New Zealand will you achieve a ten-fold increase in carrying capacity for such a low fertiliser input.*

It is estimated that there are 400,000 acres of these soils in the Upper Clutha catchment alone.

It must be stressed that this potential only exists provided there continues to be good rabbit control.

At the field day at Tara Hills last year, the Advisory Services Division of the Department of Agriculture discussed the profitability of tussock country development. It was shown that the cost of improving fescue tussock grasslands including the cost of ewes was approximately $16.50 per acre and the percentage return on investment was 29 per cent per annum. If the cost of fencing, access tracks, buildings and yards were taken into account, the cost per acre was $30 and the return on investment is 16 per cent per annum.

The potential for fescue tussock grassland development in the Upper Clutha is a real national asset and should be taken into account when the profitability of hydro electric schemes is being assessed. It must be remembered that if the potential of fescue tussock grasslands on the mountain ranges is to be realised it is essential to produce winter feed on the flat terrace country, a large percentage of which would be flooded if hydro electric development was to take place in this catchment.
Report of the N.Z. Wool Marketing Corporation Establishment Company

MAY 1972

The Company has investigated the structure, functions, powers, methods of operation and financing of the proposed marketing corporation.

The Company invited submissions from national organisations in New Zealand and subsequently held a number of meetings. Overseas the Company held 19 meetings and met over 180 representatives of the wool trading and manufacturing industries. The organisations making submissions in New Zealand and those with whom meetings were held in New Zealand and overseas are listed in the appendix.

Over the past few years wool marketing has been investigated extensively both in New Zealand and in other wool producing countries. The Company has drawn on these earlier investigations including particularly the report of the Wool Marketing Study Group (1967), the report of the Wool Marketing Committee (1968), the report of the Battelle Memorial Institute (1971) and the New Zealand Wool Board Marketing Plan (1971). In addition to these major reports, a number of other investigations were examined by the Company, including various marketing proposals put forward by woolbroking, trading, buying and using organisations.

The Company acknowledges these contributions. It also acknowledges the cooperation of those who accepted its invitation to make submissions or have discussions in New Zealand and overseas.

The Establishment Company submits herewith its report to the New Zealand Wool Board and the Government of New Zealand. The report contains the Company’s recommendation for the creation of a New Zealand Wool Marketing Corporation and proposals on legislation necessary for this purpose.

A basic and essential element of this recommendation is that the said Corporation be empowered to acquire all wool and that it initiate such a scheme in accordance with the proposals contained in the report. The Company considers acquisition, as proposed, to be an inseparable feature of its recommendation for the creation of a marketing corporation.

H. P. RALPH,
Chairman.
The New Zealand Wool Marketing Corporation Act, with the exception of Part III relating to acquisition, came into force on 1st December 1972, the Wool Commission staff providing nucleus administrative staff of the Corporation. On 21 December the Minister of Agriculture announced an intention that with the approval of the Wool Board, which has been given, the provision in the Act for a growers' referendum will be removed in the next Parliamentary session. The recommendations of the Establishment Company were closely followed in the drafting of the Act except on the matter of the referendum. The Company was emphatic that acquisition was essential to the efficiency of the Corporation and the wool marketing and grower industries as a whole and recommended acquisition from the outset. The Company's recommendations are expected to considerably influence the regulations of the Corporation. My summary annotations are made where the Act is definitive to or differing from the Company recommendations and thinking. They are brief and serve as a guide only. The Act may be obtained from bookshops of the Government Printing Office. — Ed.

1. Recommended Form of Corporation

The most desirable organisation to market wool produced in New Zealand is a Statutory Corporation.

The organisation should be named the New Zealand Wool Marketing Corporation. It should be marketing oriented, commercial in outlook, profit seeking and flexible in its planning and operations. Only such a Corporation would have the strength required to act effectively on behalf of the 37,000 New Zealand woolgrowers who now make individual marketing decisions.

The Marketing Corporation should have wide powers embracing the marketing of wool in all its aspects; it should be open to public scrutiny in the exercise of those powers.

2. Recommended Objective

The objective of the Wool Marketing Corporation should be to obtain maximum long-term returns for New Zealand woolgrowers.

The Corporation would attain this objective by:

(a) Developing a marketing system suited to the requirements of the wool textile industry.

(b) Marketing wool produced in New Zealand to the best advantage in competition with other textile fibres.

(c) Bringing about efficiencies in handling and distribution and keeping the costs of these and related items to a minimum consistent with (a) and (b).

2—The general object for which the corporation is established is to obtain, in the interest of growers, the best possible long term returns for New Zealand wool. 2a—Develeing a wool marketing system suited to the world's textile industry. 2b—Enacted. 2e—Bringing about efficiencies in the handling and distribution of wool, with a view to keeping those activities, and related costs to a minimum, . . . 2 last para— . . . Corporation shall have particular regard to the need to achieve a trading surplus with a view to maintaining its capital funds and providing for such reserves as the Corporation deems desirable . . .
In pursuit of the objective and in the exercise of its powers, the Corporation should, as a profit seeking organisation, have particular regard to the need to achieve a trading surplus, with a view to maintaining its capital and as necessary providing for working reserves over a period of years.

3. Recommended Functions

The functions of the Corporation should be:

(a) To acquire wool produced in New Zealand.
(b) To market wool at all stages within and outside New Zealand.
(c) To develop existing and new markets for wool within and outside New Zealand.
(d) To develop greater efficiency in wool preparation, handling, distribution, shipping and selling.
(e) To negotiate with persons and organisations in respect of the transport of wool within and outside New Zealand.
(f) To provide information on market requirements as a guide to the planning of wool production and to the preparation of wool.
(g) To encourage the production in New Zealand of types of wool and breeds of sheep suited to market requirements,
(h) To administer a minimum prices plan for such a period as necessary.

4. Recommended Powers of the Corporation

The Corporation should have powers to:

(a) Purchase all classes of shorn wool, slipe or pulled wool, and woolly sheepskins.
(b) Market its purchases in any manner thought to be in the best interests of New Zealand wool.
(c) Commission or undertake any activity in connection with preparation, handling, disposal, transport, scouring, processing, research or other marketing activity considered appropriate.
(d) Ensure that other parties engaged in preparing, handling, disposal, scouring, processing and exporting or other marketing activity considered appropriate, carry out these functions in accordance with its directions.
(e) Issue licences as required to organisations or persons to carry out any or all of the activities mentioned in (c) and (d).
3a . . . and elsewhere. 3bcd enacted. 3e (and) . . . in respect of freight rates and other terms and conditions for the transport of wool from New Zealand. 3f enacted. 3g enacted but the reference to breeds of sheep appears in the research clause under General Powers. 3h To administer a minimum prices plan in accordance with Pt 11 (but this is not applicable if Part III — acquisition — comes into effect). Minimum and supplement prices apply for greasy, scoured and slipe wool offered for sale for the first time and sold in N.Z. or U.K. at auction sales approved by the Corporation, or otherwise than at auction in N.Z. the minimum price may apply where such wool has been valued by the Corporation. 4abcde enacted in General Powers — see later annotations. No person (etc.) shall receive, store or appraise any wool or permit any wool to be so received stored or appraised except on premises licenced by the Corporation. No person (etc.) shall export any wool except under licence issued by the Corporation.

(f) Operate a minimum floor price scheme.

(g) Become the sole purchaser of any classes of wool or woolly sheepskins at prices to be determined after consultation with the Wool Board.

(h) Negotiate all overseas freight contracts for wool.

5. Recommended Directorate

The Corporation should consist of nine directors to be appointed by the Governor-General on the recommendation of the Minister, of whom:

(a) One director, not being a member of the Wool Board, nominated by that Board and approved by the Minister. This director to be Chairman of the Corporation.

(b) Three directors, being members of the Wool Board appointed as growers’ representatives, nominated by that Board.

(c) Two directors, not being grower-elected members of the Wool Board or public servants, who in the opinion of the Minister are qualified by commercial experience.

(d) One director, being an officer of a Government Department.

(e) Two non-voting Associate Directors of whom one shall be the Chief Executive of the Corporation and any one other person nominated by the Directors of the Corporation.

(f) All directors to retire on attaining the age of 70 years.

4f Enacted (minimum prices plan). Not applicable if acquisition comes into effect. 4g Referendum of growers not earlier than 1.1.1974 on the proposal that Part III be brought into force. Part III provides for the acquisition, marketing and exporting of any wool by or on behalf of the Corporation. Prices to be fixed for each 12 months and operative from 1 July. 5 Up to ten directors. 5a appointed as Chairman on the nomination of the Wool Board the nomination having the approval of the Minister of Agriculture and Fisheries. 5b Appointed on the nomination of the Wool Board. There is a further director, appointed on the nomination of the Wool Board, whether or not he is on the Board. 5d Being the Director-General of Agriculture and Fisheries. 5e There may be two Associate Directors, without power of vote, one being the chief executive officer, the other appointed from time to time as the Corporation thinks fit. The directors with the exception of the Associate Directors and the Director-General of Agriculture and Fisheries are to be appointed by the Governor-General on the recommendation of the Minister of Agriculture and Fisheries.
6. Industrial Marketing System

The Corporation should recognise the force of the Battelle Report statement that:

"Wool is an industrial input product. It follows a very complex and tortuous path from the sheep to the consumer who uses it in the form of a garment or a carpet.

In fact, some wool is only used in industrial products such as paper-making felts and never actually ends up in a consumer form. Therefore, an effective marketing system for wool must follow the industrial marketing concept.

"While the final product marketer is concerned with the satisfaction of consumer needs and wants, the industrial product marketer is more concerned with technical requirements, scheduling, financing, etc., of manufacturers. He is concerned eventually with consumer needs, but primarily as they are translated by his customer into need for his products. The industrial marketer, in the long run, achieves success by providing his customers with products and services that help that customer make profits in his own operations. In fact, the marketer of an industrial input is often concerned not only with selling his own product, but also he may become involved in assisting his customer market and sell the products that are made from his input".

An industrial marketing system meeting the objective of the Corporation to obtain maximum long-term returns for New Zealand woolgrowers cannot be effectively achieved by the 37,000 growers involved acting individually. Co-ordinated action by the growers' Corporation could enable an effective transition to be made to such a system.

7. Wool Marketing Operations

The Wool Board plan for marketing was directed "towards establishing a system of sale which provides better communication through the market than the auction system at present, more stable prices, better control of the timing of sales and delivery and other advantages" (e.g. "reducing the cost of wool handling, spreading the offering of selected types of wool over a greater part of the year").

It is agreed that these are desirable elements in a marketing plan.

However, the Corporation must recognise the need to work constantly towards an integrated marketing system that does not concentrate exclusively on problems of wool handling and pre-
paration in New Zealand, from farm gate to ship’s side. While these are important problems, emphasis needs to be given to marketing problems from selling point to overseas using mill.

The requirements of particular markets also need to be met. For instance, in the U.S.A, the position of New Zealand wool is such that there is an urgent need for the Corporation to establish an investigating unit. Such a unit should examine and analyse the market situation there and make its recommendations to the Corporation on action to be taken.

The Wool Board in its Marketing Plan proposed that initially the Corporation could operate commercially by buying and selling wool and “testing and proving procedures against commercial competition”. This would be alongside the continued availability to growers of all present methods of sale which were mentioned as “options” in the Wool Board’s plan.

The Wool Board recognised however that these “options” should remain open only so long as they were, in the view of the Corporation, “viable and beneficial to the marketing of New Zealand wool”. In examining this proposal in depth, it has become evident to the Establishment Company that there is a conflict between retaining such proposed options for growers in the sale of their wool and the attainment of the objective of the proposed Corporation.

The Wool Board’s plan postulates an ideal of competition that could result mainly in the Corporation becoming yet another forward seller of wool but still failing to achieve its real marketing objectives. Any acquisition scheme that retains elements of grower options would still fall short of the Battelle ideal of minimum fragmentation. After examining this whole question, the Company considers that a directed flow of wool production from farm to specified point and then to consuming mills needs to be achieved as soon as possible.

This involves a rigorous stand being taken from the outset. In short, the conflict between grower choice and marketing efficiency must be faced. To fulfill its objective of maximizing long-term returns to New Zealand woolgrowers the Corporation has to come down on the side of marketing efficiency.
8. Recommended Acquisition Scheme

It is therefore the view of the Company that the Corporation should work to a timetable that leads to the introduction of an acquisition scheme as soon as practicable. The scheme recommended is as follows:

(1) All shorn wool and woolly sheepskins would be acquired by the Corporation at receiving facilities licensed by the Corporation and slipe wool at processing point.

(2) Growers would deliver their shorn wool production to nominated licensed facilities as arranged by the Corporation.

(3) It is expected that the Corporation would utilise existing handling facilities for example those operated by brokers, N.Z. Co-operative Wool Marketing Association Ltd., private buyers, scourers, etc., where these were suited to its requirements and that this would be done at service rates to be negotiated from time to time.

(4) Payment for shorn wool would be made as soon as practicable after delivery. Appraisal would in general be made as wool was delivered to stores, and payment should be made to growers on the Friday of the next week following appraisal. When delivery was delayed or appraisal deferred at the request of the Corporation and was agreed to by the grower, then payment should include a storage and/or interest increment.

(5) It should be the objective of the Corporation to maintain a stable schedule of prices to growers and these prices within a season may be amended only in exceptional circumstances.
(6) End of season payment from trading surplus to be made to the extent deemed appropriate after agreement with the Wool Board. Over a period of years the scheme must be self balancing.

(7) The Corporation would sell as and when it chose. It would be responsible for aggregation of wool and could, therefore, plan for deliveries to enable maximum efficiency in transport utilisation.

(8) In the case of slipe wool appraisal would be made at the processing point.

Before this acquisition scheme is introduced, comprehensive re-organisation, planning and staffing must be undertaken and completed. It is therefore recommended that the legislation should provide for the scheme to be introduced on 1st July, 1973, or such other date as the Minister of Agriculture approves on the recommendation of the Corporation. The effect of this will be to provide for a firm date for introduction which would stand unless changed in the manner provided.

To provide for continued orderly and planned progression when acquisition is introduced on 1st July 1973 the following variations from the scheme are recommended for an initial phasing-in period thereafter:

(1) Slipe wool and woolly sheepskins should be excluded.

(2) Growers would decide themselves which licensed facility they wished to use. These would include stores owned by brokers and private buyers, N.Z.C.W.M.A., scourers, mills, dump stores or, by arrangement with the Corporation, U.K. auction brokers' stores.

(3) Private buyers would have the opportunity of buying from the Corporation, at the Corporation's selling price, wools delivered to their facilities or wool sent direct from farm to scour or farm to dump store for export (on appraised sample).

This proposed timetable would allow the Corporation to introduce progressively the economies that could be secured by some streamlining of the primary flow of shorn wool from farms. For the time being growers would retain options as to their selling outlets. Although optimum improvements to the flow of

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8-6. The Corporation may distribute the whole or any part of its profits in such manner as may be agreed upon between the Corporation and the Wool Board.
shorn wool to overseas would not be gained at this stage, there would be some immediate benefits in the following areas:

(a) The Corporation selling in standard modules (of, say, 12 bales) would assist in removing transportation difficulties.

(b) The Corporation controlling shipments or becoming the sole shipper to overseas destinations.

(c) The Corporation making direct sales where such opportunities arise or can be identified.

9. New Zealand Wool Commission

The New Zealand Wool Commission should be absorbed into the Corporation and its functions, for so long as may be appropriate, should be assumed by the Corporation.

10. New Zealand Wool Board

An essential part of the Corporation’s activities will be to co-ordinate its work with that of the New Zealand Wool Board. It is important that the operations of the two organisations should be properly and adequately co-ordinated. A full examination of the respective functions should be made so that a joint decision can be reached by the Wool Board and the Corporation.

11. Recommended Financing

(a) Capital

Assessments of financial needs will vary according to the price and volume of wool involved. With an acquisition scheme for shorn wool on present production levels the peak financing requirement, at an average of 55 cents per kilogram, is estimated to be of the order of $35 million if the wool were entirely sold at auction. At an average of 75 cents per kilogram the requirement would be approximately $43 million. If sales of all wool (shorn, slipet and woolly sheepskins) were entirely made by private negotiations with c.i.f. financing, the peak could rise to $115 million at 55 cents, and $155 million at 75 cents.

It is therefore recommended that the Corporation should have a capital of approximately $50 million. This would give a reasonable balance between the Corporation’s capital and its working requirements. With capital of this order, the Corporation would have the financial strength to begin activities as earlier outlined. It could entirely self-finance its initial work.

9, 10, 11. Wool Commission abolished and the funds, property and liabilities of the Commission are taken over by the Corporation excepting the special reserve account which shall be paid to the Wool Board. The Corporation from time to time at the request of the Wool Board shall pay to the Board a sum or sums not exceeding in the aggregate $600,000 in any financial year . . . and any such amounts as to supplement levy payments to the Wool Board. By arrangement with the Wool Board the Corporation shall collect on behalf of the Board any levy payable to the Board under sec. 12 of the Wool Industry Act 1944.
It is also recommended that, as it moves into later stages the Corporation should be assured of access to funds as follows:

(i) *Trading purposes*
Current account borrowing from the Reserve Bank of New Zealand.

(ii) *Losses or stock accumulation*
The Corporation should be able to borrow from the Reserve Bank of New Zealand to meet any trading losses or cost of stock accumulation. This will enable it to retain its financial position within the self-balancing principle of the scheme.

(b) **Source of Capital**

The Company in considering the possible financial requirements of the Corporation has noted the following views expressed by the Wool Board in its Marketing Plan:

"The funds of the Wool Commission were set aside for the purpose of operating a wool marketing scheme which would be beneficial to the wool industry. The current assets of the Commission are approximately $48 million, of which $21 million is in wool stocks. This would be the fund from which the wool growers' contribution to the Corporation would be drawn. The Corporation will require capital backing for a number of purposes — apart from continuing the price support and supplementation functions of the Commission — and it will also require reserves against emergencies. A tentative estimate is that the total funding necessary would be twice the Commission's present assets".

The original sources of Wool Commission capital were profits from the New Zealand Wool Disposals Commission made up from the Joint Disposals Organisation activities and the balance in the Growers' Contributory Charge Account.

The method by which these funds should be ultimately disposed was negotiated by the Wool Board and the Government in December, 1951. The Agreement provided that the proportion which arose from the Joint Organisation profits should be made available for purposes beneficial to the wool industry as mutually agreed between the Wool Board and the Government; and that the proportion which arose from the Growers' Contributory Charge should be applied in such manner as the Wool Board thought fit, for the benefit of the wool growing industry.

On the basis of the agreed formula and assuming terminal Wool Commission funds of $50 million, the share relating to Joint Organisation profits would be $37.9 million and the share
available for disposition by the Wool Board would be $12.1 million.

However, if all of these funds were to be transferred to the Corporation as its capital, negotiations would be required between the Wool Board and the Government.

One possible alternative to providing the entire $50 million in this manner would be for the Wool Board to provide $12.1 million on interest terms to be agreed. The remaining $37.9 million would come from that part of the Wool Commission terminal funds which it was agreed in 1951 should be made available for "purposes beneficial to the wool industry". In this event the Company recommends that interest paid be free of tax in the hands of the Wool Board.

It is recommended that the Government give early consideration to the method by which the Corporation's capital should be provided.

It is also recommended that the Corporation, if it agrees, may pay to the Wool Board such amounts as may from time to time be consented to by the Minister for the purposes of the Board.

12. Recommended Staffing

To enable the Corporation to begin its detailed planning work as soon as possible, it is important that the appointment of its Chief Executive Officer be regarded as a first priority. To facilitate an early appointment, the Company has advertised the position in U.K., U.S.A., Australia and New Zealand. Applicants will be screened and the Company will make a recommendation as soon as possible. Staffing at other levels should be determined by the Corporation's Directorate.

13. Timing

It is noted that "The Wool Board expects the Corporation to be installed and its initial planning completed by the middle of 1972".

The Company has conducted its investigations accordingly and the Wool Board's timing expectations should be fulfilled.

14. Legislation

The legislation needed in accordance with the foregoing should provide for:

1. The Corporation should be empowered to assume its full powers in stages. It should start operations with the basic core of functions to which would be added the remaining functions as it considered advisable.
PART 1

2. Directorate

(a) There should be nine directors:

1 Director (not being a member of the Wool Board) appointed as Chairman on the nomination of the Wool Board having the approval of the Minister.

3 Directors (members of the Wool Board as Woolgrowers' representatives) nominated by the Wool Board.

2 Directors appointed by the Minister, qualified by commercial experience, not being members of the Wool Board or officers of any Government Department.

1 Director an officer of a Government Department.

2 Non-voting Associate Directors of whom—

(a) 1 nominated by the Directors of the Corporation;

(b) 1 to be the Chief Executive Officer of the Corporation.

(b) All Directors should hold office for three years and on reaching the age of 70 should retire.

(c) Casual vacancies on the directorate should be filled in the same manner as the original appointment.

(d) The Chairman should have a deliberative and a casting vote.

(e) A quorum should be any four directors (other than associates) of whom two should be directors nominated by the Wool Board and two nominated by Government.

3. Functions and Powers of the Corporation

The objective of the Corporation should be to obtain the maximum long-term returns for New Zealand woolgrowers by:

(a) Developing a Wool Marketing system suited to the requirements of the world's textile industry.

(b) Marketing New Zealand wool to the best advantage in competition with other textile fibres.

(c) Bringing about efficiencies in the handling and distribution of wool with a view to keeping these activities and related costs to a minimum consistent with (a) and (b).

It should exercise its powers having particular regard to the need for obtaining a trading surplus with a view to maintaining its capital and as necessary creating adequate reserves over a period of years.

The Corporation should be able to:

1. Acquire wool produced in New Zealand.

2. Market wool at all stages within and outside New Zealand.
3. Develop existing and new markets for New Zealand wool.

4. Develop greater efficiency in wool preparation, handling, distribution, shipping and selling.

5. Negotiate the transport of wool both within and outside New Zealand.

6. Provide information on market requirements as a guide to the planning of wool production and to the preparation of wool.

7. Encourage the production of types of wool and breeds of sheep suited to market requirements.

8. Administer a minimum prices plan as long as is necessary.

And to carry out these functions, have the power to:

9. Buy, market, sell or have processed wool produced outside New Zealand or fibres other than wool and market, sell or have processed such wool or fibres in conjunction with the marketing or processing of New Zealand wool.

10. Engage in or take part in any activity in connection with the preparation, handling, disposal, transport, processing or marketing of wool.

11. Approve all contracts for the transport overseas of any wool.

12. Acquire or subscribe for shares or debentures, or make advances to, or give guarantees or indemnities to companies engaged in the preparation, handling, transport, marketing, scouring or processing of wool within or outside New Zealand.

13. Undertake by way of subsidy or otherwise, scientific, industrial, or economic research in relation to wool or sheep.

14. Act with other organisations within or outside New Zealand to further its objective.
3 11. Enacted. 3 12. Enacted with proviso that for companies or corporate bodies corporated outside New Zealand consent of the Minister may be given after his consultation with the Minister of Finance. The Corporation may act in combination or association with any person or organisation within or outside New Zealand for the purpose of furthering the general object for which the Corporation is established.

PART 2

4. Licensing and Appeals

(a) Licensing

The Corporation should have the powers to:

(1) License persons engaged in preparation, handling, transport, marketing, scouring, export or processing of wool; and premises which may be used in such operations as it thinks fit,

(2) Designate as licensed receiving facilities for the purpose of appraisal such premises as it thinks fit.

(3) Determine the terms and conditions of licences with power to refuse, revoke or vary licences.

(b) Appeals

(1) Affected parties may appeal against refusal, revocation or variation of licences to a Wool Industry Appeal Authority.

(2) Where the Minister consents the Corporation may make such ex gratia payments as it considers fit to persons whose licences have been refused, revoked or varied.

PART 3

5. Minimum Prices Plan

The present minimum prices plan administered by the N.Z. Wool Commission should be continued in the meantime with the change that the criteria for fixing prices should include a specific provision “to have regard to the market prices for the various types of wool”.

4a. Sec. 19 deals with the granting of licenses for receiving, storage and appraisal of wool, and exporting of wool. Sec. 15 deals with contracts for the transport of wool from New Zealand which must be in conformity with conditions to be prescribed or approved by the Corporation, and discretionary powers are held under sec. 18. 4b A Wool Industry Appeal Authority is established under sec. 25 and provision for ex gratia payments is made under sec. 23.
PART 4

6. **Acquisition and Marketing of Wool**

These powers should come into force from 1st July, 1973, or if the Corporation requests, such other date as it recommends. The Corporation should be able to decide whether it wishes to have the powers apply only to some specified classes of wool or to a specified quantity of wool.

The Corporation should be empowered to:

(a) Acquire and market wool and prohibit or control the sale or export of wool.

(b) Control the preparation, handling, pooling, storage, transport, scouring, processing or appraisal of wool.

(c) Fix the prices to be paid to growers after consultation with the Wool Board and the Minister. Except that where it has borrowed from the Reserve Bank to meet losses or stock accumulations it should not fix prices save with the Minister's prior consent.

(d) Fix prices having regard to the need to maintain capital and as appropriate to make provision for reserves. Prices should remain unaltered for a season excepting in exceptional circumstances which should be determined after consulting with the Wool Board.

(e) Make payments to growers after appraisal as laid down by Regulations.

(f) Determine disputes with growers on the appraisal of wool by arbitration as laid down by Regulations.

(g) Make an end-of-season payment from trading surpluses to the extent deemed appropriate after agreement with the Wool Board. When loans to the Reserve Bank are outstanding (to meet any losses or the value of accumulated stocks) and when more than 50 percent of a surplus is to be paid out the consent of the Minister should be obtained.

PART 5

7. **Financial and General**

(i) The Corporation should be empowered to:

(a) Borrow from the Reserve Bank to meet any losses and the value of accumulated stocks.
(b) Borrow for trading purposes from the Reserve or Trading Banks.

(c) Make such payments to the Wool Board as it agrees after securing the consent of the Minister.

(d) Invest surplus funds in such securities as may be approved by the Minister.

(ii) Provisions should be made for regulations on matters as are within the Corporation's powers.

Submissions and Meetings

(i) Organisations and Companies within New Zealand:

(a) Making submissions—

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Association/Company</th>
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<tr>
<td>Carpet Wool Development (N.I.) Ltd., also (S.I.) Ltd.</td>
<td>N.Z. Woolbrokers Association</td>
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<tr>
<td>Feltex New Zealand Limited</td>
<td>N.Z. Woolbuyers Association</td>
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<tr>
<td>Federated Farmers of New Zealand Inc.</td>
<td>N.Z. Woolscourers Association</td>
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<tr>
<td>Federation of New Zealand Wool Merchants</td>
<td>N.Z. Wool Testing Authority</td>
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<tr>
<td>Mair and Co. Ltd.</td>
<td>N.Z. Freezing Companies Association</td>
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<tr>
<td>N.Z. Co-operative Wool Marketing Association Ltd.</td>
<td>N.Z. Woolbrokers Association</td>
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<tr>
<td>N.Z. Freezing Companies Association</td>
<td>N.Z. Woolbuyers Association</td>
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<tr>
<td>N.Z. Textile and Woollen Mills Association</td>
<td>N.Z. Woolscourers Association</td>
</tr>
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(ii) Organisations and Companies outside New Zealand with whom meetings were held:

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Association/Company</th>
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<tbody>
<tr>
<td>International Wool Textile Organisation</td>
<td>American Carpet Council</td>
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<td>Interlaine</td>
<td>Burlington Industries Inc.</td>
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<tr>
<td>International Wool Association</td>
<td>Magee Carpet Co.</td>
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<tr>
<td>British Wool Marketing Board</td>
<td>J. P. Stevens Industries</td>
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<tr>
<td>Federation of British Carpet Manufacturers</td>
<td>Roxbury Carpet Co.</td>
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<tr>
<td>London Wool Brokers Ltd.</td>
<td>Riverside Mills</td>
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<tr>
<td>British Wool Federation</td>
<td>C. H. Masland &amp; Sons.</td>
</tr>
<tr>
<td>Rolls &amp; Co. (Produce) Ltd.</td>
<td>Karastan Rug Mills</td>
</tr>
<tr>
<td>Tupman, Thurlow Co.</td>
<td>Japan Wool Importers Association</td>
</tr>
<tr>
<td>Boston Wool Trade Association</td>
<td>Japan Wool Spinners Association</td>
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BOARD OF THE NEW ZEALAND WOOL MARKETING CORPORATION

Messrs W. M. D. Bremner (Chairman), G. J. Stern, Prof. B. P. Philpott, Messrs J. Clarke (Chairman of the Wool Board), F. G. Spackman, T. C. Allen, D. C. MacDougal, Dr. A. T. Johns (Director-General of Agriculture and Fisheries).
Coltsfoot

A Potentially Dangerous Weed

Dr C. J. Burrows
Botany Department, University of Canterbury.

Two occurrences of coltsfoot (*Tussilago farfara*) have been discovered in the Waimakariri basin, Canterbury. These are the first records for the species in New Zealand. The first find was made in 1966, on the eroding bank of a small creek beneath Mt. Misery, Cass (grid reference S66/200142), at 3,000 ft. A specimen remained unidentified in the University of Canterbury Botany Department herbarium until 1971. The second find was at the bottom of a scree in the lower Mingha River, Arthur's Pass National Park (grid ref. S59/093250), at 2,200 ft. This discovery was made by Ranger John Charles.

Coltsfoot is regarded as quite a serious weed of arable land in Britain (Salisbury 1961). If it becomes widely established in the South Island mountains, it is likely to spread onto lowland farmland. Favourite habitats are eroding banks and damp screees and though it is favoured by relatively high base status, it can live in a wide range of soil conditions. There is no doubt that potentially it could invade much of the South Island mountain system.

The characters by which coltsfoot may be recognized are, firstly its stems (naked except for scale leaves) which appear above the soil in September. They are capped by bright yellow daisy flower-heads. Secondly, its medium-green leaves are notable for their angular outline. The upper surface bears cobwebby hairs while the lower is covered with a felt of white hairs. The plant reproduces and spreads by means of "parachute" seeds. The Waimakariri plants must have originated in this way. The most important means of local spread, however, is by underground stems. The rhizomes can penetrate to a depth of several feet and can extend radially from one to three feet in one season. Thus it forms large patches often to the exclusion of other plants.

Coltsfoot is resistant to most common herbicides except soil sterilants. It is not palatable to stock.

Persons finding new localities for the weed are requested to collect a specimen, press and dry it and send it to Mr A. J. Healey, Botany Division, D.S.I.R., Private Bag, Christchurch. Upon verification of its identity strenuous efforts should be made to eradicate the plant.
Coltsfoot (*Tussilago farfara*), leaf, flower stems and rhizome.  
(After Hutchinson, 1955).

**REFERENCES**

Preventing Cattle Fertility Diseases On Molesworth

M. M. Chisholm
Molesworth Station.

Based on address to the Canterbury Branch of the Royal Society of New Zealand, November, 1971.

Increased density of stock numbers brings problems and the greater transfer of stock today makes inevitable the exposure of animals to disease. Some diseases in cattle have tremendous effects on the economics of raising cattle and their control is important to human health.

The present herd was founded in 1940-41 by the Lands Department but cattle were the first stock carried in the early settlements, Tarndale (1850s) and Molesworth (1865). These properties were combined in the 1890s and the third, St. Helens, was joined with Molesworth in 1949.

The first natural increase numbered 60 calves in 1941. In 1942 there were 472 calves but along with increased numbers in the breeding herd the natural increase remained at an unsatisfactory 58 percent. Because of the isolation of this station no great emphasis was placed on the likelihood of disease affecting the calving percentage.

Brucellosis

Work on the problem of low calving in the beef herds of the Gisborne district revealed the disease brucellosis, or contagious abortion. Blood samples were immediately taken from a cross section of the Molesworth herd. These were flown by Tiger Moth to Blenheim and to Christchurch for dispatch to the research station at Wallaceville. The tests disclosed a very high percentage of positive reactors to brucellosis. Although the disease was well known in the dairy industry, I believe this and the Gisborne exercise was the first real attempt to uncover the disease in the beef industry.

In the past four years inoculation against brucellosis on all female calves has been compulsory in New Zealand. Within a short time testing for brucellosis will also become compulsory in all beef herds. On Molesworth, inoculation with vaccine 19 of all female calves was undertaken instantly and has been management practice for the last 20 years.

Calving on Molesworth after the inclusion of inoculated replacement heifers showed considerable improvement with calving numbers up to 2,118 by 1960.
Vibriosis

Calving dropped to 1,800 in 1961, 1,650 in 1962, 1,082 in 1963, and 1,600 in 1964. It was thought that the brucellosis inoculant had broken down. Numerous blood samples were taken and sent to Wallaceville, all samples giving negative results. This added confusion to the problem of low fertility. Bulls were not suspect but were increased to try to improve calving.

In 1963-64 Mr John Graham of Tasman Vaccine Laboratories was conducting an experiment on the problem of foot abscess in cattle. A decision was reached to fly Mr Graham and Mr John Muir of the Graham Veterinary Club, Blenheim, into Tarndale to examine a sample of breeding cows and heifers. Because of the importance of the investigation Mr W. Carter, journalist of the New Zealand Meat Producer, was included in the party.

Blood samples and vaginal smears were taken for testing at Wallaceville. Pregnancy tests showed an expected calving rate of no more than 15 percent.

The smears revealed the presence of vibriosis in the herd.

The two-year heifers coming into the breeding herd each year numbered some 800, but it was among the older 1,200 head that the low calving was coming from.

The two veterinarians described the disease—there was no vaccine anywhere in the world to combat it, possible and only means of elimination, a completely new herd.

The measures taken in the dairy herds to deal with vibriosis had no practical application in the large beef herds.

We now knew vibriosis would stay for many years. We were also convinced this problem was widespread in other beef herds and costing farmers substantial money because of low calving percentages.

The two veterinarians suggested that vibriosis would result in poor calving in the first mating. Within the year a large percentage of heifers would become naturally immune to the disease—some would become sterile, some may not be affected but could be carriers.

On this evidence it was decided to return the dry three-year heifers to the herd. Normally the wasteful procedure had been to dispose of these beasts to slaughter. It was also decided that no two-year heifers would be included in the herd for up to two years and that they would be sold.

It was felt the herd could stand a programme of no culling for that period and that this might see a vaccine developed to counter vibriosis. However, the sale of surplus two-year heifers caused numerous and unfounded criticism and rumour that Molesworth was quitting infected stock. Lobbying resulted in an embargo on the disposal of Molesworth's surplus female stock in 1967.

The development of a vaccine to combat vibriosis, a disease of economic importance rather than a threat to human health, is a success of co-operation between Wallaceville, Tasman Laboratories, and research taking place in the United States.

A published report in 1965 notes the first vaccine for vibriosis, developed by the Colorado State University. A university veterinarian stated that in a study of the Western States' beef herds, pregnancy rates were from zero to 50 percent with the average of 30 percent because of vibriosis.

Within the two years a vaccine was available in this country. Our order was for an initial 1,000 to 1,200 doses. A double race was constructed to hold some ten beasts aside. This enabled ten beasts to be held and inoculated while the opposite side was filling. We were able to inoculate some 400 beasts per hour.
The initial inoculation of some 500 heifers on the 17th December 1966 was followed by the routine inoculation of some 1,200 per annum ever since. Improved calving percentage has reached a satisfactory 91 percent or 2,700 calves. Very satisfactory in an operation of this size.

A disease-free herd means improved facilities to handle cattle, especially the female herd. Our main crushes and bails at Bush Gully and Tarndale are roofed. These clinics have concrete floors, water and power.

We are again on the threshold of further checks to maintain disease-free, exportable beef to meet regulations now in force and regulations to come. An example is the check on female cattle already inoculated. Blood samples will be taken for agglutination tests to ascertain the presence of brucellosis. Tests for leptospirosis and vibriosis could well follow.

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**Outdoor Sport**

**In The United Kingdom**

Professor J. T. Coppock, Georhaphy Department, University of Edinburgh, interviewed by J. Runge. The third and final article on outdoor recreation and its effects on land use in the United Kingdom. The first article Review 22, was entitled *Lambs or Caravans*, the second Review 24, was entitled *The Pressure of Recreation in the United Kingdom*.

Professor apparently recreational fishing is a source of income on a national scale.

Yes, there are about three million fishermen in Great Britain engaged in either game fishing or coarse fishing. Game fishing for salmon or trout is a very valuable source of income. The rights to this are vested in landowners and the number of people enjoying game fishing is relatively small. In one instance I know of a mile of fishing rights was sold for more than £25,000. But most fishermen in Great Britain are concerned with coarse fishing — the catching of fish other than salmon or trout. The cost of this is quite low. One of the problems with fishing generally is the location of suitable fishing in relation to the distribution of population. In the Midlands you find people sitting along a canal or river every few yards. Some anglers travel up to 200 miles at weekends, from industrial England to Scotland.
The charging for access to fishing is a landlord privilege rarely used in New Zealand.

It does vary throughout the country. In Scotland there is a general, if not legal, use of water for any purpose other than game fishing. But here pressures are building up too and access is being limited to members of associations and people who are prepared to pay. This is happening in other forms of recreation as well. We have long had a tradition of using farmland for game shooting — pheasant and partridge in the lowlands, grouse in the uplands, and deer in northwest Scotland. Here the value of the land for shooting may be higher than its agricultural value, though this is not generally the case — revenue from shooting is usually a supplementary source of income.

On cereal crop lands of East Anglia (that is Norfolk and Suffolk) the shooting income may represent one-fifth or one-tenth of rental value of the land. On some grouse moors in Scotland shooting value is sometimes more valuable than agricultural value. Such shooting can be very expensive, much of it is used by the landowner but an increasing amount is taken up by businessmen and syndicates from Britain and Europe and occasionally North America. The cost of shooting on a good grouse moor, including accommodation and the provision of ghillies might be £400 a gun, and sporting holidays have recently been advertised at £250-£800 a week. There is Lammermuir Hills, East Lothian. The heather moor is regularly burned in small patches to provide food and cover for grouse. The moors are also used for grazing Scottish Blackface and, in this case, for water collection for urban water supplies.

(Photo: J. T. Coppock from a transparency.)
still, however, a lot of such recreation that is much less formally organised. Many more people indulge in rough shooting, rabbits, hares and birds, other than game birds, where costs are less. Much of this is by private arrangement with families.

What are the alternatives to paying for recreation either through an association or direct to landowners?

Some hotels have an arrangement with landowners whereby guests are permitted a day’s fishing or shooting under certain conditions or payment. Sea fishing is generally free but occasionally jetty and boat access is to be paid for. Hotel sponsored recreation is reasonable in relation to the cost of doing this some other way. You may pay £5 for access to salmon fishing for a day but this is comparatively cheap. But fishing, if you are not concerned with game fishing is cheap. Shooting, if you are not concerned with deer, grouse, pheasant or partridge, is also cheap. Shooting on farm land is generally reserved for the farmer or landowner. The other kind of game shooting is where there is some kind of land management. For instance heather moors are regularly burnt to provide suitable feed for grouse.

To what extent does the Government exercise a protective role over these resources?

The Nature Conservancy has established national nature reserves throughout the country to preserve a representative selection of wild life, that is, both flora and fauna. But the preservation of recreational resources is a comparatively recent undertaking. It was only in the early 1960s that local authorities were required for the first time, to make some survey, plans and provision for outdoor recreation. The Nature Conservancy is a statutory body, with powers it has never used concerning the compulsory acquisition of land. It maintains a network of regional offices and acts in an advisory capacity to Government and public bodies, particularly on matters of threats to wildlife. There is also a complex structure of organisations concerned with recreation in its wider sense. Most of these began with concern for the preservation of amenity, scenery and wildlife, but are now changing emphasis towards the positive provision for recreation. There is now frequently incorporated in all acts of Parliament an amenity clause which states that the body concerned will have regard for the conservation of amenity and wildlife. We have not got to the stage being implemented in America whereby any proposal affecting the environment is to
have the environmental costs attached to it — an assessment of what is the likely impact of the development on amenity and wildlife. This does not exist in the United Kingdom legislation but we hope it will develop. However, our legislation and administration is effective. Where we have been poor, until recently, is this provision for recreation. The introduction of country parks as a focus for recreation is an important step in line with this new concept.

Deer in your country are evidently an asset. In New Zealand they are a pest. This outlook may change as we learn more about deer and how to manage them.

Red deer in Britain are largely confined to northwest Scotland. Most of this land is poor, with little value for agriculture. The deer population is comparatively small, some 180,000 head. The Red Deer Commission has the responsibility of conserving this resource. It promotes research, census and recommends the size of cull. These are major differences with New Zealand. The other differences are that much of our upland environment is less fragile, and that the deer is indigenous. Since the rocks from which the uplands are formed...
are older, major erosion there has ceased. The area over which the deer range intensively is some three million acres of deer forest and a further $7\frac{1}{2}$ million acres extensively. Deer forest (a misleading term since most are only sparsely wooded) is so classified for taxation purposes. Most of Scotland is rough grazing and of this about one-fifth is deer forest. There are smaller numbers of other species of deer such as fallow, sika and roe, mostly accommodated in private forests. But the deer managed as a national resource are confined to red deer in the Highlands.

Land in Scotland over which red deer range: approximately seven million acres.
How many sportsmen pursue these and what is the kill?

The kill is about 15,000 head per year. I can’t give a figure for deer shooters alone, but there are about 50,000 game licences for deer, grouse and pheasants. My guess would be under 10,000. Since the post-war period Germans, French, other Europeans and latterly North Americans are seeking access to the deer forests. Shoots are advertised and these are bid for or alternatively private arrangements are made. As in New Zealand, there is also a valuable market for venison.

The profit motive is far more advanced in your country. Game shooting and fishing in New Zealand are considered a right of the individual and this has been protected by the provision of public lands.

The difference is the result of population pressure. For example, less than half a million people in the South Island compared with five million in Scotland, or fifty five million in Great Britain.

Probably our concepts will change in the same direction as yours.

Yes, although the situation will never be comparable since you have a much greater resource for outdoor sport. But it is important you should evaluate land capacity for recreation, assessing which are the areas suitable for different kinds. It is all too easy, as we have found to our cost, to leave things until problems have arisen. I am told there is a considerable build up of recreational use, even in the areas accessible from Christchurch, and this needs looking at before the problems become acute. It may be that farmers and runholders can provide a solution in extending recreational facilities to the public. I would recommend that you should have an over-view of the recreational demands and resources in New Zealand, even at this early stage.

Summary of Lincoln Research Findings For Deer

In May, 1972 Professor I. E. Coop of the Animal Science Department, Lincoln College, assisted by Mr R. Lamming, manager of the College research farm, announced the findings related to red deer raised in captivity, after almost four years of study. The original animals were provided by the New
Zealand Game Exporters Association in July, 1968. The association also met the cost of fencing the five acre, ryegrass/white clover compound allocated for the project.

The herd wintered in 1968 comprised 12 head and in 1971, 25 head. This performance required occasional irrigation and the purchase of small quantities of hay (about four bales per head). However, Professor Coop maintains that in a drought-free year, five head per acre can be carried without irrigation or hay purchases. In autumn 1972 the herd stood at 38 head on the five acres, representing 13 surplus head that could not be wintered on the small compound.

The main points are:

1. It is possible to produce 140 lb of venison per acre, the same quantity as for beef or lamb.

2. The premium for venison, the income from skins and other by-products indicate that commercial deer farming is viable.

3. Reproduction rate would be at least equal to that of cattle under similar management. There was no difficulty of getting yearling hinds in-calf.

4. Survival rate was good. One hind died of natural causes and one stag died from being tranquillised.

5. Liveweights were: three-year-old stags 400 lb; yearling stags 200-250 lb; four-year-old hinds 250 lb; two-year-old hinds 200 lb; yearling hinds 150-200 lb.

6. The stocking rate at these liveweights was 800 lb per acre or five head per acre.

7. Birthweight 20 lb, average growth rate for pearlings, \( \frac{1}{2} \) lb per day.

8. Growth rates from high nutritive feeds: .75 lb per day on sheep nuts (Lincoln); .8 lb per day on concentrates and high-quality dried grass after weaning (Rowett Research Institute). Conversion efficiency for stags, less than 3 lb dry matter per 1 lb of gain, approaches conversion rate for pigs (Rowett Research Institute).

9. Subsequent flavour and palatability trials comparing wild venison and venison from deer off improved pasture were inconclusive.
A Review of Soil Conservation in New Zealand

J. T. Hogg
Rangitikei Catchment Board, Marton.

A paper presented to the 1971 Conference of the New Zealand Institute of Agricultural Science (Inc.), Lincoln College, on behalf of the New Zealand Association of Soil Conservators

In the forties the outlook for unploughable hills in both Islands appeared to be bleak. In the South the depletive practice of burning of tussock land, plus overgrazing, compounded by periodic explosions in the rabbit population, set the scene for severe erosion problems, while in the North, the fertility generated by the burning of the forests at the turn of the century had been dissipated, reversion to second growth manuka was increasing, erosion was widespread, and carrying capacities were declining.

Though 1941 saw the official birth of soil conservation in this country, it had very little impact on the rural scene for the next decade.

Initial progress was slow because it was difficult to recruit staff into a new uncertain profession, and the small number of soil conservators in the field had to develop a whole range of techniques for their particular districts, usually working in isolation. Overseas literature was of little assistance, apart from providing the first principles of conservation. At first catchment authorities were far more interested in the more spectacular river and drainage schemes and were most chary of soil conservation generally. Worst of all, because the Soil Conservation and Rivers Control Act 1941 contained very powerful and far reaching land use clauses, owners suspected that catchment authorities were seeking to take over the management of their properties, and this prejudice was most difficult to overcome.

At the outset many conservators fell into the trap of attempting treatment of the most spectacular and well known erosion problems in their districts, and in many cases the results were disastrous. However, as techniques were developed, and a few farmers adopted the new methods, the movement gradually gained impetus.
Incentives

The successful implementation of a soil conservation policy depends on the willingness of the landowners to co-operate, and on the willingness of the nation to provide incentives for the landowner to do work, or manage his farm for the national good, as well as his own benefit.

The 1941 Act empowered the making of grants or loans to encourage conservation practices, and a system of cost sharing of work between the Government and the landowner, has provided the incentives required and resulted in implementation control practices, some of which were formerly unattractive to farmers.

The justification for cost sharing is that the complete cost of repairing the erosion problems accumulated since initial development of the land, together with the prevention of future problems, would be an unfair charge on the present occupier and may also be too expensive for one generation to bear. Many conservation practices are essentially long term in the development of their effect, so it is reasonable to spread this cost, as eventually the nation receives the main benefit.

Because conservation in New Zealand is based mainly on the biotic aids of grass and trees, some difficulty has been experienced by the Soil Conservation Council, particularly in the South Island tussock lands, in separating conservation from good farming practice, and deciding on fair cost-sharing. The expenditure of public moneys on land from which individuals receive benefits, is always subject to criticism, but when the boundaries are as ill defined as in some of these cases, the administrator is in real difficulties. Safeguards necessary to ensure rightful expenditure of government finance have resulted in the development of a somewhat involved system of subsidy approval.

Tools and Techniques

The following main tools and techniques have been developed after periods of trial and error.

(a) The Aeroplane

In 1947, the Soil Council financed a series of aerial sowing and topdressing trials under the direction of the late D. A. Campbell. The success of this early work has now gone into Agricultural history. Development of an efficient means
A section of the 8000 acre Wither Hills Catchment control scheme where up to 45 percent of the land suffers tunnel gully and sheet erosion. The problem was originally induced by rabbits and burning which bared the hills of silver tussock. Surface cracks developed during droughts and with subsequent rain the tunnels formed. Some success in control has been achieved by bulldozing, contouring and oversowing.

(Photo: W. F. Rennie — D.S.I.R.).
of applying fertiliser and seed to hitherto inaccessible hill country transformed the declining production into a tremendous upsurge in only a few years.

The resultant increases in pasture density have facilitated weed control, brought about a reduction in the incidence of sheet erosion, and promoted the rapid healing of slips on steep hill country.

To date cost-shared oversowing and initial topdressing totals 135,000 acres.

Soil conservators have been closely identified with the development of aircraft for other uses such as supply dropping for hill country fencing and the distribution of trees and poles onto otherwise inaccessible sites.

(b) **Fencing**

Fencing has been widely used in erosion control and a total of 3,568 miles have been built for seven different categories of cost sharing. These include strategic siting of fences in order to separate eroding land from other classes of hill country so that differential management may be carried out to restore the damaged land, the strengthening of existing sheep fences to encourage the use of cattle on tussock land to reduce the need for burning and to relieve the more severe sheep grazing pressures, and the retirement of steep eroded mountain land to permit de-stocking. Under this imaginative scheme provision is made for the improvement of stable land elsewhere to carry a number of stock, equivalent to those withdrawn from the retired class VIII land. Retired land to date totals 393,000 acres while temporary spelling has been carried out on 15,000 acres.

The high cost of fencing has been a major inhibiting factor in erosion control, and until a few years ago there was little effort being made to reduce fencing costs, apart from the development of electric fencing, which at that time had a number of unsatisfactory features.

The District Soil Conservator at Palmerston North, Mr H. C. H. Pearse, has been responsible for introducing various types of cheaper and more easily erected permanent fencing. Ultimately this will bring about considerable savings to the agricultural industry as a whole, as well as reducing conservation fencing costs.

(c) **Grazing Management**

Grazing management is closely associated with the treatment of various forms of soil erosion.
A basic problem has been to effect a treatment without reducing the farmer’s income. The form of grazing most suited to conservation requirements has proved to be mob stocking. Trials on the Soil Council’s hill country experimental property at Waerenga-o-kuri, Gisborne, compared mob stocking with set stocking of sheep and it was found that mob stocking was superior in carrying capacity, wool production, lambing percentage and meat weights. Wear in sheep’s teeth was much less with this form of grazing.

Conservation-wise, under mob stocking, it is considered that land is less vulnerable to sheet erosion and probably less damage to open spaced tree planting occurs.

Modified forms of mob stocking are widely used in North Island hill country and are becoming more common in improved grasslands in the South.

(d) Tree Planting

In North Island tree planting forms the main conservation work. Where fencing of severely eroding gullies has been undertaken, a high degree of success has been achieved.

However, on much of North Island hill country, erosion is an extensive problem and it was found necessary to develop planting techniques in the presence of the grazing animal. This has been achieved by the planting of long poles or setts of various willows and poplar species. Through the work of the Plant Materials Centre at Palmerston North under Mr C. W. S. Van Kraayenoord, selection of vigorous hybrids have given trees which are infinitely superior to the common species previously used. The new species may, under some circumstances, have the dual role of conservation and timber production.

Cheap, effective protection of these trees from cattle has proved to be a surprisingly difficult problem to overcome. However, W. R. Edwards has developed a technique of fitting plastic mesh stockings to the poles and these now enable planting to be successfully undertaken in the presence of cattle. Hitherto, it has been necessary to modify cattle management considerably to permit establishment of poles.

Schemes to date have included the establishment of nearly 10 million trees close planted on 9000 acres and 2.4 million planted in the presence of stock over a total of 20,000 acres. In addition, many miles of paired planting of gullies also have been completed.
Windbreaks, to protect light arable land, have been established in critical areas through both Islands and total in excess of 500 miles.

(e) Construction Works

Sixteen major types of construction works have been developed and include a wide range of gully structures, of which 5,400 have been built, and contour works including graded banking, terracing and grassed waterways—a total of 824 miles. Strategic firebreaks amount to 1100 miles.

*Flood detention dams of which 71 have been constructed have given spectacular results in the control of eroding gullies.*

(f) Land Use Capability Mapping

*Land Use Capability mapping for water and soil conservation purposes has been carried out over 29.6 million acres and this includes most of the critical South Island high country.*

Implementation

Conservation practices are so closely identified with and dependent upon farm management and farm practices, that it was necessary to look at the overall problems of the farm. Soil conservators were among the first in this field of the *whole farm* approach. The need to integrate various facets of management and conservation resulted in the *soil and water conservation plan* and it is through this that soil conservation work is predominantly implemented.

Plans are usually prepared in five year stages but can be later modified to take account of unforeseen factors.

Nine hundred farm plans have been prepared plus 600 erosion-control schemes over a total of five million acres.

The fact that catchment authorities have a large backlog of applications for soil and water schemes indicates the degree of success that this form of planning has achieved in the normally conservative farming community.

This "whole look" concept has been extended also to catchment control schemes of which there are 23 over nearly a million acres and four regional schemes over 3 million acres.

Expenditure

In the early fifties, about $50,000 per year was the Government's cost-shared contribution to soil conservation and this rose only slowly over the next decade, but increased five fold during the affluent early sixties to $550,000 in 1967. Though there
was a reduction in the recession years 1967-68 the growth rate has again resumed at the same rate as the early 1960s. Government expenditure of $589,000 last financial year would be matched by a similar amount as the unsubsidised share by land owners. Therefore, the direct current expenditure on cost-shared conservation works would amount to about $1.2 million annually. A much larger amount (perhaps ten times) is expended on some types of development work which has a conservation value, though it is not recognised for subsidy purposes. Pasture improvement would be in this category.

Rate of Progress

In 1961 a target was set to complete the treatment of known erosion control within a fifty year period. A review after the first decade based on the number of farm plans prepared showed that the rate of progress actually achieved has been a disappointing 25 percent of the desired rate. It is apparent that if a faster rate of work is to be achieved incentives must be improved and servicing facilities increased. The present rate of cost sharing appears to be somewhat lower in New Zealand than in comparable Australian states, or the U.S.A.

Working parties set up by the Soil Conservation Council have been considering the slow rate of progress compared with other aspects of the Council’s activities, and recommendations to accelerate conservation works can be expected shortly.

Organisation and Staff

The Water and Soil Division of the Ministry of Works is the Government agency responsible for preparing policy, administering cost-sharing schemes and for research. Seventeen catchment authorities throughout New Zealand have the responsibility of implementing river control and soil conservation and under the 1967 Act, control of water quality has been added to their functions.

A total of 69 professional staff and 55 technical assistants are engaged in conservation—half being employed by Water and Soil Division, Ministry of Works, the remainder by catchment authorities.

A recent survey indicates that a 60 percent increase in staff establishment could be utilised.
Above and below: Porewa Valley Control Scheme, Marton. A flood detention dam used to control down-valley flooding and erosion.

(Photo: D. S. Spence).
Appleby, Nelson. On this experimental orchard graded banks were used to decrease runoff. (Photo: Water and Soil Division, Ministry of Works).

Other agencies dealing with specialised aspects of soil conservation include the Tussock Grasslands and Mountain Lands Institute which was set up in 1961 to deal with high country farming problems and the Forest and Range Experiment Station of the New Zealand Forest Service which investigates the erosion problems of unfarmed mountain lands.

Future Trends

To date, emphasis has been concentrated on single farm-plan schemes. Although catchment authorities recognise the value of the overall catchment control schemes, there has been considerable difficulties in launching these due to the involved rating and loan poll procedures. In the future, although farm plans must continue to be the main vehicle for soil conservation implementation there will be an increasing emphasis placed on catchment or sub-catchment planning, this being necessary not only because of efficiency but because of political considerations.
Graded banks under cropping on S.C.R.C.C. Adair Experimental Farm, managed by Ministry of Works. Trials are aimed at moisture conservation for better crop yields and control of sheet and rill erosion under cropping. Cereal crops sod-seeded on chemically defoliated surfaces may yield as well as those on ploughed surfaces.

(Photo: Water and Soil Division, Ministry of Works).

Already there has been some criticism of subsidies paid to private individuals particularly with the techniques where it has been difficult to differentiate between conservation and production, and it is believed that this criticism is likely to escalate in the future. Therefore emphasis must be given to schemes which benefit the nation or the local community rather than those which highlight the benefits to individual farmers.

One of the main tenets for future survival of agriculture in this country is obviously more production per acre. With the present fattening country—the flats and the rolling land—being increasingly used for cash cropping or urbanisation, and hill country being required for fattening, farming frontiers will be pushed onto increasingly inhospitable and unsuitable land, and more risky land usage will result. Therefore, not only must more emphasis be placed on using each acre according to its capability but there must also be an increasing emphasis on the protection and preservation of the land.
As development increases, erosion problems which formerly received scant attention, will require an increasing degree of treatment. Already this is showing up in some areas. For example in the Rangitikei Catchment District, the Taihape farms are about half the size of those over the whole catchment district. Although the soil erosion problem is much less severe than in other parts of the district the average amount per acre spent on soil conservation is twice that in other areas, indicating that increased development brings to light the need for increased protection.

So far our main soil conservation effort has been directed to steep hills. As cash cropping increases more attention must be given to protection of easy sloping land by the use of contour structures and perhaps the development of contour cultivation and cropping.

I suspect, that nationally, the dominant type of erosion is sheet wash. This is certainly so regarding the quality of soil lost and also probably the quantity. We have not yet solved this problem although strong and dense pastures will reduce this soil loss. Because it is not obvious to the average farmer there has not been a great demand for sheet erosion control.

Despite wide publicity given to industrial pollutants in New Zealand, the pollution of our natural waters by soil and nutrient loss from farming land, at this point in time, would far outweigh human and industrial pollution, and an increasing regard to the erosion factor affecting water quality is required.

ONE ASPECT OF INDIRECT SOIL CONSERVATION MUST BE GIVEN A MUCH CLOSER SCRUTINY IN THE NEAR FUTURE. OF THE 3.3 MILLION ACRES OF FIRST CLASS FLAT LAND IN NEW ZEALAND ABOUT 15 PERCENT, OR 500,000 ACRES, IS OCCUPIED BY TOWNS AND CITIES. TO DATE THERE SEEMS TO BE VERY LITTLE EFFORT TO CHANNEL URBAN DEVELOPMENT ON TO LAND WHICH IS UNSUITABLE FOR AGRICULTURE. ALTHOUGH THE TOWN AND COUNTRY PLANNING ACT PROVIDES FOR LAND PLANNING IN ITS WIDER SENSE, VERY FEW LOCAL AUTHORITIES HAVE INVOKED THIS PART OF THIS LEGISLATION. MUCH MORE ACTIVITY IN THIS DIRECTION MUST BE UNDERTAKEN IN THE NEAR FUTURE BEFORE, UNDER URBAN DEVELOPMENT, IN THE WORDS OF MR E. R. MACKILLOP, A FORMER CHAIRMAN OF SOIL CONSERVATION AND RIVERS CONTROL COUNCIL “THE LAND IS CONSERVED FOR EVER”.

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Similarly, more attention must be paid to wise rural land use and zoning it within its capability. This will be undoubtedly considered a drastic step but our land resources are definitely limited and guidelines must be set so that land may be used to the best advantage of the nation and remain in good heart for succeeding generations.

In some aspects of soil conservation research, notably the development of tree species, there has been good progress, but in other areas progress has been limited. It has been necessary to endeavour to upgrade the nutrient status of hill country to sustain high fertility demanding grass species. What is required is development of a species which will have a wide habitat and will provide dense cover and high production in the medium to low fertility hill country soils.

Much more attention must be paid to multiple land and water use. As an illustration of this, it is considered that the use of detention dams for flood control will increase, and there is scope for incorporating facilities for aquatic recreation into these projects as has been done in the Taylor Dam near Blenheim.

Although opportunity for diversification on hill country is limited, various forms of forestry appear to offer the best possibility. For example the spaced planting of a few poplars per acre in sheltered parts of hill country could realise an income equivalent to an extra two sheep per acre. Other forms of forestry require investigation.

Increases in pasture production on hill country have been achieved by the use of vigorous clovers, but generally inferior grasses. There is sufficient technical knowledge available to bring an increase in hill country carrying capacity, similar to that of the last 20 years. As this occurs there will be an increase in gully erosion and probably slipping on some soil types.

It has taken between two and three decades to develop satisfactory conservation techniques, but soil conservators are confident that they will be able to cope with the conservation problems brought about by the next stage of hill country development.

Acknowledgments

The author wishes to thank Messrs E. H. H. Kelman and A. T. Warrington of Water and Soil Division, Ministry of Works, Wellington, for their assistance in the preparation of this paper.

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High-Country Hogget Management (3)

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Hogget management from weaning until the end of winter was discussed in Review 21 and 22 from data collected in a survey of several North Otago runs. It was shown that success depends on holding liveweight during winter, and that different stresses checked growth. Factors contributing to good growth rates were early weaning, maintaining a supply of quality feed, especially legumes, not changing the type of feed, and regular worm drenching.

Hoggets did not grow in the 1970 winter no matter what type of supplement was fed. It was suggested that growth was limited by stress from cold temperatures at the feeding site or from the method of feeding the supplement. Wintering on warm, improved tussock blocks was recommended. Of the supplementary feeds tried, turnips were the cheapest and gave satisfactory growth when hoggets were locked on a break.

The hogget survey has been continued and records taken of liveweight changes and two-tooth lambing performances.

Spring Liveweights

Many different weighings have shown that hoggets can be expected to lose liveweight in winter, thus hogget liveweight in August is often similar to their liveweight in May. Table 1 shows records from two consecutive winters.
TABLE 1 Hogget liveweight changes recorded in some North Otago high country flocks in two winters.

<table>
<thead>
<tr>
<th>Flock</th>
<th>Winter Feed</th>
<th>Liveweights 1970</th>
<th>Liveweights 1971</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>May kg</td>
<td>Aug. kg</td>
</tr>
<tr>
<td>(1)</td>
<td>Merino</td>
<td>Turnips</td>
<td>29.0</td>
</tr>
<tr>
<td>(2)</td>
<td>Merino</td>
<td>No Supplement</td>
<td>27.0</td>
</tr>
<tr>
<td>(4)</td>
<td>Corriedale</td>
<td>No Supplement</td>
<td>32.0</td>
</tr>
<tr>
<td>(5)</td>
<td>Halfbred</td>
<td>No Supplement</td>
<td>33.0</td>
</tr>
<tr>
<td>(6)</td>
<td>Halfbred</td>
<td>Grain and Hay</td>
<td>26.0</td>
</tr>
<tr>
<td>(8)</td>
<td>Corriedale2</td>
<td>Hay</td>
<td>36.0</td>
</tr>
</tbody>
</table>

1These are the same flocks as described by Thompson 1971(2)
2This is a new flock, not reported in previous articles.

In 1970 there was an overall liveweight loss in all flocks. The winter of 1971 was exceptionally mild and slight gains were recorded in all flocks.

Even with good supplements in the mild 1970 winter the hoggets did not grow which suggests that careful management and removal of all stress is as important as the amount and quality of feed. Although it is possible for hoggets to grow during winter I consider it uneconomic to achieve winter weight gains by feeding large quantities of supplementary feed.

For each flock there is similarity in the average spring liveweights between the seasons. The difference between runs may largely be due to the rate of growth that the hoggets achieved after weaning.

Spring and Summer Gains

For good lambing percentages two-tooths need to be of a high liveweight at tupping. A probable optimum liveweight for Merinos, Halfbreds, Corriedales, Perendales and Romneys on high country is about 50 kg or 110 lb at tupping. A threshold weight of this order should give a 95-100 percent lambing. Present data suggests that to obtain satisfactory lambing the hoggets need to be 35 kg at the end of winter and gain about 15 kg over the summer.

In all flocks under survey the summer gains (table 2) were 12-15 kg which is satisfactory. But in many flocks liveweights were low at the end of winter and there is no possibility of these hoggets reaching the optimum 50 kg for mating.
TABLE 3 Tipping Liveweights and two-tooths and mixed aged ewes, May, 1971

<table>
<thead>
<tr>
<th>Flock</th>
<th>Spring Liveweight</th>
<th>Two-tooth Liveweight</th>
<th>Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>August (kg)</td>
<td>May (kg)</td>
<td></td>
</tr>
<tr>
<td>(1) Merino</td>
<td>27.0</td>
<td>38.0</td>
<td>11.0</td>
</tr>
<tr>
<td>(2) Merino</td>
<td>23.5</td>
<td>36.0</td>
<td>12.5</td>
</tr>
<tr>
<td>(4) Corriedale</td>
<td>30.0</td>
<td>43.0</td>
<td>13.0</td>
</tr>
<tr>
<td>(5) Halfbred</td>
<td>30.0</td>
<td>43.0</td>
<td>13.0</td>
</tr>
<tr>
<td>(6) Halfbred</td>
<td>24.0</td>
<td>39.0</td>
<td>15.0</td>
</tr>
<tr>
<td>(8) Corriedale</td>
<td>37.5</td>
<td>54.5</td>
<td>17.0</td>
</tr>
</tbody>
</table>

Flocks (1), (2), (4), (5), (6) recorded in the 1970-71 season. Flock (8) recorded in the 1971-72 season.

These runs were all typical of the high country with the hoggets run on improved tussock from shearing to mating. No single management factor emerged to suggest a change from this system. However, it is obvious that the success in having high liveweight two-tooths lies in growing them more quickly from weaning.

Weighings of rising two-tooths over the summer showed that most of the gain was made from August to February with very little weight added in the autumn.

In some flocks the hoggets received a check. One period which caused problems was immediately after shearing. Hoggets in one flock lost 7lb over the two weeks after shearing then took a further three weeks to recover. Checks such as this should be avoided if possible although in many cases they are due to an unseasonal shortage of feed. Hogget shearing should coincide with the spring flush so that the extra feed demands are satisfied and the hoggets grow unchecked.

Time of shearing and blades versus machines have been briefly compared. Overall, blade shearing in September appeared as satisfactory as machine shearing or later shearing.

Hoggets sometimes suffer a check when turned onto improved tussock blocks after winter feeding. Thus studies are being undertaken at Tara Hills High Country Research Station.
to determine suitable management to prevent this. Although these checks are undesirable they are usually temporary and hoggets grazing improved tussock blocks can make satisfactory liveweight gains over the summer to mate at 50 kg. However, this is dependent on a 30-35 kg liveweight at the end of winter.

Mating to Lambing

Ewe liveweight at mating will determine the fertility level of the ewe flock. In a study of four high country flocks Coop and Clarke (1966) showed an increase in barrenness with decreasing ewe liveweight at mating. They also showed that two-tooth ewes do not get heavier in subsequent years, that the liveweight of the two-tooths at mating determines their average lifetime weight.

In our present survey two-tooth and adult ewe liveweights were measured at tupping in 1971 and are shown in Table 3.

<table>
<thead>
<tr>
<th>Flock</th>
<th>Two-tooth Liveweight</th>
<th>Adult Ewe Liveweight</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Merino</td>
<td>38 kg</td>
<td>44 kg</td>
</tr>
<tr>
<td>(2) Merino</td>
<td>36 kg</td>
<td>37 kg</td>
</tr>
<tr>
<td>(4) Corriedale</td>
<td>43 kg</td>
<td>48 kg</td>
</tr>
<tr>
<td>(5) Halfbred</td>
<td>43 kg</td>
<td>49 kg</td>
</tr>
<tr>
<td>(6) Halfbred</td>
<td>39 kg</td>
<td>39 kg</td>
</tr>
</tbody>
</table>

In some flocks the adult ewes are up to 6 kg heavier than the two-tooths but these flocks are on stations where there is easier country with considerable development. On these runs with limited areas of improved tussock two-tooths were of similar liveweight to adult ewes.

Mating Management: Ram Ratios

Most runholders traditionally use one ram to 30 ewes. With the two-tooths being recorded 1 ram to 50 or 60 ewes were used. All rams were inspected before use, especially for malformed testicles. An external palpation for differences in size, or swelling on the testicles, frequently shows rams that are likely to be infertile. In some high country flocks I found up to 30 per cent of the rams to be abnormal.

Tupping harnesses were used in some flocks and pregnancy diagnoses were used in other flocks. In all flocks 95 per cent of two-tooths were mated in seven weeks.
Management of ewes at mating has been studied by Allison and Davis (1972). Their recommendations are:

(a) Two-tooth ewes should be given preferential management at mating time. Higher ram/ewe ratios than those required for older ewes are necessary and intensive mating conditions are desirable. Under these conditions the proportion of barren two-tooths is likely to be extremely low.

(b) A ram/ewe ratio of 1:100 has given quite satisfactory results with mixed-age ewes. This ratio is inadequate for two-tooths due to differences in the mating behaviour of two-tooths.

Pre-tup Ewe Drenching

Pre-tup ewe drenching has caused considerable interest and conjecture. A study was conducted during the 1971 lambing to see if responses could be achieved. One problem with this type of investigation is the large number of ewes required to measure a significant response in lambing percentages. Therefore several North Otago farms were used of which three were in high country.

In this study a group of ewes on each farm was drenched with Thiabendazole just prior to mating. All ewes were mated and wintered together. Drenched ewes were separated before lambing and lambed on a separate block, the mob size being determined by the carrying capacity of the lambing block.

Responses are shown in Table 4. These ranged from a depression to an impressive 19 per cent increase. In interpreting the results from Table 4 performance of the drenched and undrenched groups need to be compared with the main mob.

<table>
<thead>
<tr>
<th>TABLE 4 Tailing and weaning percentages for ewes in three high-country flocks. Ewes pre-tup drenched with Thiabendazole prior to mating. All ewes were wintered on improved tussock.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Corriedales Control Drenched All Undrenched Ewes</td>
</tr>
<tr>
<td>Number of Ewes to Ram 625 705 1,031</td>
</tr>
<tr>
<td>Weaning % 111% 118% 110%</td>
</tr>
<tr>
<td>(b) Halfbred Control Drenched All Drenched Ewes</td>
</tr>
<tr>
<td>Number of Ewes to Ram 310 308 1,256</td>
</tr>
<tr>
<td>Tailing % 122% 143% 137%</td>
</tr>
<tr>
<td>(c) Halfbred Control Drenched All Undrenched Ewes</td>
</tr>
<tr>
<td>Number of Ewes to Ram 246 148</td>
</tr>
<tr>
<td>Tailing % 101% 92% 96%</td>
</tr>
</tbody>
</table>

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A review of all the national trials involving 18,000 ewes shows there is on average a five per cent lambing response to pre-tup drenching although the range is from a 20 per cent increase to a 4 per cent depression. In over 70 per cent of the trials a worthwhile response was shown. Further work will clarify the conditions that lead to reliable response. Until these results are available farmers can be recommended to pre-tup drench their ewes. Although only Thiabendazole was used in this work experiments are being conducted with other drenches as well.

**Lambing Losses**

The final part of the hogget survey was to look at two-tooth fertility. In one flock all two-tooths were weighed at tupping. Pregnancy was diagnosed with an ultrasonic technique described by Allison (1971). Lamb losses were evaluated by classifying ewes as wet or dry by udder inspection at lamb marking.

A 79.9 per cent lambing was recorded in this flock, 14.4 per cent were lost-lamb and 5.7 per cent dry.

**TABLE 5** Fertility of two-tooth ewes in a high-country Halfbred flock.

<table>
<thead>
<tr>
<th></th>
<th>No. of Ewes</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pregnant and lambed</td>
<td>404</td>
<td>79.9</td>
</tr>
<tr>
<td>Pregnant and Lost Lamb</td>
<td>73</td>
<td>14.4</td>
</tr>
<tr>
<td>Dry</td>
<td>29</td>
<td>5.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>506</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

The dries probably were never mated or possibly were not cycling. Since the two-tooths were tupped on a 200 acre tussock block this number of dries is probably normal. The 14.4 per cent of lambs lost at about lambing time is frequently normal on high country and even on low country losses of 10-15 per cent also occur. In the high country many runholders claim they do not want twins and must therefore accept these losses which contribute to lower lambing percentages. On the other hand some runholders are already achieving 100 per cent lambing which requires that about 25 per cent of the ewes have twins.
Well grown sheep which are fed liberal hay during winter. This flock on Braemar Station approach lambing in forward condition.
Summary

Some high country flocks are today being carried on increasing areas of improved pasture and liveweights of both hoggets and ewes are tending to increase — with consequent better fertility than in the past.

Hoggets on high country need to weigh 35 kg by the end of winter to reach an optimum 50 kg by mating. This can be achieved with good management from weaning to winter. Winter feed should be a maintenance ration supplied at minimum cost. Careful flock management to prevent checks in growth will ensure high liveweight two-tooths. Mating management is important and indications are that pre-tup drenching can improve lambing percentages.

With a one ewe one lamb philosophy only an 80 per cent lambing can be expected. However, a 100 per cent lambing is possible and should be aimed for where increased profitability from lamb sales or where increased selectivity for flock improvement or larger flocks are desired.

Acknowledgements

The co-operation of several runholders has assisted in the collection of data for this survey. In particular I thank the managers and staff of Benmore, Ribbonwood, Omarama, Otekaieke and Mt. Dasher stations.

References


The following article presents the interesting discovery that small scale forestry is often more efficient than large scale forestry a matter of significance for private investors especially local bodies, trusts, corporations and companies. The point is relevant to the farm forester who faces alone the risk of fire, a long wait for the return and above all is limited by the years he is able to devote to forestry. — Ed.
Forest size and the scale of operations can influence many aspects of forestry. It can have a significant influence on both direct and indirect costs, and can be an important consideration in the availability and quality of labour, in the susceptibility and control of forest diseases, in the prevention and suppression of forest fires and in managerial flexibility. All of these aspects can be important in determining forest profitability.

Direct Costs

In theory large forest and/or large scale operations should have the lowest direct costs. The possibilities for increasing efficiency through rationalisation, mechanisation, method development, labour specialisation etc. are greater with large scale than with small scale forestry. There should also be advantages of competition and better management. This should result in lower direct costs for the large scale forests. In practice, however, there is little evidence that the potential advantages of large scale forestry have been realised.

A limited and unpublished study (J. O. Drewitt pers. comm.) of direct costs for silvicultural operations in New Zealand failed to demonstrate any obvious trend towards lower costs with either the larger forests or the large scale operations. Other factors, such as site, working conditions, labour and management quality were as important, if not more so.

Land clearing costs in New Zealand are very variable but there are some indications that direct costs are lower when the scale of operations is large enough to allow machinery to work near its capacity (Chavasse, 1969).
Cost studies on New Zealand logging and harvesting (Terlesk, 1972) have also failed to show any obvious advantages of scale: work method, and to a lesser extent piece size, topography etc. are more important than scale. Indeed, some small scale contractors have been able to achieve average man-day and machine productions (at correspondingly lower costs) up to 50 percent better than have the State or large private companies in comparable work. Fenton (1970a) has shown, at least for the State operations, that radiata pine clearfelling average manhour productions have remained virtually constant in the 8-year period 1961-68.

One observation common to all the above studies was that while large scale operations may not have had the lowest costs they are almost certainly not likely to have the highest. Increasing the scale of operation appears to be more important in preventing high costs than in ensuring low ones.

Overseas studies are rare. Jarrold and Griffin (1966) in a study of establishment costs on private forests in Great Britain showed that there was "... little decrease in cost with increase in (forest) size". They found, as in New Zealand, that other factors such as site, etc. were equally important in determining costs.

In a Swedish study (Streyffert 1957) claimed that the possibilities for increasing efficiency are greater for the large than the small forestry enterprise but the small enterprise may also raise its efficiency through some form of co-operation. However, no actual values are given.

The New Zealand experience suggests that large scale forests or large scale operations do not of their own accord ensure lowest costs. Indeed, it appears that there is considerable reluctance among the large operators to either improve efficiency or reduce costs.

In early 1969, Kaingaroa’s work study officer, C. J. Terlesk, published details of the ladder and jack-saw method of pruning which had been introduced by contractors two years earlier. This improved method reduced the costs of the 8-14 ft pruning lift by 30-40 per cent over current methods. By 1970 only the smallest Forest Service conservancy (Westland) and one of the smaller private companies had formally adopted the new method as standard practice — although Southland Conservancy was using it in conjunction with conventional pole saws.
(James et al. 1970). Even now (1972) the method is not universal even at Kaingaroa Forest and is not used on neighbouring forests such as Rotoehu or Whakarewarewa.

Rogers (1970) in a discussion of the problems of implementing the new method claimed that the introduction was more difficult in wage gangs than with contractors.

A study of Soviet logging enterprises (Ramanov, 1966) showed that increasing labour productivity offered much more scope for reducing costs than increasing the size of the enterprise.

Better management, methods studies and competition would therefore appear to be a much more sure means of reducing costs than increasing the scale of operations. Within an organisation this could be achieved by placing much less emphasis on the physical aspects (men employed; areas planted, volumes extracted, etc.), and much more on the actual costs of operations when assessing staff for promotion, the allocating of finance, etc. As indicated by the experience cited above in logging and pruning, lowest costs are likely to be achieved by using contractors where possible, and by encouraging and rewarding men and their managers for the development and improvement of new methods.

Indirect Costs

This covers all those costs which cannot be directly allocated to a specific area or operation; viz. the costs of all general administration, fire prevention, social services (e.g. housing, work camps), repairs and maintenance (e.g. roads, bridges, buildings etc.), capital costs of all buildings and depreciation, and external overheads. Since many of these services must be provided irrespective of how much they are used it should be expected that there are economies of scale. Also the larger forest should allow greater specialisation and this should also reduce unit costs.

In a study of my own (Sutton, 1969) of the major non-capital costs (general administration, camps and hostels, fire protection, repairs and maintenance) of New Zealand State exotic forests I found that although there was some variation resulting from the level of activity on the forest there was an obvious trend towards lower unit costs on the larger forests.
If the costs for Kaingaroa Forest (New Zealand's largest at 300,000 acres approximately) expressed as an annual cost in dollars per acre per annum are taken as a base, then as a general rule the unit costs for forests in the 10-20,000 acre range are just over double, and those in 1-2,000 acre range quintuple, those for Kaingaroa. Similar trends almost certainly exist for the other indirect costs — mainly capital costs (e.g. buildings, roads, vehicles) and their depreciation — but no detailed analysis is available.

Above average unit costs (in dollars per acre per year) for Kaingoroa (based on costs for 1962-1964) of those overhead costs studied were: general administration $0.60, camps and hostels $0.20, fire protection $0.20, repairs and maintenance $0.40, a total of $1.40. On a 10-20,000 acre State forest these costs were about $3.00 and on a 1-2,000 acre State forest about $7.00 per acre per year. If these costs are capitalised at 5 per cent compound interest this is equivalent to $28 per acre for Kaingaroa, $60 per acre for a 10-20,000 acre forest and $140 per acre for a 1-2,000 acre forest.

Had the other indirect costs (e.g. capital cost of buildings and their depreciation) been included the magnitude of the difference would have been even greater.

The magnitude of the economies of scale for indirect costs is such that it is doubtful if small State forests (at least those under 10,000 acres) can be economically justified.

Indirect costs on private forests are not known but it would be reasonable to assume that for the large company forests these costs would be similar to those of the State — especially the on-forest overhead costs as discussed above.

Small company forests and independent operators should be able to avoid some of the overhead costs found in the State and large companies. With possibilities for more personal involvement there should be less need for a large administrative overhead.

Indeed, both the small forest owner and the independent contractor at the lower end of the operational scale appear to have definite advantages. Frost (1971) showed that, even with a 20 per cent loading on direct costs, the small private
forest grower in New Zealand would only incur about $\frac{3}{4}$ of the total growing costs which would be expected by the State or a large private company. Weber’s (1953) study of U.S.A. forest products firms showed that although the large operator may be more efficient his costs will be higher than the small operator as there are many overhead costs which the latter can avoid.

Other overseas studies tend to confirm the New Zealand observation. Cost studies in South Australia (Woods, 1965) on plantation maintenance costs showed a variation from $3.70 per acre per annum to over $10.00; most of the difference derived from forest size.

Sinden’s (1966) study of forest size in Wales demonstrated the importance to costs of maintaining regularity of operations. He suggested that this could be achieved by amalgamating small forests into larger management units with an estimated 2 per cent saving in overall expenditure.

I found one overseas reference which implied that there was an upper limit to forest size. A Russian comparison (Sudackov and Vitalev, 1967) of the management efficiency of 38 “forests” ranging from 150,000 acres to 250 million acres (an area four times the size of New Zealand!) showed that the optimum size should be 200-250,000 acres in the central and southern Siberia and 1 to 1.2 million acres in the north. On these standards and considering our growth rates Kaingaroa and N.Z. Forest Products Ltd. (both now around 300,000 acres) are somewhat too large.

Labour and Social Aspects

In principle an increase in forest size should benefit the labour and social aspects of forestry. Larger scale operations have greater scope for better management and for labour specialisation (which should improve efficiency and make the job more attractive). The larger the concern, the better should be the facilities which can be provided and supported in forest villages and townships.

Since in the past the greater part of the New Zealand forest labour has consisted “... of left-overs from the general labour pool” (Entrican, 1957), and as a consequence labour turnovers have been high (115-195 per cent — Fenton, 1969) there has been little scope for specialisation. Only with the introduction of incentive work and more lately contract work
have better workmen been employed. However desirable they may be, contactors are difficult to hold when the silvicultural operations on which they depend are generally one of the first expenditure items cut in periods of financial restraint.

Industrial unrest and strikes are rare in New Zealand State forests; the only official strike, at least since 1945, has occurred in our largest forest, Kaingaroa. The Kaingaroa unrest was interesting as it highlights a psychological aspect of labour which affects large organisations rather than small ones. The Forest Service wished to introduce a more efficient system of clearfelling, but this was not acceptable to the fellers.

Despite attempts at improvement many of the problems of the forestry village have not been solved. The problems have been fully documented elsewhere (Middleton and Jane, 1964; Chapman, 1966 etc. and fully discussed in Fenton, 1969).

They can be summarised:

"... the rural disadvantages of poor educational, religious, cultural, medical and commercial services".

"... the difficulty where a supervisor lives next door to an employee".

"... the wives and children have to bear the greater part of the social disadvantages".

"... limited number of job vacancies (for) teenage children" etc.

"... The inhabitants overwhelmingly depend (ent) on one industry".


In practice it is doubtful if there are any advantages to the large villages. Indeed, it is almost certainly better to do away with forest villages completely. Overhead costs are high and it is now almost always cheaper to transport men from a neighbouring town (Crainger, 1969). Such changes are likely to favour the small forest.

The problems of the forestry village are only one symptom of a much more important social problem in forestry. Since forestry tends to be largely a monolithic rural industry in which the ultimate employers are generally one government department or a few large companies (Fenton, 1969) there exist the dangers common to all large organisations "... viz over-centralisation and the suppression of initiative in the junior members of the service" (Hiley, 1930), or, as has been so ably

“And God created the Organisation and gave it dominion over man.”

In forestry the problem is compounded because of a general absence of any pressure to make operations efficient and profitable, and, because of the time scale involved, malpractices do not immediately affect the financial returns. These organisational problems are the more probable explanation for the non-realisation of many of the potential advantages of large scale forestry.

Pathological Considerations

As “... forest management has become more intensive, trees have been grown on large areas in even-aged stands” (Smith, 1970). This practice of large scale monoculture has in the past been generally condemned by overseas forest pathologists.

Smith continued “... If this type of growth pattern is not natural to the tree species, the situation becomes analogous to that extent in agriculture (where) ... much effort must be applied to avoid the occurrence of epidemics”.

Boyce (1961): “Pure stands are more susceptible to diseases ... an ideal situation for a pathogen to build up to epidemic proportions. The most hazardous pure stands are even-aged ... .”

Graham and Knight (1965): “... foresters tend to favour large-scale pure stand silviculture over practices that grow trees diversified (in) age and size classes. In the past this has led to encouraging pests ... that under primitive forest conditions were unknown”.

In particular reference to New Zealand de Gryse (1955) claimed that:

“... to ignore the notorious susceptibility of P. radiata to attack by insects and fungi, the extreme vulnerability of the extensive monocultures in which it occurs, or the astounding aggressiveness of radiata under New Zealand conditions, is tantamount to challenging all the laws of Nature ... .”

The underlying assumptions of the pathologists’ claim are that natural forests are generally a mixture not only of age classes but also of species and that these forests are less susceptible to disease and insect attack than artificially established
forests. The implications for management being: that large scale forests with a single species should be avoided; that mixtures are preferable to pure stands; and that within a forest areas of single age class should be kept as small as possible.

How well supported are these basic claims and to what extent should forest management heed the recommendations?

Contrary to general belief the natural forest habitats of most of the commercially important temperate zone softwoods (including the pines) are even-aged monocultures (Jones, 1945). Even the natural stands of radiata pine on the Californian coast are uniform with the pine dominant; although the region from which the New Zealand stands are considered to have largely originated (Ano Nuevo) the radiata pine sometimes occurs in mixture with Douglas fir (Forde, 1966; I. J. Thulin, pers. comm.).

Losses to pathogens in indigenous forests are considerable. Davidson and Buchanan (1964) estimated the total annual losses from forest tree diseases in the United States and Canada at 4.9 and 0.96 thousand million cubic feet respectively. This is equivalent to a half and a quarter respectively of the total annual cuts for these countries. All these losses were in indigenous forests. Nearer home the recently discovered New Zealand totara and West Australian jarrah deaths provide further demonstration that the natural forest environment is no guarantee of protection.

New Zealand experience with the introduced pathogens has only served to strengthen, rather than weaken the case for large scale monoculture. The introduced Sirex noctilio wood wasp did more to demonstrate the importance of timely silviculture than support a trend to species other than radiata pine — stem losses being generally confined to the lower dominance classes (Spurr, 1962; Jackson, 1955).

The introduction of the Dothistroma pini needle cast has shown that diversification with species of the same genus is no guarantee of protection — ponderosa and Corsican pines being more seriously affected than radiata.

The Douglas fir needle fungus (Phaeocryptopus gaeumannii) which has already seriously affected some stands has shown that our main alternative genera may be just as prone to attack as the major one.
From an economic viewpoint diversification can probably only be justified if the alternative species has similar growth rates. The only alternatives to radiata in New Zealand are some of the Eucalyptus species (but wood properties are not similar), or possibly some promising strains of the closely related Pinus muricata (but growth rates are slower).

Even a moderately intensive spraying programme to control Dothistroma pini on radiata has a relatively minor effect on the species' profitability. It is the equivalent of about 4 per cent of the total compounded growing costs (assuming 7 per cent compound interest (Fenton and Tustin, 1969) ). It certainly would not justify diversification to another less productive species. On the other hand Corsican and ponderosa pine are so marginal from an economic point of view that cost of spraying only adds to their undesirability.

Physical separation of forests has not effectively prevented the spread of any of the three major introduced pathogens, although it may have slowed down their rate of spread. There would seem little point, therefore, in restricting forest size simply on the grounds that it may slow down the rate of initial infection and attack. Experience with the introduction of Dothistroma pini in Kenya supports this view. Gilmour (1968) reported that although radiata plantings were generally in small blocks of 10-50 acres and scattered amongst the other exotic species and indigenous forests this did not prevent the spread of the disease. It did, however, prevent the introduction of an affective spraying control programme which has been so successful in New Zealand.

The lesson here is that blocks should be kept as large as possible so that control measures, if required, can be applied effectively and at minimal costs.

Species mixtures have not been seriously considered for plantation forestry in New Zealand. To be successful the species must have similar growth rates. The only possible species for mixture with radiata pine are the fast-growing eucalypts.

Monoculture of radiata in New Zealand has now been generally accepted. Knight (1971) after visiting New Zealand stated:
“Everyone recognises that growing plants over large areas in single species stands is more risky than hiding them as single stems in a vast mixture of species. However, I do not go along with those who might suggest making major changes in the management of radiata pine in New Zealand. Common sense tells us that monocultures are more risky than mixed forests and common sense also tells us that despite the “dangers” we have no valid reason to change the management system. We need radiata pine monocultures and we must be willing to pay for the precautions necessary to maintain them.”

As prevention is better than cure strict quarantine must be one of our major precautions (Milligan, 1970).

With pathological considerations the advantages appear to favour the large scale forest. Control measures on small forests are likely to be more expensive but costs could be reduced by planting blocks as large as possible in areas where there is, or will be, considerable forestry development.

**Fire Prevention and Control**

All indications are that fire protection is greatly assisted by an increase in forest size. In New Zealand State forests fire protection costs showed similar trends to that of general administration and other indirect costs, i.e. they can be expected to be five times higher per unit area on a 1-2,000 acre forest than at Kaingaroa Forest, etc. (Kaingaroa costs were 20c per acre per year in 1964 — Sutton, 1969). Similar trends were observed by Woods (1965) in South Australia.

Woods also found that fire protection required a minimum strength (not specified) of adequately trained personnel — a factor also important in New Zealand (see statement by Canterbury Conservancy in James et al, 1970). This aspect of control is assisted by the increase in forest size.

It could be argued that the larger the forest the greater the area at risk. It is claimed that, once started, a crown fire is almost impossible to put out. However, the largest two exotic forest fires in New Zealand, the 1946 Taupo fires and 1956 Balmoral fire, destroyed 30,000 and 6,267 acres respectively (Anon 1946 and 1956). With improved experience and knowledge of fire control methods it is most unlikely that such losses will be repeated. Also, past forest losses were in untended forests which have an accumulation of ground fuel and branch-covered stems both of which assisted the fire and allowed crowning.
The tended forest of the future, especially if grown on the silviculturally and economically superior short rotation regime (Fenton and Sutton, 1968), or its variants, in which the stand is reduced to the final crop stocking of pruned stems as soon as possible should after the time of high pruning be practically immune to fires (J. N. Valentine, pers. comm.). This immunity would be virtually complete if the regime is combined with grazing as is now proposed (Knowles, 1972).

For the small forest owner, especially a farm forest, growing trees in combination with grazing the risk of fire is so small that it can probably be ignored after first selection pruning, the associated cull thinning and the slash has broken down, providing always that grazing is maintained.

**General Discussion**

The main advantages of scale in forestry are lower overhead and administration costs and some advantages in fire and pathological control. The implications for the State and for the larger private companies are that efforts should be concentrated into large forest and that *ideally these should be expanded before new forests are begun*. New forests should only be started if the forest is likely to be large — at least in excess of 10,000 acres and preferably several times this size.

The social and organisational problems of large scale forestry can be reduced by better management and by a much greater emphasis on efficiency and economics at all levels.

There appears to be little place for the small State forest. On the other hand there does appear to be an important role for the small, independent forest — this can be either a small company forest or an individually-owned forest such as a farm forest. It could also include the local body forest.

While the area in small forests is not large (e.g. of New Zealand's total plantation resource of about 1.4 million acres (Anon, 1971a) about 75,000 acres (5 per cent) are in ownership holdings of 50 acres or less), and although the proportion of these holdings is now small their contribution to the forestry economy is still important — an estimated 100 million bd ft of sawn timber per year, or a little less than 20 per cent of the total exotic cut, and an estimated 8-10 million cu ft of log exports, or about 15 per cent of the total volume exported.* (1970 figures — I. A. Frost, pers. comm.).

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* Some of these volumes would have come from small owners with holdings greater than 50 acres.
Some overseas studies have indicated that the independently-owned forests have lower yields than the State or large company forests (Hasel, 1954; Abetz, 1958). It is doubtful if this is so in New Zealand for practically all forests (both State and private) being utilised are largely untended, and the small private forests are often on better quality sites.

Despite their size the small independent forest, whether company or privately owned, has several advantages over the large forestry organisation (State or company):

1. As the forest is unlikely to be committed they can sell on a free market and if the market declines they have option of not selling without incurring financial loss and at only minimal risks.

2. Because of the smallness of their organisation they have the greatest flexibility in the management of the forest.

The small private forest has two further advantages:

3. That of low overhead and administration costs.

4. Since he has no national or company interests or status to worry him and since he is spending his own, rather than someone else’s money, the owner has every direct incentive to reduce all costs and to sell on the best market.

Of these, flexibility of management is probably the most important advantage. Traditional forestry has emphasised heavily the importance of costs. However, current economic studies (viz. the current F.R.I. economic models, Fenton et al. 1968a,b,c) have shown that individual costs have a relatively minor effect on overall profitability. Far more important than costs is the timing of operations and the regimes on which the trees are grown. For example, the total direct growing costs of trees grown on the short rotation sawlog regime equivalent to $80 per acre, discounted at 7 per cent, more than doubled and the regime would still be considerably more profitable than trees grown on a conventional extractions thinning regime for which the overall profitability is about $110 per acre lower (at 7 per cent) (Fenton, et al. 1968a,b).

As one directly concerned with the advocation of the new forest regimes (Fenton and Sutton, 1968), I can say that while there has been very little acceptance of the new regimes by the large State* and large private company forests, we have had

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* Some State forests, notably those in Nelson and Westland Conservancies, have adopted new regimes similar to those proposed.
The concept of forests in pasture — predictably the trend for all forests. The advantages are great especially the re-cycling of minerals by livestock.

a fair amount of success with the smaller private companies and individual private growers. Indeed, some of the latter two groups must be credited with the introduction of the new regimes before their advocation by research workers — some organisations and individuals having given invaluable assistance in the development of the new regimes.

Because of their possible flexibility both in management and markets, the potentially most profitable forests are likely to be that of the independent owner. The small independent company has some of independent owners' advantages but also disadvantage in that they could be forced into take-overs by the large companies. The local body forest has the potential advantages of the small independent company, without the risk of a take-over. Whether the potential is realised will depend largely on the quality of the forest manager and freedom which he is given. For the State and the large private companies the
advantages of scale do not appear to be sufficient to offset the disadvantages of a generally inflexible management and they are unlikely to attain maximum profits from their forestry operations.

Importance of Size and Scale in Forest Industries

The major wood-using industries are the sawmilling, and the pulp and paper industries.

Sawmilling Industry

The classical study of the sawmilling industry in Dr Thunell's Swedish study (MacGregor, 1956) in which the economics of 8 types of sawmills cutting from 1.7 to 20 million bd ft were compared. Thunell found that although labour costs per unit volume of production approximately halved and the conversion efficiency improved with the increase in sawmill size these gains were almost entirely offset by much greater capital and depreciation costs with the larger plants. When the transport costs (larger sawmills tend to obtain their supplies from a wider area) were included the total production costs were practically the same for all sawmills; the implications are that there are few economies of scale in sawmills. In conversion, in the utilisation of waste and in the provision of amenities for workers, etc. the larger sawmills were superior.

Few other studies are known. Duerr (1960) suggested that there were few economies of scale in sawmilling. Limited New Zealand studies also support this view. Some of the old indigenous mills for example, despite their lower conversion have so little capital overhead that the cost of sawing is virtually limited to the direct cost of sawing. They, therefore, have some of the lowest unit costs. (C. H. Brown, pers. comm.).

Zaremba (1963) in a study of U.S.A. sawmills found evidence of a trend away from both small and large sawmills to medium sized mills and this he regarded as optimum. He defined this mill size at 80-120 million bd ft for the west and 15 to 20 million bd ft for the east. (In New Zealand there are 462 sawmills and of these only 9 produced over 10 million bd ft per year — their average production being 32 million bd ft — Yska (1970).

While the actual cost of sawing does not appear to be dependent on mill size there are other considerations. Use of mill residues is now an important aspect of mill economics. Although there can be some tolerance of bark in low grade pulps and there are now some flotation processes for removing bark from
chips it appears still preferable to debark logs prior to sawing (J. M. Uprichard, pers. comm.). Since modern sawlog debarkers cost in excess of $50,000 it is only possible for the larger sawmills to install such equipment.

On the marketing side small sawmills have a distinct disadvantage. The range of products from our exotic forests has become so great that the grading, sorting and storing is a major cost in sawmilling. For radiata pine there are at least one and often three, or more, grades of at least 16 common sizes of sawn timber. These can be supplied in most combination of finish, dryness or preservative treatment, combinations which give a total of at least 400 common basic treatments without the complication of specified piece lengths. For other species such as Douglas fir the problem is simpler since the timber is generally sold ungraded and untreated. To provide a full service stocks must be large. Waipa sawmill, for example, had sawn timber stock valued at $1.3 million dollars in 1970 — equivalent to nearly 14 per cent of its total sales, or, four times the mill operating profit (Anon, 1971a). It is not difficult to see that it is only the large exotic sawmills that can provide such service. Similar problems exist for the small independent sawmills in the U.S.A. (Senate Report, 1959).

One possible solution to the marketing problem would be the creation of co-operative or independent timber merchants who would be supplied from several sawmills and thereby free individual sawmills from the need to produce the full range of sawn end-products. This system has worked well in some areas of the U.S.A. "... but had led to some abuses in others". (Senate Report, 1959) Merchants in this system provide a service and do more than act as commission agents as they tend to in New Zealand at present.

The general conclusion is that although there are a few apparent economies of scale in sawmilling there are advantages to size in the utilisation of residues and in marketing.

Pulp and Paper Industry

In the pulp and paper industry there are many references to the importance of scale (Duerr, 1960; Mutch, 1971; etc.). Pulp and paper companies tend to expand existing mills rather than build new ones.
Studies on the economics of scale in pulp mills provide confirmation of this. For example, for hypothetical Swedish pulp mills producing bleached chemical pulp the relative production costs for a range of mill sizes are:

<table>
<thead>
<tr>
<th>Metric Tons per Day</th>
<th>300</th>
<th>200</th>
<th>100</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>$/US per Daily Ton</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(FAO, 1955)

More recent studies on the investment requirements for pulpmills gave:

<table>
<thead>
<tr>
<th>Rated Capacity Daily Tons (Metric)</th>
<th>Investment Requirements in $US1,000 per Daily Ton For Mill</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Groundwood</td>
</tr>
<tr>
<td>800</td>
<td>22</td>
</tr>
<tr>
<td>600</td>
<td>23</td>
</tr>
<tr>
<td>400</td>
<td>25</td>
</tr>
<tr>
<td>200</td>
<td>36</td>
</tr>
<tr>
<td>100</td>
<td>53</td>
</tr>
</tbody>
</table>

(J. M. Uprichard, pers. comm.)

The figures show that there are economies of scale especially with sulphate pulps — for these 400-500 tons per day (say 450 tons) appears to be an objective minimum size. At a conversion factor of 160 cu ft per short ton (Yska, 1970) this is equivalent to about 70,000 cu ft per day or about 25 million cu ft per year. Under New Zealand conditions with a mean annual increment of around 300 cu ft per acre per year the forest area would need to be at least 80,000 acres assuming all production goes to the pulpmill.

Similar economies of scale are considered to apply in paper mills. An exception would be specialists' papers where technique and quality are probably more important than plant size.

Pulp and paper authorities, however, are not always in complete agreement on the importance of size. Burd (1970) claimed that "... technological changes in the next 20 years might make smaller mills viable"; Gibson (1970) questioned whether too much emphasis was being placed on size — he instanced St. Anne's pulp mill (in the U.K.) which showed that it was not necessary to be big in order to obtain a reasonable return.
The Problems of Pulp Mill Supply and its Importance to Forest Management

To enable the pulp mill to realise the full economies of scale the forests on which they depend for supply must not only be large but they should also be under the complete control of the mills so that a continuous supply of raw material can be assured. For this reason pulp mills prefer to own their own forests (as with N.Z. Forest Products Ltd. which has a forest of 238,000 acres and is planning on 400,000 acres — Anon (1971b) ) or to have long term supply contracts (as with Tasman Pulp and Paper Co. Ltd. to which the New Zealand Forest Service is committed to supply 60 million cu ft a year for a 60 years (Anon, 1971c) — 23 million cu ft of which was originally negotiated at a price of 2.5c a cu ft. (Hansard, 1954) ). In practice this means that forest considerations must be subservient to those of the pulp mill; the return on capital to pulp mill being considered far more important than the return on forest capital. This has a depressing effect on forest management and has almost certainly been a contributing factor in the non realisation of the potential economies of scale on the forests as discussed above. Inefficient and non profitable practices (such as the maintenance of high stocking, production thinning, long rotations, etc.) exist in our industrial supply forest because they are considered necessary to ensure efficiency in the pulp mills.

Recent economic studies both in New Zealand (Fenton, 1970b) and overseas (Segur, 1970, and others) have shown that despite the high capital requirements of the processing mills the capital value of the supplying forest is at least as great as the plant which it supplied; for example (Segur, 1970, calculated the forest investment to be almost 150 per cent more than that in the plant). It should therefore be just as important to ensure a maximum return on the forest investment as on the plant investment. Maximum profitability can only be assured if the forests as well as the processing industry are efficient. The forest should never undertake non-profitable operations because of possible minor effects on pulp mill profitability.
Because of the economies of scale in the pulp and paper industry and because of the relative smallness of our forest resources and our population it is probably inevitable that New Zealand's two major companies have achieved monopoly positions and have chosen not to compete in the various pulp and paper end-products (Doige, 1969). This is one of the possible disadvantages of scale.

Other Wood-Using Industries

There are probable economies of scale in the panel product industries (plywood, particle board, etc.) but they would not be of the same order as in pulp mills since the production units required are not very large (Worrell, 1959).

For some specialist industries such as furniture, joinery, etc. where considerable human skill is required there are probable dis-economies of scale since increase in the factory size can result in poor supervision (Duerr, 1960).

Integration of Forest Industries

Entrican (1950) claimed that "integration of manufacture (was) the key to optimum forest development". Integration he defined as

"... a system of economically combining the various types of conversion-sawmilling, plywood manufacture, structural fibreboard production, pulp and paper manufacture, etc. etc. Each section of the integrated set-up takes the particular kinds of raw forest material most suited to its production and thereby secures these at a minimum price ... Yet by the sharing of common facilities ... both capital and operating costs per unit of product are so reduced that the forest owner can realise a higher total value for his raw material".

The two largest wood-using companies in New Zealand (N.Z. Forest Products Ltd. and Tasman) have a sawmill each integrated with their pulp and paper mills. As N.Z. Forest Products does not pay stumpage and as Tasman pays only a contract stumpage (not actually known but the return of wood sold in the Rotorua Conservancy — most of which went to Tasman, and practically all of the remainder went to Waipa Sawmill at 5.0c cu ft — for the year ended 31 March, 1971 was 3.3c cu ft — Anon, 1971a) an analysis of their total profits expressed as price per cut ft is probably the best indicator of profitability.
For Tasman for the year ended 30 October 1970 the total profit before taxation was $9.7 million and after taxation $5.3 million (Anon, 1970). During the year the mill processed 44.6 million cu ft so the profit per cu ft was 21.8c and 11.9c before and after tax respectively.

N.Z. Forest Products in the year ended 31 March 1971 had a net operating profit before tax of $15.9 million and after tax of $8.5 million (Anon, 1971b). The volume processed is not given but their annual report stated that “over 2,000,000 tons of logs are used annually by the company”. At Kaingaroa’s conversion factor of 34.5 cu ft per ton (J. D. Mackintosh, pers. comm.) this is equivalent to about 70 million cu ft. The profit per cu ft is therefore about 22.6c and 12.1c before and after tax respectively.

These profits are generally considered very satisfactory but it should be noted that especially for N.Z. Forest Products, there is a considerable degree of processing involved. The gross profit per cu ft after all the processing is only marginally better than the residual stumpage being currently paid for logs sold on the log export trade (17c per cu ft or more — Anon, 1971d; Fenton et al. 1968; there are unofficial reports of stumpages well over 20c per cu ft).

It is extremely doubtful therefore, when in open competition the integrated industries can ever match the stumpages of log export trade. This means that the small independent forest with the advantages of a free market as well as its major advantage in managerial flexibility is even more likely to be the most profitable forest owner.

Summary

Increase in forest size results in marginally lower direct costs, considerably lower overhead and administration costs (farm forests are an exception) no potentially greater risk of pathological attack (and probably fire), but possibly greater social problems. As economic studies have shown that forest profitability depends more on tree management than the actual growing costs the forests with the greatest managerial flexibility should be the most profitable. In practice this is most likely to be the small independent forest.

In sawmilling there appear to be few economies of scale, the higher direct operating costs of small sawmills being offset by lower capital, depreciation and transport costs. In the use
of residues and definitely in marketing, larger sawmills have an advantage.

In the pulp and paper industry there are apparent economies of scale; companies tend to expand existing mills rather than build new ones.

Although, now a reality in New Zealand, integration in the wood processing industry has not realised some of the anticipated advantages — especially the ability to pay high stumpages. Indeed the total profits of the major companies when expressed as a price per unit volume are not much higher than current stumpages being paid in the log export trade.

Acknowledgements

Although opinions and interpretations of basic information are the responsibility of the writer many Forest Service officers have been of considerable assistance in providing information and references. In particular: R. T. Fenton, I. A. Frost, J. D. Mackintosh, C. J. Terlesk and J. M. Uprichard. Their assistance and that of others is gratefully acknowledged. The technical publication assistance of I. Davey is also appreciated.

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Anon, 1971d: Logs could be better than lambs. New Zealand Forest Service, Information Item No. 15 (1).


The Bendigo Goldfield: Writing from Bendigo Station, Tarras, Mr R. F. Lucas says he is most interested in the formation of the presently mooted Otago Goldfields National Historic Park. "I have had word from the Commissioner of Crown Lands about this but there has not been a decision as they are not sure where it will be. At present a company called A.C.I. holds the prospecting rights over about 16,500 acres. There are no mining activities at the moment."

Mr Lucas considers that the best structures on Bendigo Station should be restored and created historic reserve. Most of the original buildings have toppled over or were taken away. Some interesting structures remain and are described and recently photographed by Mrs Lucas and Miss D. Lucas in the following article. The introduction which follows was presented to farmers when Mr Lucas hosted the 1972 High Country Field Day in the Upper Clutha.

— Ed.
Welshtown also known as Cornishtown, thought to have been settled about the same time as Logantown, a half mile away, in the late 1860s. Thomas Logan took up a quartz claim in 1863.

Photo: E. Lucas
The Bendigo Goldfield

Part 1 — Introduction

By R. F. Lucas of Bendigo
Station as told to R. Riddel

At the base of the gold-quartz hill near the present Bendigo Station homestead was at one time the small gold town of Bendigo and uphill a mile away was Logantown. Adjoining Logantown was Welshtown, sometimes called Cornishtown. Welshtown was situated at an elevation of approx. 1,600 ft. above sea level and overlooking the other two gold towns as well as the Rocky Point and Wakefield settlements nearer the Clutha River. There was a ferry at Wakefield.

In 1869 Bendigo had 400 people, its largest population. There were four hotels, five shops and a school. Logantown eventually had five hotels, seven shops, two restaurants, a billiard saloon and a post office. In that year there were 52 claims, 294 shareholders, on these the richest quartz reefs of the Dunstan Range.

Below: Remains of the blacksmith’s shop near Logan’s mine. R. F. Lucas sits on steps leading up to the site where the engineer, J. Maxwell, lived during the 1890s.

Photo: E. Lucas
Above: The dam which supplied water to drive machinery at the mine some two miles away. The water attendant's hut had a telephone to inform the attendant to turn on the water. Photo: D. Lucas

The most successful company took out £500,000 worth of gold.

It is supposed there are 150 shafts in the area and the deepest went to 520 ft. There were several attempts to sink a shaft to 600 feet, but never enough money to finish it.

Most of the mining was concentrated around Logantown and there were two batteries working on the Bendigo Creek where all the quartz had to be carted for crushing. Mining stopped at the time of the first world war. There was a brief renewal of interest but no one could get enough capital to keep the mines going for as the shafts got deeper, costs increased and the ore was lower in quality.
Above: At Cornishtown or Welshtown. The most well preserved building in the area.

Photo: E. Lucas

Below: Looking down one of the deep mine shafts on the "Cromwell Reef". Fifteen surface mines are on this reef, most of them under 100 ft.

Photo: D. Lucas
Part 2 — Principal Events

By E. Lucas quoting Parcell*

In 1863 Thomas Logan arrived at the Bendigo goldfield and mined there without much success due to lack of finance. Alluvial mining was considered to be the only worthwhile method but even the alluvial fields were winding up at the time. In 1869 Logan and party, along with George Wellington Goodger, a Cromwell hotel keeper and a Californian who knew something of quartz and who had the necessary capital, formed the Cromwell Mining Company. The new company mined on what is know as the "Cromwell Reef" and as prospects were good they built a battery, a twelve-head machine driven by water power, at the foot of the hill at Bendigo Creek, almost one and a half miles from the mine. The quartz had to be carted down by dray or wagon over a rough and very difficult road. They erected five stampers for crushing the quartz.
Upper: Above the deepest mine shaft — claimed to be 520 ft. deep. These workings were approximately 1,470 ft. above sea level.

Photo: D. Lucas

Lower: Spoil from the deepest shaft on the "Cromwell Reef", the richest strike on the Bendigo goldfield.

Photo: D. Lucas
In May, 1869 the first results were announced: 238 ounces for 10 days crushing.

The Cromwell Company bought up the assets of the Aurora Company which was mining further up the hill. Cromwell Company decided to shift their battery from Bendigo Creek and build a new one at their mine, using the materials from their old battery and the Aurora plant. The new battery was a 20-head machine driven by steam power from an 18 h.p. engine plus a water turbine. In 1878 the new “Matilda” battery was officially opened and was soon operating most successfully. For the first four months it recovered 2460 ounces of gold and 4086 ounces for six months. By the end of 1879 the company was employing 70 men and operating the full battery of 20 heads.

As well as the Cromwell Reef there were a number of other reefs being worked nearby by other companies. The Cromwell Company wound up in 1884 due to having lost the reef at 320 ft. and it was getting unworkable at 465 ft.

Logan and party were stated to have taken half a million pounds worth of gold from the old mine. Their outfit was bought by Ferguson and Mitchell who formed a new company and put down a shaft just north of the existing one. They met with varied success and the mine eventually reached down to 520 ft.

Although several attempts over the years were made to take this shaft to 600 ft. seepage was a problem and the pumping machinery was heavy and ponderous. A number of attempts were made to drive in a low level tunnel to drain the mine but were unsuccessful mostly through lack of capital.


PHOTO OPPOSITE

Reliance Hill, containing deep mine shafts, was worked by the Reliance Mine Company in 1873. It is said that crystals found here were used for radio station 4YA. On the right is the foundation of a battery used for crushing quartz off this hill. In the foreground are the remains of the blacksmith’s shop.

Photo: E. Lucas
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