

TUSSOCK GRASSLANDS AND
MOUNTAIN LANDS INSTITUTE

REVIEW



No. 11

September, 1966

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

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WHY NOT SILAGE ?

1. FEED VALUES, MATERIALS AND EXPERIMENTS

By R. J. Lancaster, Ruakura Agricultural Research Centre.

Traditionally hay has been regarded as *the* conserved feed for sheep and run cattle, silage for dairy cattle. Perhaps silage would be used more on runs but for its bad reputation. It is said to stink, to be heavy to handle and feed out, and to be an inefficient process anyway. Silage need not stink, it need not be handled for feeding out, and when properly managed is probably the most efficient conservation process available.

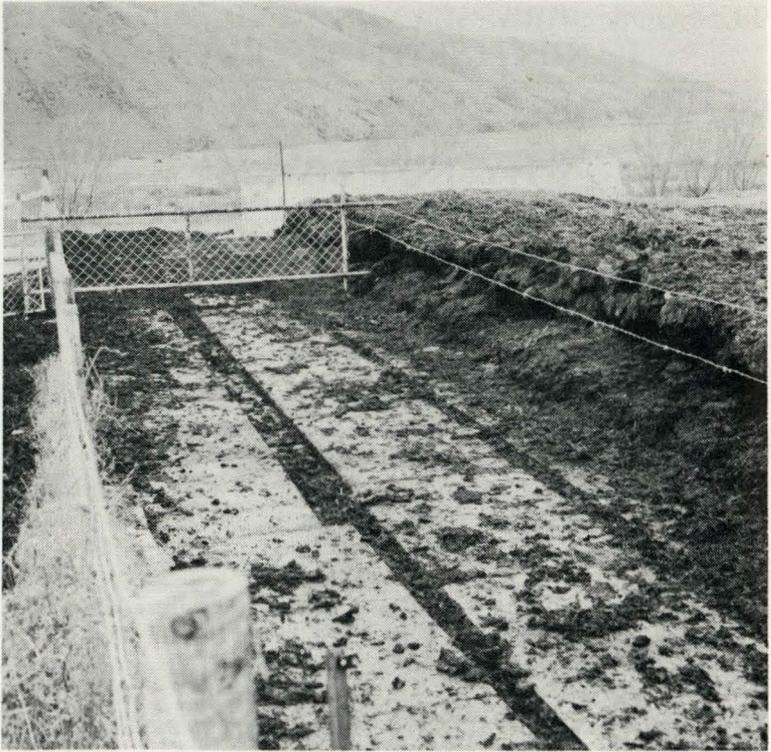
Silage is easily and cheaply produced, and the overall efficiency is generally higher than hay. True, when badly made in uncovered stocks, 50 per cent losses are common, but this surely is of historical interest only. By making in trenches or bunkers and covering with polythene, or by using vacuum compression, losses may be reduced to 10 per cent. Hay-making losses have been reported by English workers as 20 per cent, and Ruakura measurements put the loss from cutting to baling at 25 per cent. Even haylage, claimed to be a highly efficient method of conservation, suffers losses of some 15 per cent from cutting to feeding according to American reports.

The relative production values of hay and silage are in some doubt. Certainly hay will out-produce silage when both are cut from the same material, mainly because stock eat more hay. In practice hay is cut from much more mature crops than silage hence the doubt in the relative feeding values.

The demonstration by Southland farmers that silage can be self fed by sheep should encourage the high-country man to give this technique serious consideration. It should be easier and cheaper to self feed large mobs of sheep than to cart hay out to them. The silage stacks could be conveniently sited on gravelly river flats where drainage and mud should not be a problem.

CROPS FOR SILAGE

Any leafy crop normally consumed by stock may be ensiled. The nutritive value of the silage will generally be somewhat lower than that of the original crop. The acceptability will depend on the type of fermentation, and on the maturity of the crop. The more mature the crop the lower the intake.



Pad and bunker for self-feeding cattle at Otamatapaio Station.

Silage results from the spontaneous fermentation of sugar to lactic acid; the greater the production of lactic acid the better the quality of the silage. It follows that crops rich in sugar produce the best silage fermentation. At the same time they must not be too wet as excessive moisture encourages secondary fermentation which decomposes the lactic acid to butyric, and forms evil smelling compounds from protein. About 3 per cent of sugar in the plant juice is necessary to ensure a good fermentation.

In New Zealand, silage is regarded as a means of controlling and conserving excess grass. Little consideration is therefore given to the composition of the grass crop from the silage point of view, and few crops are grown specifically for silage.

The most readily ensiled grass is Italian ryegrass which has sugar concentrations in the 3 per cent to 5 per cent range. Short rotation and perennial are also readily ensiled though sugar

levels are generally lower than those in Italian. Cocksfoot is poor in sugar and is therefore a poor silage bet. Clovers and lucerne are also rather poor in sugar, have a high water content and are generally difficult to ensile.

Maize has long been regarded as the No. 1 silage crop but has been little used in New Zealand. It makes excellent silage providing it is chopped very finely and filled into tower silos. Most New Zealand attempts to ensile maize use grass handling techniques with indifferent results. Chou moellier can be successfully ensiled, and pea vine residues from the canning industry make excellent silage.

WHEN TO MAKE SILAGE

For a good silage fermentation mixed pasture herbage should be ensiled as the dominant species is coming into flower, when sugar levels are maximal and water content is satisfactory. For maximum feed value, the silage should be made at the grazing stage, but this is not a proposition. Yields would be too low, hence costs of making very high. Also immature herbage is poor in sugar, and contains excessive moisture and high protein levels, hence is liable to produce sour silage. Quite high nutrient losses from juice flow would also occur.

The crop continues to produce useful nutrients as it grows to the flowering stage. Thereafter, the extra weight of dry matter in the crop is dung-making material, which there is little point in conserving. **On all counts the best time to cut for silage would be near flowering.** This applies to lucerne crops as well as mixed pastures.

HOW TO MAKE SILAGE

Air is the enemy of silage at all stages from harvesting to the end of storage. In the early stages, it produces heat by burning sugar required for lactic acid production. Temperatures of 90 to 100 degrees Fahrenheit cause deterioration. Temperatures of 70 to 80 degrees check this tendency. The main object in the ensilage process then, is to eliminate air as rapidly as possible.

The crop, nowadays cut with flail-type forage harvester, is immediately stacked, or filled into a trench. Heavy consolidation is applied by tractor rolling, and immediately ensiling is finished, the stack is covered with polythene film weighted with soil or other material.

Rapid filling implies not only large tonnages per day, but also

the elimination of delays between filling periods except where vacuum compression is adopted. The once-popular Friday start-weekend warm-up procedure is out, as is the idea of working two stacks on alternate days. During this rapid ensiling the tractor should be kept moving over the stack as much as possible. Vacuum compression achieves the objects of this conventional procedure more effectively and more positively, by heavier and more even consolidation and by withdrawal of air.

STORAGE FACILITIES

Stacks

Silage can be made as a simple, unprotected stack, usually in the form of a wedge, but losses are heavy. It was demonstrated very clearly at Ruakura that polythene costing one penny per square foot could, if applied properly to such a stack, save something like ninepence worth of silage per square foot if hay is worth one penny per pound. The cheapest form of storage, then, is to cover the top area of a wedge with .0015in. strip polythene. The strips, laid across the stack, are lapped 12 inches to prevent entry of water. The whole is well weighted with soil which is confined to the top area by means of posts laid along the shoulders of the stack. The posts are held in position by wiring in pairs across the stack. This arrangement is satisfactory for up to six months but, as the side rot is progressive, long term storage demands completely airtight conditions.

Bunkers and Trenches

Bunkers and trenches have been used in New Zealand for many years, but by few farmers. Ruakura studies have shown this method of storage to be very efficient. Grass silage was made in 30-ton capacity concrete bunkers. After filling, the grass was covered in six different ways. Table 1 shows that losses from all sources were only 12 per cent in the bunkers covered with weighted polythene.

TABLE 1. PERCENTAGE LOSS OF SILAGE IN CONCRETE BUNKERS COVERED IN DIFFERENT WAYS

Type of loss		Type of Cover					None
		Roof	Soil	Polythene	Lime	Sawdust	
Rot	-	10.0	6.3	0.8	5.8	4.2	5.6
Drainage	-	3.0	5.0	2.5	5.5	6.5	7.5
Gaseous	-	19.6	13.8	8.6	12.3	19.3	21.1
TOTAL	-	32.6	25.1	11.9	23.6	30.0	34.2

Drainage losses are derived from the juice naturally present in the silage, from water released by the rotting process and from

rain leachings where rain can penetrate the silage. Gaseous loss covers a variety of sources of loss, including experimental error. Some of it is carbon dioxide, the final product of decomposition.

Surface rot in the polythene covered bunkers was found only where plastic met concrete sides and in the corners of the bunker. In the other bunkers rot covered the whole top surface whether protected or not. With both roof and no cover, the combined surface loss (from rot) and drainage loss was identical, though the roofed silage showed twice the surface rot. Evidently rain penetrating the rot on the unprotected silage leached much of it and carried it to the drainage. The total waste cannot be gauged from the thickness of surface rot as this changes very little as the rotting progresses into the stack.

Vacuum Silage

Instructions how to make vacuum silage are issued with every commercial vacuum pack. This article will discuss experiments now under way at Ruakura to evaluate vacuum, bunkers and covered stacks.

In the 1963-64 season two 50-ton stacks, one vacuum one non-vacuum, were made at Ruakura. Both turned out excellent silage six months later. Samples of farm silages made in clay pits, stacks and by vacuum were also excellent. The 1963 spring was an excellent one for silage, the grass generally being of good silage "potential." The similar high quality of vacuum and the other silages was therefore expected.

Ruakura tests commencing in 1964 compared bunker, stack and vacuum silage. A range of herbages was used to investigate the effects of crop quality on silage quality and on storage losses. The tests are not yet finished, but tentative results are as follows:

With grass of good ensiling "potential," losses were small (10 to 12 per cent) by the three methods, and all silages were equally good. With grasses of poorer ensiling potential, the vacuum method gave lowest losses and highest quality. Milking trials with dairy cows are also under way, and until the data are complete, the economics of the more expensive vacuum method cannot be calculated.

To sum up, the success of the vacuum method has underlined the basic principles of silage making. It has introduced many farmers to high quality silage who have never made it before. Owing to the great variety of skills and interpretations applied to orthodox silage in farm practice, one would expect a better result on average with vacuum than with conventional methods.

WHY NOT SILAGE ?

2. A REVIEW OF CURRENT PRACTICE

By J. G. Hughes, Management Officer, Tussock Grasslands & Mountain Lands Institute.

Silage can be of real use to back country farmers. Up until this season, Otamatapaio Station at Omarama was one of the only runs making it regularly although others had tried. This year, several more, particularly in the western valleys, are feeding silage to both sheep and cattle.

Its advantages on runs are:

Making

- (i) The labour requirement for making is low with modern equipment.
- (ii) Making silage can fit in readily between other jobs or between bad weather periods, particularly if vacuum compression and plastic covers are used.
- (iii) Surplus growth in grass paddocks can be cut and stored for future use.
- (iv) In wet areas where hay is often ruined the risk with silage is very low. It is better not to make silage when the grass is very wet, however, as the amount of seepage and nutrient loss is greater.

Storing

- (v) If well ensiled and protected it can be kept for many years.
- (vi) Recent developments in compressing (by vacuum) and covering (with plastic sheets) have greatly reduced wastage.

Feeding

- (vii) Good silage is an excellent foodstuff—valuable in winter, and in summer droughts, too.
- (viii) It can be fed out on fern or other rough areas to aid trampling by stock.
- (ix) Although feeding out can be laborious unless modern equipment is used, self-feeding is successful for most classes of stock.

MAKING

Silage is now made with either

1. A modified hay baler (rarely).
2. A buck rake or front-end loader, or
3. A forage harvester.

For 1 and 2 the grass or other material must first be cut with a mower.

Haybaler. The knotter trip lever has to be altered to make half size bales weighing about 75lb and the auger held down onto the cut grass. A large windrow is essential. An International B45 can bale about 7 tons of green material per hour. A truck and 3 men can cart about 3 tons per hour to the pit. After storage the bales of silage weigh about 45lb. The method is fairly expensive (£2 per ton) particularly for cartage and stacking labour, but makes use of a normal item of farm equipment. It is possible to mount a mower on the tractor so that the swath is picked up by a baler towed by the same tractor.

Buckrake or Front-end-Loader. The rear-mounted buckrake revolutionised silage making 15 years ago. It is simple and cheap but is only efficient where no more than a few hundred yards have to be travelled. An 8ft buckrake can handle as much as 3 tons per hour with 250yd travel to the pit. Rear buckrakes cost £50 to £60.

A hydraulic front-end-loader with buckrake tines is more ver-



Digging silage from a vacuum stack on Makaroro Station.

satile but much more expensive (£260 with hydraulic push-off). A short-tined silage fork can be fitted on the front-end gear instead of the buckrake for loading a trailer when feeding out.

Forage Harvester. These machines chop the material into short lengths and may also bruise and crush it before blowing it into a trailer or truck. They can cut the standing material or, on most models, pick up that which has been previously cut and wilted. Earlier forage harvesters used various types of cutters and sometimes separate fans. They were costly (£400-£1100), but made up to 25 tons per hour. Newer, simple flail drum harvesters are generally cheaper and are not easily damaged by stones but can have a slower through-put. In the most common models the flail hurls the green material up a chute to the delivery spout. Some are rear-mounted and some side-mounted. One side-mounted harvester blows to a wire bin on the 3-point linkage. Others blow to trailers or trucks. Forage harvesters with skids or wheels alongside the drum are better than those with trailing wheels. They follow the contours of the ground more accurately and reduce the scalping of ground humps. Soil in the silage is bad. The bacteria in it can cause spoilage and rotting. Thus cutting too low in dusty or bumpy conditions must be avoided.

Prices range from £350 to £850. Useful chopper and trailer units can be bought for under £450.

Of these machines the flail harvester is recommended. A self-loading bin or trailer will be needed with it.

It is advisable with bunkers and free-sided clamps to use a second tractor to run over the heap to keep it firm for the tractor-trailer unit.

CONTRACT MAKING

An average price is 15/- per ton exclusive of the cost of any vacuum pack or other sheeting.

RATE OF MAKING

On average silage can be made by one man with a forage harvester at the rate of 1 acre per hour, although one or two more men are often used.

Examples:

15 hours to make 120 tons (2 men, first season).

2 days to make 110 tons (2 men).

13 hours to make 150 tons (2 men).

1 hour per 15 tons of lucerne.

On a run, 11 broken days to make 500 tons.

13 hours to cut 12 acres.

SUNDRY QUANTITIES

1 ton of vacuum silage about equals 12 bales of average quality hay.

1 acre of average quality grass could produce 10 tons of silage.

Yield per acre can be measured by cutting and weighing a square yard of crop and multiplying the answer by two, e.g. 5lb x 2 = 10 tons per acre. The average of several sites would be better.

When first ensiled 1 cubic foot may weigh 30-40lb.

When fully settled 1 cubic foot may weigh 45-60lb. Weight (density) however, depends on the material and the method used.

1 ton of consolidated grass (not vacuum compressed) is about 2 cubic yards. Half of this volume is air.

STORAGE

Silage can be stored in below-ground pits (usually cut into a bank) or above-ground bunkers or heaps. The heaps are given various names depending on their shape—wedge, bun, clamp, etc. The silage can be covered with earth or lime but plastic sheets are now widely used. The most recent development is compression of the covered head by exhausting the air out of it.

Free draining sites especially river gravels are preferred, particularly if self-feeding is to be practised.

Good storage is important. Mt Torlesse Station feeds cattle on silage which may have been stored for up to ten years.

PITS

Pits have the following disadvantages:

Cost of excavation.

Fixed to one site.

Drainage may be a problem.

Access may be difficult.

They do, however, give cheap walling if the banks are stable and may permit tipping for easy filling. They have declined in popularity with the advent of vacuum ensiling, although this method can still be used with them.

BUNKERS

Bunkers with above-ground walls may be either temporary or permanent.

Temporary walls can be made of wood planking, wooden wall sections, or concrete, braced by wood, concrete or steel frames. Some layouts use liftable, perhaps interlocking, concrete slabs which may be later lowered to form platforms for self-feeding stock. Two runholders have made whole walls of wood planking on steel framework which can be towed to new bunker sites. Temporary walls are often used for the filling and consolidation period, then removed.

Permanent bunkers can be made of 4in. concrete walls either cast *in situ*, cast on the floor over polythene sheet and raised upright, or made of slab sections. Walls can also be made of wood planking fixed to posts. Wood walling is economical and easily handled, and if of treated timber lasts well. Bridge planking is also satisfactory.

Specifications for wooden walls are:

Posts not less than 5in. in diameter spaced not more than 6ft. apart. If pine planking is used space posts at 4ft.

Stays to posts not less than 4in. in diameter. 4in. x 3in. timber is suitable for brace frames.

Planks not less than 2in. thick, and walls 8ft high (for cattle).

All types of walls must be able to resist pressure of at least 100lb per square inch.

The wall vertical slope should be 1in. in 1ft. Walls should be made as airtight as possible or better still, lined with plastic sheet in use.

Bunkers can also be made by cutting along a bank, using the bank as one wall and a removable bunker front as the other.

COVERING BUNKERS

Bunkers are best lined with plastic sheet which, after filling and consolidation of the grass or other material, is sealed and covered with soil or grass. Free ends at the bottom, particularly with a stack built on grass, should be sealed by burying in a 10 or 12 inch deep trench and covering with soil. "Five-thou" thick plastic is most often used but even "2 thou" plastic at 1d per square foot will do if properly weighted down. The 5-thousandths of an inch thick sheet costs about 4d per square foot. Ruakura experiments showed that 4d worth of sheet saved 9d worth of silage. Exclusion of air is even more important than exclusion of water. Covering with soil or lime alone cannot prevent rotting and much waste. It is also hard to place and to remove.

FEATURES OF BUNKERS

Bunkers allow safer filling with tractors than free-sided heaps and, where a vacuum is not being used for compression, more even consolidation.

If silage in a bunker is well consolidated, covered quickly with a plastic sheet and weighted down it can be a very efficient way of keeping silage with total losses of only about 12 per cent. Bunkers are, however, expensive to build. One authority quotes £2/10/- per ton capacity as the average costs of a concrete pit or bunker. Thus a 200-ton capacity pit or bunker would cost £500.

FLOORS

Permanent bunkers, or clamp sites, almost always have concrete floors. These would be 4in. thick for average concrete and preferably reinforced with steel mesh. The concrete should be thicker if without reinforcing. The floor should be laid on hard gravel fill and sloping at least one inch in 10 feet. The steeper the slope, the less cleaning of mud and dung is necessary.

If self-feeding, a standing platform about 12ft wide for cattle and 4ft for sheep is desirable.

Otamatapoio Station stands wooden wall sections in one line of drainage channels in the concrete floor and braces them with stays from the next line of channels.

BUNS OR CLAMPS

These are above-ground heaps made with open sides. As with bunkers, the tractor and trailer run up over the material, unloading as they go. Buns and clamps are satisfactory if well covered, but can be dangerous to build. They are the most common form of stacking for vacuum compression and, with movable-side-wall bunkers, are ideal for self-feeding.

Covering is as recommended for bunkers.

Bun and stacks have the supreme advantage that they can be changed in size to suit the crop, sited near the crop or sited near a feeding area. However, they can become muddy. A flat concrete pad on a permanent site does reduce this problem.

VACUUM SILAGE

Method and Equipment

A stack of grass is built on a plastic sheet or on a concrete pad with sealer strip round the outside. The plastic bottom sheet should be laid on top of a thin layer of grass to cushion it and prevent puncturing. Similarly, it is advisable to place a layer of grass on top of the sheet before machinery drives over

it. When the heap is high enough or at the end of each day, another sheet is unrolled over the top, the two sheets are sealed together with a special strip and the air within is sucked out by a tractor-driven vacuum pump with liquid trap tank (£50-£80). The higher the vacuum achieved the more grass can be got in the pack. A 15-18in. of mercury vacuum should be aimed at. Good evacuation will reduce the stack to about half its original height. The final stack should have a dome-shaped top to shed water.

Soft green material is best. Any sharp stalks may puncture the sheet and let air whistle in, but these can be patched with tape as they appear.

The outside air pressure is equivalent to the compressive effect of six feet of concrete over the stack.

Standard sheet packs to hold 50, 100, 150 and 200 tons of silage can be bought. Larger sheets can also be made to order. Top and bottom sheets to hold 100 tons of silage, together cost £44. They may last for two years at the most. Usually in the second year the top sheet is used on the bottom and a new top sheet bought.

The strip seal for this size costs £14. It lasts for many years. It is a small diameter plastic pipe fitting closely inside a larger diameter split plastic pipe.

When finally finished and sealed off the stack should be covered with a twine or wire network (bale strings are useful), weighted with perhaps old rubber tyres, and preferably, then covered with a layer of mushy grass. The loose part of the top cover lying around the bottom of the stack should be well covered with soil. These precautions prevent the sheet being ripped by wind.

Effluent can be drained by removing part of the sealing strip after a week or so, or better by making a small hole in the cover at its lowest point and covering the sheet above it with soil to prevent loss of gas. By this time the stack will have become so compacted it will be almost airtight itself. However, it must still be kept covered and as airtight as possible.

The stack must be well fenced. A ripped cover allows great wastage.

A Time Example:

Time to build a 120-ton heap: 15 hours. Covering and strip sealing around the heap: 1 hour. Pumping out air: 2 hours. Overnight a gas forms so on the second and third days this has to be pumped out. This takes 10 minutes.

Cost of vacuum silage v. conventional silage:

A Department of Agriculture calculation has shown that, assessing all working and equipment costs and taking into account the extra feed value of vacuum silage, it becomes cheaper than conventional storage once 130 tons or more are made.

Silage:

Annual cost for 100-ton pack top and bottom sheets @ £44	-	-	-	-	-	9/- per ton
Silage made by farmer using own equipment						13/- per ton
						<hr/>
Total cost of silage						22/- per ton

Cost of vacuum silage v. hay:

If hay making and cartage is costed at 3/- per bale then hay at 27 bales per ton costs - - - - 81/- per ton. Since 1 ton of hay is roughly equal to 3 tons of silage in feed value (silage is 3-4 times as wet as hay) then, silage at 3 x 22/- = 66/- is 15/- cheaper than the equivalent amount of hay at 81/-.

On top of this, silage making now requires less labour and there is little worry about bad weather.

Features of Vacuum Silage:

With reasonable care a very high quality feed is produced. This is particularly important in self-feeding.

The total loss is only about 5 per cent, compared with 40-60 per cent for an uncovered stack or pit and 10-30 per cent for a covered stack or pit. This total loss is the difference between weight of green material at the start and the weight of silage produced. It is fermentation, seepage and surface spoilage loss. (Jowsey, N.Z. Farmer 13/8/64).

More air is exhausted than by rolling. Air causes fermentation and heating which reduces the food value of the resultant silage. (The old method of allowing silage to heat up is no longer recommended.)

With no rotting there is little smell.

Because of extra compression, twice as much material can be put on one site as conventional silage. The first compression reduces a stack to half its height or less.

There is very little drainage effluent.

No less labour is needed than with pit or bunker silage.

The air can be exhausted after each day. Rapid fermentation to preserve the grass then takes place. The stack can be opened next day or whenever it is convenient to add more grass. If rain

stops ensiling, the stack can be closed, pumped out and left until the grass is dry for cutting again. Thus there is very little wastage over a long period of ensiling. It is advisable to hold down the cover with weights to prevent wind damage even when ensiling is stopped temporarily.

FEEDING

Silage can be cut out of the stack and fed from a trailer, or self-fed at the stack itself.

CUTTING AND FEEDING

A stack can be cut with a hayknife or chain saw and the trailer loaded with a hand fork. This is slow, laborious and to be avoided if possible unless only a small amount is made.

Hydraulic front-end-loaders with short tines on tractors are often used. These are good, but on wet ground their manoeuvring can cause a quagmire. A concrete apron prevents this. Special silage grabs and silage loaders are available but not in common use.

On one run, 6-8 tons per days are dug from a pit with a front-end-loader fork, stacked on a trailer and fed out in two hours by one man.

SELF-FEEDING

Self-feeding reduces the labour (and sometimes equipment) cost of feeding out silage

Most commonly, a long stack is made and one side opened up for feeding. Any plastic sheet is gradually rolled back as the silage is eaten. Uncovering too soon causes spoilage. Stock are prevented from breaking down the face by an electric wire or pipe, or wooden or pipe barriers. The face is trimmed periodically. Trimmings can be carted away and fed to young or shy stock drafted off. A well-drained site is essential, or a concrete or wood feeding pad provided. Access must be good.

The sunny face should be opened up and shelter from wind is desirable.

Mud and dung should be cleaned from immediately in front of the stack at least once a week.

SELF-FEEDING SHEEP

- (i) The settled height should not be greater than 3ft.
- (ii) Silage stacks for self-feeding should be about 10ft long per 100 sheep. If opened on both sides, a stack 60ft long will feed 1600 sheep.

(iii) Sheep eat about 6-8lb per day. At 22/- per ton this costs 1d per day.

(iv) With continuous access to the face some sheep eat more than others and put on unnecessary fat. This cannot easily be prevented.

(v) Self-feeding hoggets is as yet unsuccessful.

(vi) The run-off area should not be expected to carry more than about 80 sheep per acre.

(vii) Sheep need at least 8 hours at the face.

(viii) Some few sheep do not take to self-feeding. These should be watched for and drafted off before they lose too much condition.

(ix) 10ft long feeding barriers of galvanised pipe with short platforms cost about £12.

(x) The barriers have to be moved up daily.

(xi) Barriers should be about 4ft high and have 7in. wide spacings for the sheep heads.

SELF-FEEDING CATTLE

(i) The settled height of the silage should be not greater than 6ft.

(ii) Self-feeding clamps need about 9 inches of feeding space per cattle beast if there is continuous access (thus 75ft for 100 cattle) or at least 2ft per beast if feeding is less than 4 hours per day.

(iii) Needless to say, it is best to have dehorned cattle.

(iv) The barrier or electric fence needs shifting every day or two.

(v) Cattle eat a cubic foot (45-55lb) per day, or more. At 22/- per ton, this costs about 6d per day. Dry in-calf Jersey cows at Ruakura on silage alone ate 15-20lb per hour, 80-85lb per day or just over 1 ton per month. Rising 2-year steers self-fed silage with autumn saved pasture ate 33lb of silage per day. Both groups gained 4-5lb each in liveweight per week. Milking dairy cows have eaten 80-120lb per day with free access.

Assuming a beast eats about a cubic foot of silage per day and has an average 9 inches of feeding face, then a 5 or 6ft high stack will be cut back at the rate of about 2ft per week. The period of feeding must be allowed for when building the stack.

Two- to three-month-old calves have been successfully reared on silage, but young stock to 12 months do not self-feed satisfactorily. They can be fed in troughs or elsewhere.

On hill country properties, isolated small flat areas might be

temporarily fenced off with electric fencing, the grass later ensiled and the silage clamp self-fed in the winter to beef cattle from the adjoining block.

The more chopped up the material the more difficulty cattle are said to have in eating it out of the feeding face.

One runholder successfully allows his beef cows 24 hours a day access to the silage. They feed daily for an hour or two and then move well out onto the hill face run-off.

Silage and Sheep

Sheep do well on silage.

Ewes and especially hoggets unaccustomed to it must be started on silage when boxed up tightly on a completely bare paddock. New sheep may need only hours or up to a week or two of this treatment before they accept it readily depending on its quality. Once the taste is acquired they are eager for it.

Southland practice is to feed hay during the late autumn and early winter for a month then silage for two months and autumn-saved pasture for the last three weeks before lambing.

If silage alone is fed for a long period the appetite may decline but hay, grass or greenfeed will restore it.

Silage fed to in-lamb ewes has been shown to have advantages in maintaining good bowel condition and keeping the ewes themselves in good condition.

In Canterbury experiments, large mobs of ewes fed on silage and the barest pasture pickings for four months, came out of the winter in reasonable condition and lambed satisfactorily. It is not, however, recommended that silage (or any other supplement) be the sole diet for such a long period in practice.

A turnip or swede crop may still be needed for a pasture renewal rotation and form the main diet for paddock sheep. Silage then becomes an alternative to hay for a supplement rather than the main ration.

Some authorities recommend using other supplements such as hay, roots, or saved grass with silage and feeding say 3lb of silage per sheep per day.

Two hundred tons feed about 100 ewes for two months.

Silage and Cattle

Silage will find its best use on runs for feeding cattle. They take to it readily and its virtues for maintenance or even fattening are well known. One farmer made 120 tons for the first time, "We self-fed it with the electric fence and fed 40 yearling steers for three months. We had six falls of six inches of snow this winter which stayed on the ground for two weeks at a time,

so also fed it to some sheep instead of turnips because of the wet and snow.”

CONCLUSION

Runholders who are making and feeding silage by modern methods are enthusiastic about it. All those interviewed plan to continue making it, most of them in increasing amounts.

I recommend runholders who have winter feed problems to try one clamp of silage.

Acknowledgements

This article owes much to the work and writing of: J. E. Bell, A. C. Burgess, G. R. Cleland, I. E. Coop, D. J. G. Davies, J. Doutre, D. L. King, R. J. Lancaster, G. G. Lindsay, D. J. Minson, M. Monteith, P. G. Stevens, and L. H. Weston; and to personal discussions with Messrs J. Aspinall, M. Milliken, C. Pennycook, D. E. and R. V. Smith, J. Sutherland, and G. Wardell.

Should You Develop A High-Country Run? "YES"

says Mr C. J. Crutchley, of "Shortlands," Kyeburn Diggings, Otago.

I am reluctant to write this article even though asked, because there are many others who have done more. I believe what has happened here over the last few years has happened as a matter of course.

My brothers and I were brought up on a nearby place and after leaving school I mustered in the district, and was able to acquire a fair knowledge of this locality. There was not much money about but if you were lucky you worked and saved and bought a place as I did in time. What made me do this when farming prospects were not too good in those days? It wasn't that there were not other ways to make more money—it was simply that you went farming because that was your way of life. You looked for the satisfaction of trying to run your place well and have enough returns to pay off the mortgage and call some land your own.



Photo Mr T. E. M. Brooks.

Mr Crutchley

To understand what has happened, I think I should tell you about the place and what it looked like just after the war when I bought it. It was no different from scores of other Otago runs. There was not much grass and the rabbits had a firm hold. On the 15,000 acres there were 4,800 sheep grazing and they were not doing too well.

We have perhaps 2,000 acres that are ploughable but the rest is steep hill country mostly facing southwest and running up to over 5,000 feet. Our winters are hard with heavy frosts and a snow risk if feed is not available. At the homestead, about 1,700 feet up, we get 21-22 inches of rain on average but there are often droughts in the summer. Of course more rain falls higher up and particularly in the Danseys Pass itself, but that is mostly snowgrass country.

However, as I said, the sheep were not doing too well. I worked out what the blocks could carry through the winter, as that is the leanest time of the year and governs the size of the flock. I found I would have to cut back. Next year this proved that numbers without feed do not help as there were three *more* bales of wool off 500 less sheep and less death rate at lambing.

Before we bought in, there had been some turnips grown for wintering and as soon as we could, we raised this to about 80 acres a year with half as much against for oats or chaff. All this was fed to the hoggets. Our main job was rabbiting. As soon as the seasonal work was done we went straight back to the rabbits and I believe we had the back of them broken by the time the Board took over.

To see that I was on the right lines I started an experimental block and did most of my own trial work with the help of the Department of Agriculture.

It was the wool boom in '51-'52 that gave us the real lift. We now had wool freeze money available for improvement and we were ready to make full use of it while it lasted. With the rabbit on the way out anyway, a change had to come. In the next year I had several hundred acres under the plough and it took three men to handle the work. After that I used to break in more each year until we got to the present stage where there is not much easy country left to do.

Even though the wool boom dried up, the increased production we got made money available for more improvement. In my opinion the basis of running a place is to spend money where you will get the best return. By that I mean not wasting money during the development period on unnecessary frills. For instance, we have some useful tracks here but you can easily

put in too many, and fancy sheds are often a luxury you can do without. You have to keep unproductive capital expenditure down to a minimum.

With the improvement that was going on, established management had to change. Fine-woolled sheep were not suited to the improved feed so I gradually moved into stronger-woolled flock with a smaller number of wethers. Footrot and scald forced my hand. The stronger-woolled sheep have helped with this problem and they also graze the country much more evenly, especially the rough gullies and shady faces.

With more feed about, I can use a more intensive and more flexible system of grazing. I move the sheep about and stock the paddocks at times with up to about six sheep to the acre. We do a bit of wild flooding to help us through the summer. The extra production has paid for the extra fencing. To my mind there is often much money wasted on over-elaborate fencing. Mine do not cost anywhere near £6 a chain, but they still hold stock. I also find cattle are not so hard on fences if there is plenty of feed available.

Talking of cattle, one of the good uses of them on this country is that they almost cut out snow raking. They tramp tracks and let the sheep out. The cattle do not get any special treatment and in winter they live on the tussock and pickings in the gullies. They are used where they are wanted. I try to make the income from them cover the cost of super so that the sheep pay for the rest.

Early topdressing with reverted super was a fair success but when sulphur super was used the results were better and lasted longer. It seems to make the browntop more palatable and under mob stocking the browntop tends to weaken and allow the clovers to strengthen. However, when topdressing is started, it must be continued to ensure a return on the money you have invested. The topdressing on this cold country gives a much longer growing period, up to three or four weeks earlier in the spring. With the extra feed, the same amount of shepherding is not required as strong sheep are so much better to handle and will stay out on their country much better. I firmly believe the extra stock build up the grazing. I have spread DDT on the paddocks regularly for grass grub but the results have been very mixed. There doesn't seem to be much damage yet on the hill.

Besides the paddocks, we have topdressed and seeded about 3,000 acres of steeper tussock. The improvement has not been spectacular, but besides much other use, we winter 1,000 more

ewes on the topdressed hill country where once there were only wethers.

I think you could say our development work has been successful. I have tried to cover rising costs by increasing stock. We now have almost twice the number of sheep we started with, our lambing percentage is higher and all the spare lambs go away fat. We clip about half as much wool again per sheep as we used to. There are also 200 breeding cows.

The labour position has not changed much. I have not had to employ any more men since I started. I think they find their work is more interesting too when there is a good variety. Since we changed from all turnips for winter feed to mainly lucerne hay and autumn-saved grass there has actually been a drop in tractor hours.

Improvement has been my own choice. I wanted to make the place better and this led to a greater return and a higher standard of living. I do believe that a lack of desire to improve one's own property and an opposition to change is an unnatural philosophy. Sometimes it is a bit easy to stress the difficulties as opposed to the possibilities but on my country the responses have proved payable. My indebtedness has not increased at any stage as I have worked out of revenue. In my opinion, the improvement of tussock country is a capital gain. While on this subject, it is no good thinking about development unless you think about good accounting and use all the incentives and subsidies which are available. You might as well for they are there for others to use too.

A lifetime is too short to develop a place. I am a strong believer that young farmers should be encouraged to strive early in life as their best working years are before 40; after that you don't put up with hardship the same. You must make up your mind to take the first opportunity. You can talk about money and everything else but you have only one lifetime and you've got to make it interesting. It's the challenge that makes it worthwhile.

Should You Develop A High-Country Run? "NO"

says Mr R. T. Turnbull, of Mount White Station, Canterbury.

I have been asked to give my views on high-country development. I must stress that these are purely my own ideas as they apply to Mount White Station. I am not criticising men on other runs who think differently.

Firstly, let me describe the run. Mount White has a very large area of high country to muster extending for a riding distance of 45 miles from Cora Lynn to the Esk Head saddle. It is subject to snow every winter—not just now and then—and has a definitely restricted area of safe country to run breeding ewes on. It has very heavy rainfall at times, although the annual fall at the homestead is not excessive. On the credit side, it is so split up by mountains that it is unusual for the whole place to be snowed up at once. Droughts are unknown. There is a vast area of splendid summer grazing and the natural divisions make it easy to spell the country adequately. For example, the area on which the 6,000-odd wethers spend the winter has no sheep on it from Christmas to early May. The other blocks are spelled to the same extent.

I now come to the stock limitations, which came into force in 1948. At the time, I thought they would strangle the place, but



North Canterbury Catchment Board photo.

Mustering on Mt White Station. Nigger Hill and the Puketeraki Range in the background.

they have turned out to have been a very sound move in every way. In 1934, the run carried 20,000 sheep but, because of the labour shortage during the war and the difficulty of finding musterers, sheep numbers had been reduced by sale to about 12,000 in 1948. The stock restriction was about this number so the station has been consistently understocked for the last 16 years. Also, between 30,000 and 40,000 deer have been shot on the place and we see far fewer about than we did in the old days.

Now I come to the results. I do not believe that the stock are damaging the country. From the observations of a number of practical men who are familiar with the country, the place has never looked better than at present. With ample feed everywhere, our sheep go into winter in first class order. Our winter losses are at a very satisfactory level, including the hoggets which can be a problem. Our hoggets get no pampering whatever, apart from being put on a good sunny block. No feeding out is done apart from a bit of hay to the rams.

Last winter was without question the worst for 20 years, yet our shearing tally was as good as ever though lambing and calving percentages dropped a little. No sheep have been bought for 32 years and over that period the flock has been changed from halfbred to merino. The fact that stock have been bred and pastured on the country for generations must have some bearing on our winter losses. Our lambing percentage is between 80 and 90 which is good for our class of sheep.

Another direct benefit of being understocked is that we get good prices for surplus sheep. When we draft out sale sheep, we are not selling culls in the ordinary sense of the word. We can get rid of sheep with wool faults or other minor defects and these sheep usually have several years of life ahead of them.

Wool weights have gradually crept up over the years but I would not claim that this increase can be kept up, for in plain English the sheep cannot be done any better than they are now.

My story is, then, that by being deliberately understocked, I can run the station cheaply and profitably without development and at the same time see the country improving.

Mount White has several thousand acres of arable flats right by the homestead and people frequently suggest that we should: (1) topdress, (2) grow grass, (3) grow lucerne or (4) grow turnips. This could be done, but my reply is to show these people aerial photos of these same flats in winter under 12 to 15 inches of snow. When the feed was wanted, it would be buried. I would hate to think of trying to look after 4,000 ewes under

these conditions instead of leaving them to do the best they can themselves on the hills. This seems to be quite a lot for sheep are not as silly as they look.

People have also suggested that, if I do not raise my production by development, I shall sooner or later be squeezed by rising costs. It is quite true that the costs of mustering and shearing will go up, but so may the price of wool and meat. I do not see why, given ordinary luck, the present system should not continue to be profitable.

What is more, if the price of wool and meat does not rise, I am not at all convinced that I would be better off if I adopted a high-cost system of intensive farming. Mount White is remote and it would be expensive to freight the materials needed for development over these big distances. I feel that I might have to spend 25/- to make £1.

I realise that the nation needs increased agricultural production, but we must not fall into the pitfall of trying to develop everywhere at once. New Zealand cannot do this with her small population. From the national viewpoint, there are many farms which could be more easily and cheaply developed than remote, snow-troubled Mount White.

Thus I believe that my present conservative management policy on Mount White may well be in the best interests of myself, the land and the nation.

JETTING AS A SUPPLEMENTARY METHOD OF SHEEP DIPPING

By Susan Millar, Wallaceville Animal Research Centre,
Department of Agriculture, Wellington.

Jetting is a method of applying insecticide to sheep to combat a sudden outbreak of external parasites such as blow-flies, lice or keds. It is only a supplement to the normal dipping programme and does not take its place. Its advantages include quickness, ease of treatment of small flocks, and the portable nature of the equipment.

Jetting is a good method of treating a flock at the onset of a fly-strike period. Mustering and treatment can be done flock by flock, and mass mustering at central yards is not necessary. Jetting can also control a sudden outbreak of lice or keds at a time when saturation dipping is not possible (e.g. just before or just after lambing) or when only a few animals are involved.

Jetting deposits insecticide on the fleece at skin level where it is of most value in preventing fly-strike, and is least affected by the weathering action of sun, wind and rain.

Careful and thorough jetting will give excellent protection from fly-strike and good control of lice and keds. Thus it will prove of use to many farmers.

Method of Treatment

There are at least two types of hand spray guns for jetting. They have three to five nozzles which deliver an unbroken stream of liquid under high pressure (70-80lb per square inch) enabling thorough penetration of the fleece to skin level. For recently shorn sheep, lower pressures are used as otherwise the liquid will be deflected straight off the skin and will not run down the sides of the animal. For lambs, the pressure used should be less than 40lb per square inch or the pelts will be damaged.

The tips of the nozzles are either passed lightly over the surface of the fleece or actually combed through it. Two adjacent sweeps along the back from head to tail usually cover the sheep, although extra insecticide may be applied around the crutch area if desired. Run-off from the application area will cover the sheep well provided the gun is held close to the fleece surface.

Only two to three pints of liquid are needed to treat a fully grown sheep with several months wool growth, and this can be applied in 10 to 15 seconds at 80lb per square inch. Less liquid



Dept. of Agriculture photo.

Jetting of the crutch area for additional protection from blow-fly strike.

is needed for younger sheep, or for sheep with less wool. The low volume of liquid needed is an advantage. Twenty gallons of liquid will treat 60 to 80 sheep. Thus a readily available source of water is not essential as it is with plunge and shower dipping. The little that is necessary can easily be transported with the other gear.

Jetting Equipment

Apart from a jetting gun a reliable pump is most necessary, and must be able to deliver and maintain a pressure of up to 80lb per square inch for considerable periods. Several drums for the dip and for spare water are advisable, and these should be calibrated in 5 or 10 gallons to facilitate mixing small amounts of jetting fluid. The gun, pump, and connecting hoses should be thoroughly cleaned after use.

Yarding

Two people with one jetting gun can treat 150 sheep per hour. If there are two guns and additional help to move sheep, 250 sheep an hour can be treated. This, of course, depends largely on the yarding facilities. Jetting is best done where a narrow race or crush is available or can be constructed. In this way sheep can be treated individually with a minimum of effort, being held quietly while the operator works amongst them.

Insecticide and Cost

The Department of Agriculture tested six commercial insecticides in 1963 and ten in 1964. Those tested were: Luci-jet, Diazinon, VC-13, Asuntol, Bayer S1752, Nankor, Carbophenothion, Cela S1942, Delnav, and Dieldrin.

Dieldrin, surprisingly enough, did not provide good protection against fly strike in this trial. All organo-phosphorus insecticides used were effective. The most promising insecticide was LUCI-JET, with DIAZINON, VC-13 and ASUNTIL being the next most effective compounds.

Increasing the concentration of the insecticide above that recommended did not give a proportionately increased period of protection from blowfly strike.

The cost of treating 100 sheep is between ten and fifteen shillings depending on just how much insecticide is applied per sheep.

DR O'CONNOR INTERVIEWED

Dr O'Connor, Officer-in-Charge of the D.S.I.R. Grasslands Division at Lincoln, and his colleagues have made some most interesting experiments on pasture development in the Mackenzie Country. We interviewed him recently about the implications of this work.



Christchurch "Press" photo

You believe, Dr O'Connor, that there is great scope for agricultural development in the Mackenzie Country. Why do you think this?

Because the Mackenzie is one of the best endowed places in New Zealand with light available for plant growth. We know now that the cold weather and drought don't limit plant growth nearly as much as we thought they did.

What's your evidence for that?

Our experiments on grazed clover-grass pastures in the Mackenzie showed that we could produce about 10,000 pounds of dry matter per year—on one site we even had over 17,000 pounds. Growth rates are as high as 200 pounds of dry matter per acre per day in summer. Again, Mr Clifford and Mr Vartha showed that we could grow over 3,000 pounds of dry matter per acre of rye-corn during the coldest six months—in one of the severest winters of recent years.

How does this compare with other parts of New Zealand?

Annual levels of production are comparable with those measured in many places from Waikato southward. Also the winter trough in production is not much more serious than in coastal South Island areas.

What does all this dry matter mean in terms of ewe equivalents?

Professor Coop reckons you need 1,050 pounds dry matter for a ewe of 120 pounds liveweight with 120 per cent lambing. I'm allowing for some feed wastage so, to be on the safe side, let's say 1,500 pounds dry matter for a ewe equivalent.

On that basis, how many ewe equivalents do you think the Mackenzie could carry?

Full development to present known capacity of 570,000 acres would give 4,400,000 ewe equivalents. This assumes irrigation

of 215,000 acres and movement of stock within the district appropriate to seasonal pasture limitation.

So, compared with the present stocking of only 220,000 ewe equivalents, you think that stock numbers could be increased 20 times. How long would it take to build up to this level?

Well, the Mackenzie runholders restocked from about 90,000 sheep after the snow losses of 1895 to 220,000 in 1906—a gain of 140 per cent in 11 years. If they sold no juvenile stock and thus increased stock numbers at the maximum rate, they would have 1,000,000 ewe equivalents in 15 years and about 4,000,000 by the end of the century.

Stock increases at this rate are all very well, but would it pay the runholder?

I have looked into this question of profitability fairly thoroughly. If runholders increased stock numbers at the maximum rate, and if present costs and wool prices hold, compounded development income would exceed compounded development costs after about 13 years.

In practice, though, runholders would not want to increase their stock numbers at the maximum rate.

Quite so. They could increase profits at the expense of capital gains by developing more slowly. Another point is that my assumed development costs are based on present-day technology. I am confident that current and future discoveries will reduce costs.

In what way?

For one thing, I expect a reduction in the costs of growing winter feed. Again, on any particular run the best soils should be developed first. If this were done, a run would probably be in the black well before 13 years, even if stock were increasing at the maximum rate. The best soils are those which give the most usable feed per unit of fertilizer, which can be easily fenced and so on.

You obviously think that rapid development of the Mackenzie runs would be a good thing all round for the runholder. If a runholder were thinking of developing fast, exactly how would you advise him to set about it?

(1) Have a map of each of his soils made by a Soil Conservator. I believe that this map is the most valuable feature of the Run Plans at present being prepared.

(2) Learn how best to use each of his soils by asking as many experienced people as he can. The Department of Agriculture Farm Advisory Officers can help here.

(3) Get a sound development programme organized by a management expert, incorporating the technical essentials outlined above.

(4) Re-organize the structure of his business for growth, being prepared to borrow money, and to reform his holding as a company, trust or in any other way that suits his needs.

There has been a lot of talk about a conflict of interest between hydro-electric and agricultural development in the Mackenzie Country. How important is this? For example, about 13,000 acres of land may be flooded if Lake Pukaki is raised. Even though these will be 13,000 of the better acres, do they really matter in a basin of over a million acres?

The loss of a few thousand acres would seriously interfere with several runs if they stick to their present management system. If, however, compensating intensive development of other lands was accelerated, the loss of these 13,000 acres permanently from agriculture may not be too serious.

But would there be trouble in the future if water were needed for irrigation? When the power stations in the Waitaki Basin are built, the engineers hope to be able to use all the water without spillage. Thus any acre-foot of water taken for irrigation would be lost to the turbines. Surely there would be conflict of interest here?

One point there is that irrigation would be in summer. Water is plentiful then and would often be lost because storage may be full by midsummer. I understand that the power design authorities hope to use for power generation all the water that cannot be economically used for agriculture. The amount required for agriculture is only about 4 per cent of the total annual flow.

What other conflicts may there be between agriculture and electric power?

There is some evidence that Lake Benmore is increasing winter fog in the surrounding countryside. This problem could be looked into; it might be possible to "seed" the fog with iodide if it proved serious.

Are there any other forms of land use which may complement pastoral development?

As the soils of the basin floor become more fertile by means of controlled grazing of legume-based pastures, there will be more opportunity for profitable cropping. Fears of wind erosion may be exaggerated. The most important thing is to get on now with the job of building fertility for potential cropping use.

What about potential forest use in the Mackenzie? Will this conflict with pastoral use?

Forests may develop in the Mackenzie by natural spread from plantations if pastures are not developed. This conflicts with present pastoral use, but not with pastoral development. In future, some shady slopes may be afforested and intervening sunny slopes developed for pastures. This happens in Switzerland and is being developed in the Himalayas. It can result in excellent adaptation of soil and light regimes to particularly suited crops, with comparatively low fencing costs, built-in forest fire protection and a scenically attractive landscape. It calls for some evolution in forest management but my observations in the Himalayas and my colleague, Mr Archer's experience in Switzerland suggest that New Zealand's methods of hillside production forestry could be improved.

What of the high altitude lands? Do you think that they should be developed for pasture, used for grazing animals without improvement or retired from grazing for watershed protection?

I think that 4.4 million ewe equivalents could be carried on the best 570,000 acres in the Mackenzie. This leaves nearly a million acres north of Benmore Lake and the Ohau River. The Mt Cook National Park and lakes, rivers and alpine areas outside the Park are probably best used for recreation and watershed protection. The sub-alpine area is the principal bone of contention. The higher steep slopes are difficult to develop for pasture without erosion. Other lands such as high basins, benches and less steep slopes might be developed for pasture but they also have a possible snow and water regulation function. Whether these uses are compatible we do not know but we mean to find out. We have an active research programme to look into this.

You therefore advocate the retirement of such land from grazing?

In effect I do, but only for the following reason. We need all the animals we can get on the lower country to activate the fertility cycle begun by the establishment of legumes. Our experiments show that pasture must be fully used to obtain the best return from fertilizer, the greatest yield of grass and the greatest possible improvement in winter feed. Improvement of these best 570,000 acres is going to keep busy for the rest of this century all the sheep that we can breed in the Mackenzie.

Thank you, Dr O'Connor.

POWER DEVELOPMENT IN THE MACKENZIE COUNTRY

Summary of Paper by G. G. Natusch, Investigation Engineer (Power), Ministry of Works, presented on 19 May, 1966 to the Lincoln College Farmers' Conference.

The demand for electrical power in New Zealand is doubling every nine years. Hence new power stations have to be built at an increasing rate. It is expected that, by 1970, the increase in demand will be 260,000 kW a year. To avoid power cuts, a new power station bigger than Aviemore will be needed every year.

Electricity can be made in many ways. Water power, coal fired steam, oil fired steam and atomic energy are the most common sources of power.

Coal is dear in New Zealand and there is not enough of it to justify construction of more than one further large coal fired station. Oil has to be imported. Atomic energy is still inflexible to use and has yet to prove competitive in price, except in special



Ministry of Works photo.

Benmore dam on the Waitaki River.

areas. Its fuel also must be imported. Thus water power, being cheap and home produced, is the best source of electricity for some years to come.

THE NEED TO HARNESS THE WAITAKI

When the water power of a country is being exploited, the cheapest sites are naturally exploited first. Till now the cost of generating hydro-electricity has been less than 0.35 pence a kWh, compared with 0.75 pence a kWh for steam power. As inferior hydro sites have to be developed and more efficient forms of steam power are brought in, the margin between the hydro and steam costs will narrow. But there are still many South Island sites where hydro power can be developed at 0.5 pence a kWh or a little more. The Waitaki stations come in this category.

The Waitaki is especially suitable for power generation because it is large, central and has a relatively even flow and small floods. The natural lakes in the basin have a great smoothing effect. Without control by man, the natural flood above Kurow likely to occur once in 500 years is 120,000 cusecs. The mean flow is about 12,000 cusecs. For comparison, the Wanganui river has a mean flow of 8,000 cusecs but a 500 year flood of about 230,000 cusecs. The relatively small floods on the Waitaki are important because control of flood discharges at a power station is both costly and unproductive.

In all, the Mackenzie Country water can be used to generate about 4,300 million kWh a year and justify an installed capacity of 900,000 kW. At present prices, this would provide Power Boards with power worth about £20,000,000 a year, for which they would pay the Electricity Department a little under £13,000,000 a year. For comparison, the present gross return from farming in the area is about £500,000 a year.

If an oil fired steam station were built instead of developing the Mackenzie Country hydro power, it would be necessary to import at least £7,000,000 worth of oil a year.

FUTURE DEVELOPMENT

The exact form of future development has not been finalised and the following section must therefore be taken as very tentative.

The first step would be to divert the 4,300 cusecs outflow from the Tekapo tailrace into a canal 100 feet wide and 18 feet deep. The canal would pass the Irishman's Creek Homestead to the top of the 190 feet high terrace above the Maryburn Basin, where a

62mW power station would be built. The Maryburn tailrace would cross the Basin and pass by tunnel through the Mary Range to a canal 400 feet above the present level of Lake Pukaki. There would be a series of penstocks (big pipes) down the slope to a power house on the shore of the lake.

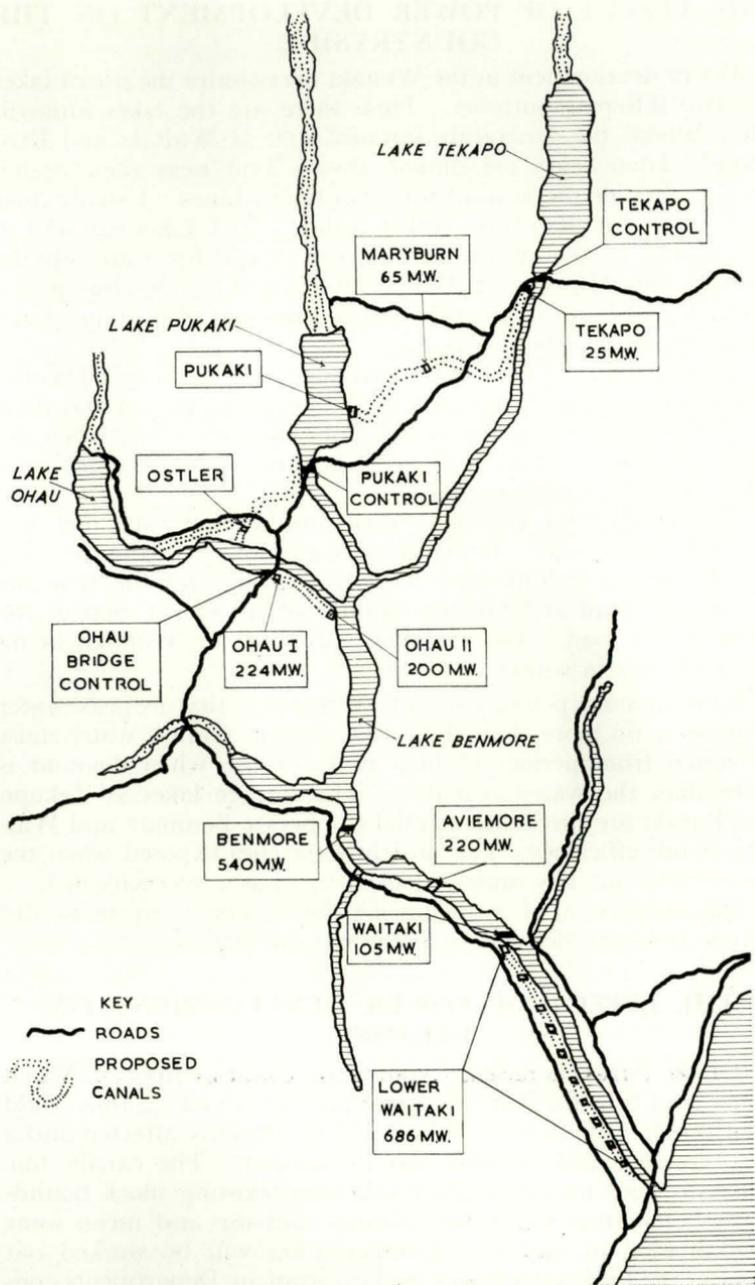
The present storage in Lake Pukaki is not enough to give proper utilization, for even in years when the lake has been empty in spring it is usually full by Christmas. From then until autumn, water is almost always wasted over the spillway and only about 80 per cent of the mean flow can be used. Doubling the storage would increase utilization of the mean flow to above 90 per cent, providing an extra income of about £1,500,000 a year.

At present Lake Ohau is uncontrolled. With the existing storage in Pukaki and Tekapo, it would be necessary to control Ohau through a range of over 50 feet to use the Waitaki water effectively. If the Pukaki storage were doubled there would be less need to store water in Ohau.

The topography around Lake Pukaki is such that it is easier to take water out of the lake about 100 feet above its present level. Should the raising of Lake Pukaki be approved, a large new dam would be built a quarter of a mile below the existing dam. Because of the extra area of the raised lake it would be possible to provide the doubled storage without increasing the existing range by very much.

If Pukaki is raised 100 feet, the combined flow of the Tekapo canal and Pukaki river, up to 12,000 cusecs, would be conducted by another canal to the terrace above the Ohau river. It would leave Pukaki at about the present junction of the Hermitage and Omarama roads, cross the plain in front of Rhoborough Downs, and pass behind Mt Ostler. A structure would stop normal flow from Lake Ohau and a canal would take the Ohau water through a gap in the moraine east of the present river to join the flow from Pukaki. Below this junction, the Ostler power-house with a capacity of 235,000 kW would discharge into the Ohau river some three miles upstream of the bridge.

A concrete dam just upstream of the bridge would back up water to the tailrace of the Ostler station. The lake formed would be small and would vary less than five feet in level. Water would be diverted into a canal about 200 feet wide along the terraces below the eastern slopes of the Benmore Range to Benmore Lake. On the way it would pass through two power stations generating about 420,000 kW in all.



THE EFFECT OF POWER DEVELOPMENT ON THE COUNTRYSIDE

Power development in the Waitaki necessitates the use of lakes for two different purposes. First, there are the lakes immediately behind the generating stations such as Waitaki and Benmore. These lakes are almost always kept near their design level to provide the head of water on the turbines. Usually their level varies less than three feet in a day. Such lakes can add to the beauty of the region and provide scope for water sports. Indeed, the Ministry of Works has helped to develop picnic grounds and launching ramps and has planted trees round Lake Benmore and in other areas.

Second, there are the storage lakes such as Pukaki and Tekapo. These lakes are used to store water over a long period and their levels fluctuate during the year. The wide beach left when the lakes are low is hardly a thing of beauty. The need for such lakes calls for an explanation.

The demand for electricity varies throughout each day and throughout the year. Demand is usually lowest in the morning and highest at a little after 5 p.m. Again, over the year the mean daily load at Christmas is only about 30 per cent of the peak winter load. Also the flow varies in the Waitaki, being usually lowest in winter.

Thus, unless a power station is designed so that its peak water demand is no more than the lowest flow in winter, water must be stored from periods of high flow for use when demand is more than the water available. The storage lakes at Tekapo and Pukaki are therefore essential to operate Benmore and Waitaki at full efficiency. The unsightly beaches exposed when the storage lakes are low must be looked upon as a necessary evil.

The conversion of swift-flowing high-country rivers to dry shingle beds also detracts from the natural beauty.

THE EFFECT OF POWER DEVELOPMENT ON FARMING

If Lake Pukaki is raised, 13,000 acres could be flooded. Much of the land is in the Tasman River bed but about 12 runs could be affected. One or two of these will be seriously affected and a major re-allocation of land may be needed. The canals, too, will cross land usually without following existing block boundaries. This may upset the existing land use and mean some re-subdivision of blocks. Compensation will be worked out between the land holders and the Government Departments concerned. There are definite forms established for assessing this.

Most of the water will be removed from the present Tekapo, Pukaki and Ohau rivers. The Tekapo river is expected to carry water from about where Gray's stream joins it, but the Pukaki and the Ohau below Ohau bridge will usually be dry. The rivers will have to be maintained as flood channels, and to replace the river as boundaries, fences will have to be provided at the expense of the Electricity Department.

As the main rivers run on perched water tables, removal of water from them is unlikely to affect the usable water beneath most of the plains. There are, however, some reaches, particularly along the middle Tekapo, where the river may provide water to the land close to its course. The availability of water to such special areas is being investigated and, if removal of the main Tekapo water does in fact dry up the land, sufficient compensation water will have to be supplied.

Similarly, as part of the construction activity, water must be supplied to stock which have up till now been able to drink from the rivers. Tests on the best way of doing this have been in hand for some time.

The competing uses to which Mackenzie Country water can be put are being studied by a committee on which the Ministry of Works and the Departments of Lands and Survey and Agriculture are represented. It is an open secret that the committee is unanimous that hydro-electric works must not be allowed to hinder the development of the area's farming potential. If future agricultural development needing additional water becomes desirable then the hydro-electric works should be operated so that this water can be supplied to the land at no greater cost than if the hydro works had not been there.

The ultimate development of the Mackenzie Basin should be for the benefit of New Zealand as a whole. I believe that this benefit will be greatest if both industrial and farming potential are allowed to develop side by side.

Since this paper was prepared the Maryburn-Pukaki scheme has been postponed. This delay, however, is not likely to affect the long term prospects for power development in the Mackenzie Country. Neither does it affect the facts outlined in the paper.

THE MERINO IN NEW ZEALAND

By J. R. Todhunter, Cleardale Station, Rakaia Gorge.

This is a short history of the origin of the Merino, the part it has played in the development of New Zealand, its present place, and some comments on its future.

ORIGIN OF THE BREED

The Merino is undoubtedly the oldest established sheep breed in the world and the most widely distributed.

Though the origin is uncertain, the name is Spanish and we must give credit to the Spanish breeders. Youatt, a noted authority, supposed that the Spanish merinos owed their origin to importations that had originally come from the coast of Syria and the Black Sea. It is known, however, that the Spanish breeders used the finest sheep of Italy and Africa to produce a type of sheep that should excell all others in fineness of fleece and quality of wool.

MERINOS IN NEW ZEALAND

The honour of landing the first sheep in New Zealand goes to that great explorer, Captain Cook, who in his second voyage landed one ram and one ewe—out of two rams and four ewes shipped in May, 1773—at Queen Charlotte Sound. Captain Cook shipped the sheep at the Cape of Good Hope and they were 117 days on the journey, which accounts for the death of four of the sheep and the weak condition of the two that reached New Zealand.

Unfortunately as Cook states in his diary—"On the 22nd May 1773, the ewe and the ram I had with so much care and trouble brought to this place were found dead, occasioned, as was supposed by eating some poisonous plant (tutu), thus my hopes of stocking this country with a breed of sheep were blasted in a moment." As Merinos were then well established at the Cape, M. H. Holford's claim that they were Merinos is probably correct. This is 25 years before this breed was established in Australia, where it has been the foundation of the prosperity of that country.

In 1844 Bidwill landed 350 Merinos in the Wairarapa from Nelson where he landed 1600 bought in Sydney in 1843. These are the first mention of Merinos, but earlier lots of sheep imported from Australia must have been Merinos though there are records that some at least were Lincoln/Merino halfbreds.

The first so-called "stud farm" was started in the Wairarapa

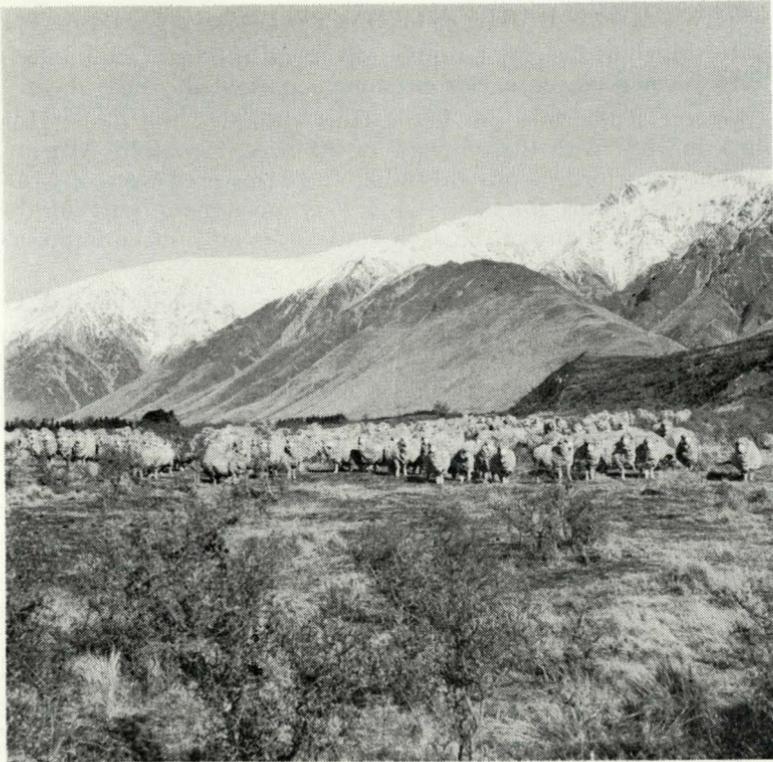


Photo Mr J. R. Todhunter.

in 1844 by Mr (afterwards Sir) Charles Clifford. Two years later, in conjunction with Sir Frederick Weld, Clifford landed Merino sheep in Marlborough and began the first sheep station, "Flaxbourne," in the South Island.

The first Merino sheep into Canterbury were bought by William Deans in 1843. After the introduction in the forties Merinos were brought over from Australia in increasing numbers to stock the sheep runs.

The sheep of these days were smaller than the modern Merino and had a lighter fleece—an average clip of 3lb to 4lb being common. Compare this with the average of 9lb to 11lb secured by leading New Zealand Merino clips of today. And to add to the comparison it must be remembered that the present-day Merino is confined to the harder and drier country for the most part and grows a much higher percentage clean yield.

EARLY STUDMASTERS

In this short history, I cannot record all the early studmasters but two men played a very prominent part in the early days.

George Rutherford of "Leslie Hills" founded the Leslie Hills flock in 1867 with the purchase of 50 ewes from John Murray, Mount Crawford, South Australia, and rams used were of Murray blood. This flock played a very prominent part in the foundation of many of the early stud flocks and in the improvement of the breed as a whole.

Charles Goulter, that noted studmaster, was another. Like many others, Goulter went to George Rutherford for some of his foundation stock. He also imported ewes from Tasmania and from South Australia, and in 1902 had three registered flocks; one predominantly Tasmanian blood; a second founded on ewes brought from George Rutherford, which appears to be the foundation of his famous Bulldog strain (sires from the Hon. James Gibson, Tasman, and also Wanganella Estate were used in this flock), and a third which was a mixture of mostly Peppin blood.

Other early flocks to have an influence were those of A. B. Smith and later F. N. Smith of Waratah, and of Watson Shennan of Puketoi.

The high standard set by these early breeders has been carried on by the present studmasters, and many high-priced Australian rams have been imported in recent years to bring the breed up to its present very high standard.

This willingness to risk large sums of money is evidence of the confidence of our studmasters in the future of the Merino.

After the introduction in the forties, Merinos spread rapidly and in 1855 the total sheep population was 760,000, of which 540,000 were in the South Island and 220,000 in the North Island. The great majority of these were Merino even in the North Island as they were almost the only breed available in numbers and sheep were wanted badly.

Merinos remained the principal breed until about the mid-seventies, when the total sheep population exceeded 10,000,000. The North Island began to cross Lincolns and then Romneys on their Merinos. In the South Island English Leicester, Border Leicester and Lincolns were crossed on the Merino.

The Merino played its part in the frozen meat trade, as when crossed with the Leicester it gave the Halfbred which laid the foundation of the world famous "prime Canterbury lamb." The Merino and Halfbred can still make a valuable contribution to the export lamb trade, particularly in view of the over-

seas insistence on meat without excess fat, and these breeds could be used still more widely.

The Merino is also responsible for half the inheritance of the Corriedale which now, next to the Merino itself, is the most numerous distinctive breed in the world.

THE FUTURE

The future of the Merino is undoubtedly associated with the Tussock Grasslands and Mountain Lands. Here the breed has stabilized its position and proved its value. Its ability to thrive under hot, dry, hard conditions and also under high rainfall and snow conditions at the head of our gorges has been proved.

There are approximately two and a half million sheep in the high country and of these about 50 per cent are Merino, so that the Merino breeder has a very real interest in the well-being of this country and its future as a source of much-needed pastoral products.

A lot of very valuable work is being done to improve the high country by subdivision, proper grazing control, topdressing and seeding. This is good, but when as so often happens, it is stated that a change of breed may become necessary with this very improvement, then we join issue.

This means, in the case of the Merino, either—

1. It will not thrive on the improved pasture, or
2. Some other breed will be more profitable.

It has been shown—not only in New Zealand but in Australia—that with proper management the present-day Merino will not only thrive under these improved conditions but will greatly increase its production. Dr Morley of the C.S.I.R.O., Canberra, has stated that about sixty million Australian Merinos are now running on improved pastures.

This brings us to the second point. Will some other breed be more profitable?

Much of this country is difficult, with only limited areas of a run being capable of profitable improvement. On this country the Merino has proved itself. The area of breeding or winter country is small and the breeding ewe numbers are just sufficient to provide replacements for the ewe and wether flocks with a small margin for culling. The result is a large wether flock and a good wool clip. Improvement to this country could well be directed to the easier portions and lead to higher lambing percentages, better hoggets and young sheep, and lower losses. In fact it could be well worth while to decrease the ewe flock in

view of the higher output and capitalise on the known wool producing ability of the Merino wether. The Merino flock, by reason of its true breeding qualities, can be maintained efficiently on a low culling rate in young stock, and thus a policy of minimum breeding ewes is possible. A factor also is the hardiness of the breed and its ability to produce wool at a stage when many other breeds would be culled for age.

This brings us to the question of those runs where, with improvement, a greater area becomes possible ewe country.

As country is developed, the cost factor can still be very important and the known wool-producing ability of the Merino utilized, by still making use of the Merino wether.

The difference in wool production between ewes and wethers is not generally realized. This can be as much as four pounds per head and two pounds per head is quite common.

If this is taken into consideration along with the ability of the wether to survive under difficult conditions, and the low cost and labour required for running a wether flock as compared to an all ewe flock, then the use of a balanced flock on even the easier country should be considered.

This can be done in conjunction with a cattle policy. The possibilities of a beef/wool association with low costs and a high output in sheep, as wool per head, can be most profitable and has the added merit of the cattle controlling the improved country for sheep. Extension of the use of old Merino ewes by mating a number to long wool rams and selling progeny has proved profitable on runs where this is practicable.

Finally I do not believe it is possible to produce a sheep that will serve the high country efficiently and still do as well down country. Conversely a sheep bred to produce on land with a high carrying capacity cannot be expected to produce equally well on high country.

The Halfbred and Corriedale certainly have a very valuable place, but here also there is talk of the need for changing to an even stronger wool.

This talk of change is not new and many high country men have regretted making the change in the past.

PRIVATE HUNTERS IN THE HIGH COUNTRY

By C. O. James, President, North Canterbury Branch of the New Zealand Deerstalkers' Association.

Hunting has long been a popular pastime in the high country and, as New Zealand's population increases, more and more shooters will inevitably go to the area. Over the years, there has been friction between runholders and shooters. Runholders are, understandably, irritated by vandals who disturb stock and trespass at will. Shooters, on the other hand, often have difficulty in getting access through private and leasehold property to shooting grounds. The North Canterbury Branch of the New Zealand Deerstalkers' Association is well aware of these problems and thinks that the time is ripe for closer and happier co-operation between the Association and runholders.

With gradual recognition of the Association as a responsible body, more and more landowners are realising that the organised shooter is much less of a problem than the vandal. Many runholders who have co-operated with the Association have been pleasantly surprised. They have found that private hunters with a regard for the good name of their club have taken a lot of worry from their shoulders.

The Association has drawn up the following code of ethics: A member shall:

1. Not hunt or carry a firearm on property without the proper approval of the owner, occupier, or controlling authority and shall strictly observe any conditions imposed upon him.
2. Exercise at all times proper precautions against fire, water pollution and damage to the forest.
3. Respect the property of others and leave huts in a clean and orderly condition with plentiful supplies of fuel and ensure the proper disposal of refuse.
4. Avoid disturbance to stock, assist stock in distress and leave gates as found.
5. Honour the Association's Policy and Field Rules.

The average Association member is therefore the type of man who wishes to associate himself with other thoughtful and considerate shooters who see the code of ethics as a fair and responsible way of conduct in the field. The shooter who sees the code as a hindrance, of course, does not join up. Thus,



N.Z. Forest Service photo by J. H. Johns, A.R.P.S.

when a runholder gives permission to shoot to Association members, he has some guarantee that he is dealing with responsible people and not gun-toting louts. Another important advantage to the runholder is that he knows all members shooting in his area. Should he have any trouble involving members, they can be located and dealt with in the appropriate manner with the Association.

There are, of course, shooters who for a variety of reasons do not wish to join the Association. We do not condemn these people or wish to exclude them from hunting grounds. But the Association cannot be held responsible for any trouble caused by non-members.

There are two more ways in which the Association can help the high country.

Firstly, all agree that there is scope for help in the control of New Zealand's problem animals. Private hunters have always killed considerably more animals than the Forest Service professionals. This margin is being increased every year as the number of private hunters increases and their access improves. This eases the burden on the taxpayer and releases Forestry personnel for other duties.

The recent scheme in which the Forest Service helps Deerstalkers' Association members to get access to remote hunting grounds is still in trial stages. Indications are that it will be very successful for all concerned. Some very good tallies have been obtained from more remote areas. Private hunters cannot hope to control the vast area of the back country under present conditions. But they can make a large contribution, at no cost to the taxpayer, to the general effort to control animals—if access through private property is made available.

Secondly, the Association trains young shooters. We well appreciate the problem of vandals who roam the roads and shoot at stock, sign-posts or even men. These are often misguided youths who have nowhere to go simply because they do not know where to apply for permission to hunt.

A good proportion of our new members are young shooters. These junior members are taken under strict control in the field by experienced shooters. They are taught hunting and bushcraft and are trained to respect other people's property. Young men need access to shooting grounds and, by finding suitable areas and taking young members out to them, the Association is contributing to a solution of the vandal problem. The Club has also built a rifle range at very considerable expense and provides safe targets, encouragement and technical training.

The Deerstalkers' Association believes that, as liaison between the two groups develops, relations between farmers and shooters are steadily improving. This improvement is most desirable for all concerned and for the high country.

FERTILIZER ECONOMY IN RUN DEVELOPMENT

By K. F. O'Connor and P. T. Clifford, Grasslands Division, D.S.I.R., Lincoln.

As fertilizer becomes dearer, runholders wish to practise economy in topdressing programmes. Fertilizer economy is, clearly, obtaining maximum return per unit of fertilizer used. Our trials on clover-oversown grasslands in the Mackenzie Basin offer some guide to this subject. A short account is given of them here.

DESCRIPTION OF GRAZING TRIALS

There are five trials, each consisting of 32 small paddocks. In each trial there are eight treatments, repeated four times to give confidence to the results. The eight treatments are combinations of two grazing intensities and four fertilizer practices.

The grazing intensities are:

- (a) *Periodic hard*, involving complete grazing down to a one-inch stubble;
- (b) *Periodic lax*, involving grazing down to a three-inch stubble.

These different grazings are obtained by stocking each paddock with sheep for a given time, usually two and a half days, the numbers of sheep being in varying proportion to the measured amount of herbage available.

The fertilizer treatments are as follows:

- 1 cwt/acre S-Super (400 lb/ton) every three years.
- 1 cwt/acre S-Super every year.
- 3 cwt/acre S-Super every three years.
- 3 cwt/acre S-Super every year.

The trials began in the spring of 1962. They are on (a) a steep dark slope at Ribbonwood; (b) an easterly hillside at Glentanner; (c) a moraine at Pukaki; (d) a damp imperfectly drained alluvial soil at Ben Ohau and (e) a north-easterly steep hillside just above the fans at Tara Hills. Herbage production has been measured from every paddock every time the trials were ready for grazing. Except at Tara Hills, where cocksfoot and some ryegrass persisted from earlier oversowing, all trials achieved their production with native and such naturalised grasses as sweet vernal, Yorkshire fog, Kentucky bluegrass, Chewings fescue and browntop.

THE NEED FOR "ENOUGH" FERTILIZER

The first thing we learn is to apply "enough" fertilizer. Table 1 shows the **extra** pounds per acre of herbage produced in the three-year period for **each additional** hundredweight of sulphur-superphosphate. The results are from the lax grazing regime, which most closely resembles run practice on topdressed blocks.

TABLE 1. ADDITIONAL HERBAGE IN THREE-YEAR PERIOD FOR EACH ADDITIONAL HUNDREDWEIGHT OF SULPHUR-SUPERPHOSPHATE APPLIED.
(lb dry matter per acre per 3 years)

Site	1 cwt/3yrs	3 cwt/3yrs	3 cwt/yr
	compared with Zero*	compared with 1 cwt/3yrs	compared with 3 cwt/3yrs
Ribbonwood	40	390	390
Glentanner	100	580	720
Pukaki	740	2360	740
Ben Ohau	1560	2200	1310
Tara Hills	310	1000	240

*Estimated.

Site maximum total yields have ranged from 6,000 to 17,000 pounds dry matter per acre per year. Table 1 does not show the total yields but simply the **increase** in herbage yield given to each **additional hundredweight** of fertilizer. The first two columns show that on all sites there was greater return per hundredweight from the second and third hundredweights than there was from the first.

As all these sites had been topdressed and oversown from two to five years before the trials were begun, the value of the heavier dressings is remarkable. When faced with higher fertilizer prices, farmers may be tempted to skimp, to apply "one and a bit" instead of three hundredweight. Our results show that this temptation should be resisted. **If funds are short, then the area topdressed for the first time could well be reduced rather than the rate per acre.**

THE NEED FOR FREQUENT FERTILIZER

The second lesson that we learn is that, for some soils at least, annual applications are best even following generous initial dressings. The last two columns in Table 1 show that, for the hill-side yellow brown earths at Ribbonwood and Glentanner, a higher yield of herbage per unit of fertilizer applied was measured when the initial 3cwt of S/Super was followed with two more annual dressings of 3cwt of S/Super. Additional fertilizer

also gives substantially more herbage on the Pukaki moraine and the gley-recent soil at Ben Ohau. These last two sites appear to represent (beyond the first 3cwt) what economists call "diminishing returns." The level to which one should then topdress is dictated by the relative cost of the fertilizer and the value of the additional production.

THE NEED FOR GRAZING

The third and perhaps the outstanding lesson that we have learned is the need for grazing. In all trials, periodic hard grazing gave substantially more forage by the end of the season than did periodic lax grazing.

TABLE 2. ADDITIONAL HERBAGE YIELD RESULTING FROM PERIODIC HARD GRAZING COMPARED WITH PERIODIC LAX GRAZING.

(lb dry matter per acre per 3 years—means of four fertilizer treatments).

Site	Gain	% Gain
Ribbonwood - - - - -	1,720	70
Glentanner - - - - -	1,390	46
Pukaki - - - - -	5,720	77
Ben Ohau - - - - -	10,650	89
Tara Hills - - - - -	5,540	95

Periodic hard grazing produced higher yields at all sites and under all fertilizer regimes. The benefit was, however, small when there was little clover as under 1cwt S/Super per 3 years at Ribbonwood (26 per cent gain) and at Glentanner (10 per cent gain). At the 3cwt/yr fertilizer regime at Ben Ohau the total gain in herbage from hard grazing—12,800 pounds dry matter in three years—was all grass. We are learning in the tussock grasslands the truth of Peter Sears's saying, "Eat grass to grow grass." It is also clear that the benefits of periodic hard grazing are highest when carried out on a good clover-rich sward.

THE NEED FOR PRUDENCE

The trials show the benefit of extra fertilizer applied more often and of hard grazing. But care is needed in applying these results to farm practice. First, the hard grazing is periodic, not continuous, in these trials. This is equivalent to mob grazing which is perhaps some years away from achievement on a run scale. Second, on a fairly dry site such as Tara Hills there is little benefit from annual topdressings. Third, there may come a time when there is little gain from periodic hard grazing with full dung and urine return. This may be when there is no

deficiency of available nitrogen in the soil. This stage may have been reached in the fourth year at Tara Hills. Finally, we are not confident that these lessons of extra fertilizer applied more often and of hard grazing are going to be applicable to all tussock grassland situations in other districts.

Even with these reservations, our experiments show that there are large areas which runholders could well improve by clover oversowing, topdressing and fencing for controlled grazing. The herbage production obtained per unit of applied fertilizer is probably as high as anywhere else in land development in New Zealand and probably much higher than that obtained in orthodox land development such as at Te Anau and in Central North Island. New Zealand could save money and fertilizer by giving greater emphasis to the likes of the Mackenzie Country. Runholders can also save money by developing first their most responsive and most utilisable sites. Not all soils are going to give high returns quickly.

The lessons from these experiments differ somewhat from those obtained from plots to which independent grazing treatments are not assigned. As a result of this recent work, we would recommend higher rates of fertilizer than were recommended in this Review some years ago. We are especially indebted to the cooperating runholders for enabling us to do these trials under grazing.

We often meet farmers who have topdressed land once or twice, had spectacular results and are now seeking advice on "maintenance fertilizer." Our trials suggest some years may elapse before the soil reaches a new steady state of organic matter containing new levels of carbon, nitrogen, sulphur and phosphorus. Some soils will take longer than others. There is not much room for the concept of regular maintenance until that steady state is reached. "Maintenance" thinking is hardly appropriate to a situation where annual increases in level of herbage production (mostly nitrogen-rich grass) with repeated heavy topdressings are greater than the initial "spectacular" responses to the original topdressing. It is difficult to give exact advice on this problem to cover all situations. Some of the disappointing aftermaths of the first spectacular responses to topdressing and clover introduction that have been experienced in recent years may have been due to lack of fences or, more likely, to lack of animals inside them.

POST DRIVERS

By J. G. Hughes, Management Officer, Tussock Grasslands & Mountain Lands Institute.

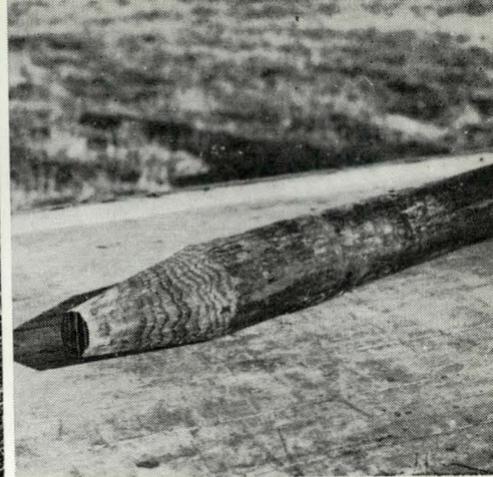
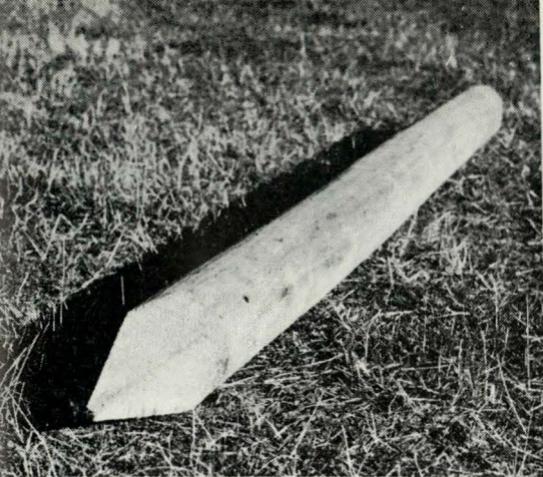
In 1964 G. Schroeder of Hororata demonstrated his mechanical post driver at a Y.F.C. machinery display near Christchurch. Since then machines of this type have rapidly caught the interest of farmers. Before, there had been only an occasional private importation. Now there are at least six machines available commercially. Several farmers and contractors have also built their own.

Capabilities

Post drivers speed up fence construction considerably and, by the firmness with which they set the post, allow smaller diameter, cheaper posts to be used. They are ideal for replacing posts in an existing fenceline. Although their speed of driving depends on the nature of the subsoil, they can work successfully on a wide range of sites particularly if they are used in winter or spring when subsoils are moist. Experienced users can drive very straight lines if ground conditions are favourable. The stony plains of Canterbury can be handled, but if large boulders are present it may be difficult to align posts accurately. Thick ironstone pans and hard dry clay are difficult and at their worst, may not take pine posts. With small diameter (3in-4in) posts, especially if they have been heavily peeled and the knots shaved off, there is a danger of crushing with heavy "monkeys" when driving into hard ground. One contractor said railway rail posts could be driven even into soft or rotten rock. Concrete posts, particularly prestressed concrete, can be driven into many soils if a wooden pad is used to protect the top of the post. Strainer posts can be driven by some machines in some soils.

Pointing Posts

Wooden posts are now available pointed before treatment (6d extra). If necessary, unpointed posts can be sharpened with an axe or circular saw but in this case it is wise to stand the points in preservative to re-treat the cut surface. A blunt, cone or pyramid point is better than a very sharp one. One contractor says sharpening the smaller end rather than the larger means a tighter post when driven, but on the other hand putting the larger end in the ground first could make the post less likely to be pushed over in wet ground. Some contractors say pyramid points are much easier to drive than conical ones. Unpointed posts can also be driven and may be more satisfactory on bould-



Pyramid cone and points.

ery sites. They are often looser than pointed posts at first but are said to become firm quite quickly. It has been suggested that a slight chamfer is beneficial on unpointed posts. Tops are best cut dead square although it seems that this is not essential.

Opening the hole with a crowbar and chipping away the turf make starting easier. The crowbar might also show whether the post would be better driven elsewhere.

Contract Cost

Post driving contractors in Canterbury charge between £2 and £2/10/- an hour. One has set 45 6ft posts in an hour in soft ground, but between 10 and 20 is the common range. This gives a per post figure of 2/- to 5/-. One contractor provides the post driver and his own labour for 2/- per post. The farmer operates his own tractor to power it.

Frequently 100 posts and more per day are set.

Features of the Machines

Principle

Five of the six machines available have a common principle. The post is clamped firmly to the upright column and a weight, lifted by a wire or hemp rope passing over the top of the column is dropped down the column to drive the post. The clamp moves down with the post. The machines differ in their weight-lifting mechanisms. The sixth machine, the "Saunders" or "H.E.C." relies on rapid vibration of the whole body of the driver. A brief description of each will be given on the following pages.

Fitting

All manufacturers make tractor-mounted models. Schroeder Engineering also make a trailed model, have fitted one to a Landrover, and plan to fit another to a crawler tractor. All the machines observed seemed capable of being operated by a light farm tractor. Levelling of the mounted models is generally by adjustment of the tractor linkage arms. Conversely the angle of driving can be varied. This is useful on hill slopes. Most models have graduations marked on the column so that posts can be driven to the same depth each time. The height to which the monkey can be lifted is important if strainers or other tall posts are to be driven.

Control

Only the Saunders machine can be said to be automatic. With the others the operator must move a lever or in one case pull a rope to engage the weight lifting mechanism before each stroke. Although a hand lever does give the operator individual stroke control, in some conditions its continued operation could become tedious. The several mechanisms give different rates of lift and strike. The variation in monkey-weights between models also affects the speed of post driving. The rates of striking given in the descriptions are those observed on machines working at full drop. They could vary with the operator and the tractor engine speed.

Since the different machines could not be tested on one site, this article describes them but cannot compare their efficiencies. Judgment is left to the reader. The intending buyer should, however, satisfy himself that the standard of manufacture is acceptable to him. The quality of design, fitting and construction, particularly welding, varied widely. The N.Z. Agricultural Engineering Institute at Lincoln College may conduct trials of post drivers at a later date. Other machines may be available but the following six are all I know of in Canterbury.

NOTE: Users of machines with high columns should remember the hazard of overhead wires.

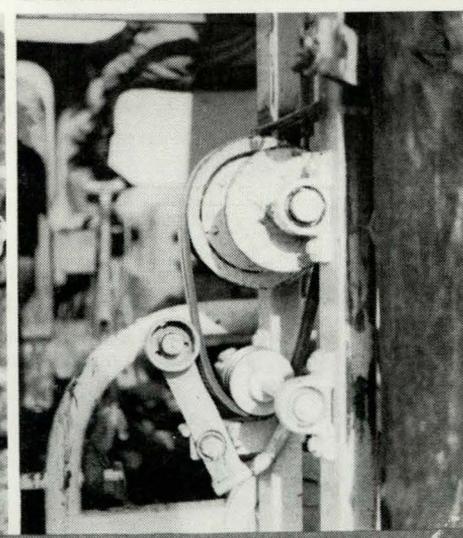
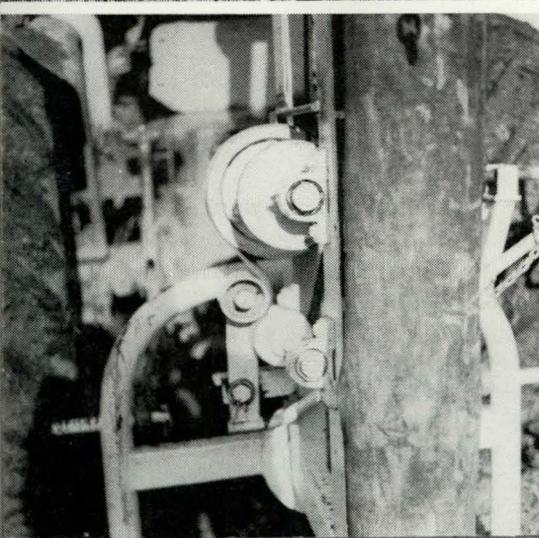
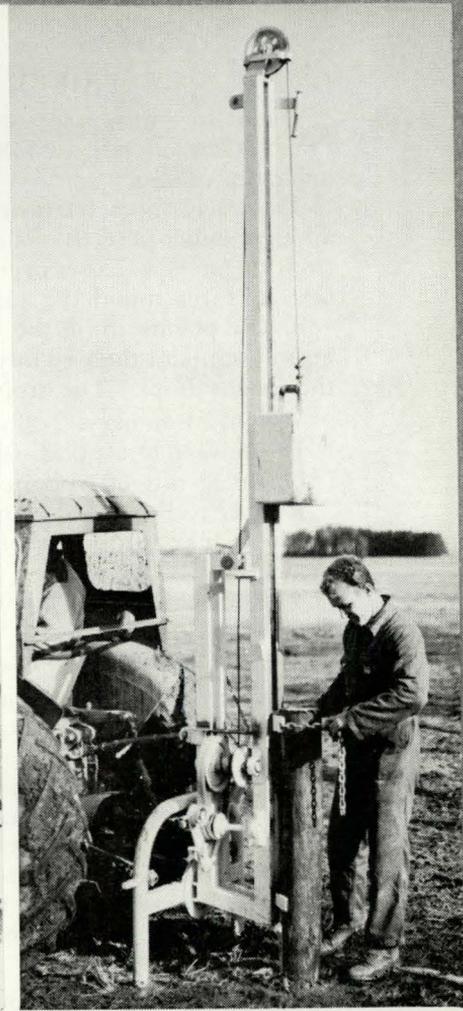
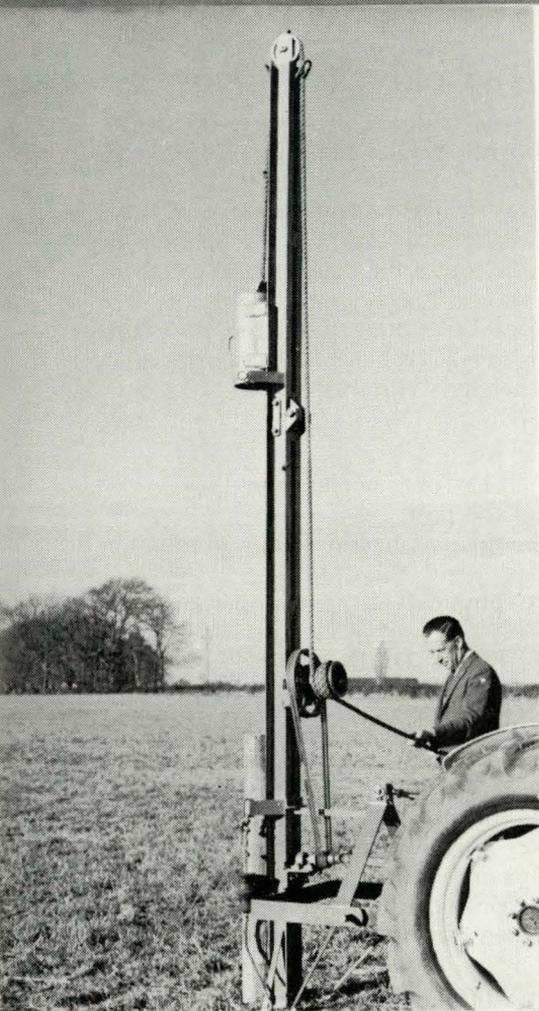


Top left: The Fairey driver.

Top right: The McDowell driver.

Bottom left: The V belt drive of a McDowell driver engaged to lift monkey.

Bottom right: The drive disengaged to let the monkey drop. The Rushton drive is similar to the McDowell.



FAIREY POST DRIVER

Made by Fairweather & Sons Ltd., Scott Street, Blenheim. Price (Christchurch) £148 with hinged column; £138 with one-piece column.

The tractor p.t.o. shaft drives twin V belts which in turn drive another pulley directly connected to a capstan. A hemp rope from the monkey passes over the top of the column and has three or four turns round the capstan. The operator holds the free end. By pulling in on the rope he tightens it around the rotating capstan and the weight is raised. When he releases the rope, the weight drops. The drop height is variable.

Weight of monkey, $2\frac{1}{2}$ cwt.

Drop to top of 6ft post—6ft 9in.

Observed rate of working—14 strokes per minute.

Rubber reels on cord clamp the post.

The monkey drops from the greatest height of any production model.

This machine takes more physical effort to operate than others.

McDOWELL POST DRIVER

Made by Schroeder Engineering, Hororata. Price £145.

The tractor p.t.o. shaft rotates a twin V pulley. Slack twin V belts pass around it and another larger V pulley which is directly connected to a winch drum. A wire rope from the monkey passes over the top of the column down to the winch.

A hand lever forces a jockey pulley to tighten the V belts, the winch rotates, winds in the rope and the monkey rises.

When the jockey pulley is released, the driven V pulley slips inside the belts and the monkey drops. The drop height is variable.

Weight of monkey 3cwt, although heavier monkeys are available on request.

Drop to top of 6ft post—4ft 10in.

Observed rate of working—26 strokes per minute.

Chain and screw post clamp.

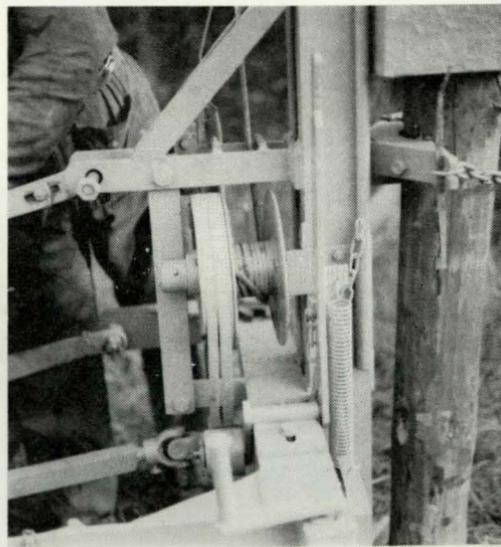
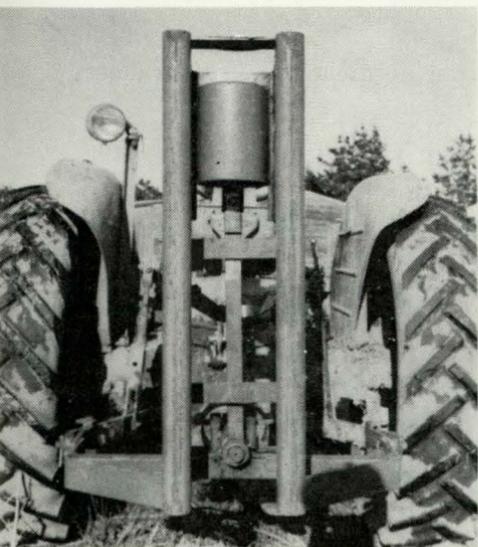
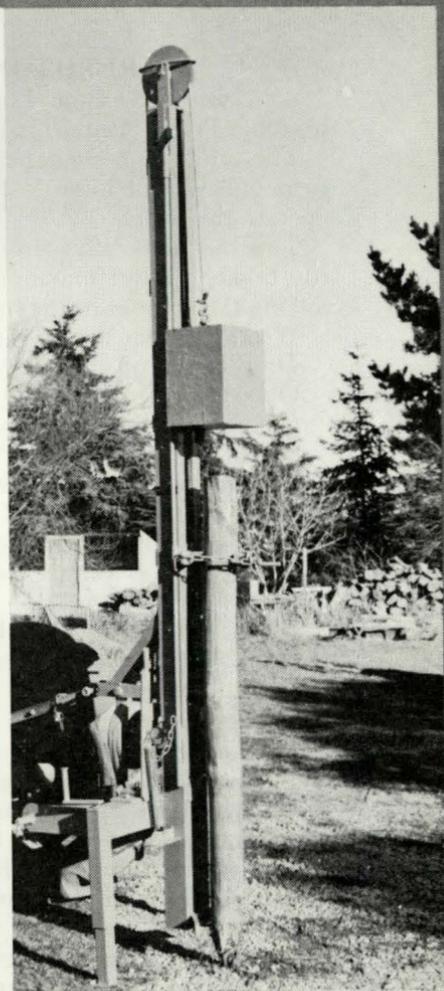
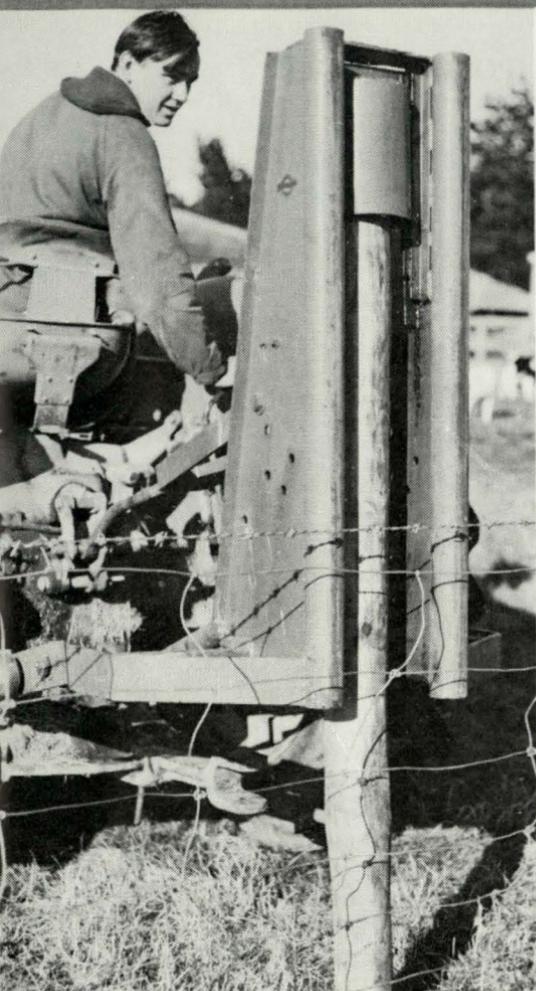
Fitted with an independent side levelling screw and stabilising legs.

Top right: The Rushton driver.

Bottom right: A Rushton winch. The McDowell is similar.

Top left: The Saunders driver.

Bottom left: Showing the eccentric and push rod of the Saunders driven by the tractor p.t.o. shaft.



RUSHTON POST DRIVER

Made by Rushton Engineering, Alford Forest Road, Ashburton. Price (Ashburton) £145.

The principle is similar to that of the McDowell driver, using twin pulleys and loose V belts tightened by a jockey pulley to operate the winch.

This machine differs from the McDowell by having an over-run brake, a lower maximum drop height and no pivoting plate linking the column to the brace legs.

Weight of monkey— $3\frac{1}{2}$ cwt.

Drop to top of 6ft post—3ft.

Observed rate of working—26 strokes per minute.

Chain and screw post clamp.

Stabilising legs.

An independent side levelling screw is being fitted to new models.

Wire rope life is sufficient to drive about 1,000 posts.

The winch has a brake to prevent overrunning.

SAUNDERS OR H.E.C.

Made by Hawera Engineering Co. Ltd., Union Street, Hawera. Price £99/15/- f.o.r. Hawera. Freight to Christchurch extra.

A short crank on the end of a p.t.o. driven shaft pushes up and down at p.t.o. speed a vertical connecting rod attached to a cap which fits over the top of the post. The reaction of the crank also raises and drops the main frame of the driver, including the tractor three-point-linkage arms, at the same speed. The weight of the frame therefore does the driving.

Weight— $2\frac{3}{4}$ cwt.

Observed rate of working—240 blows per minute.

Since the post is not clamped there is limited control over it being driven in straight.

It cannot handle posts longer than 6ft.

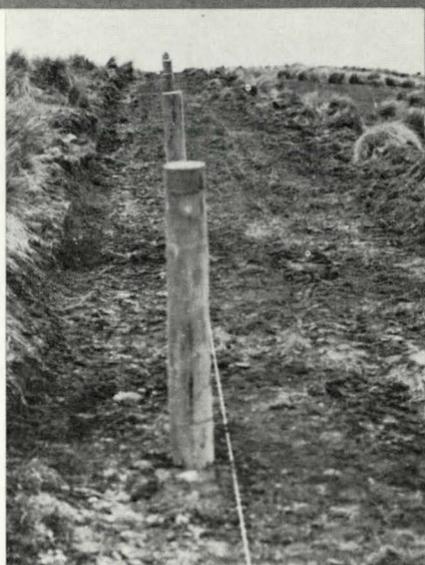
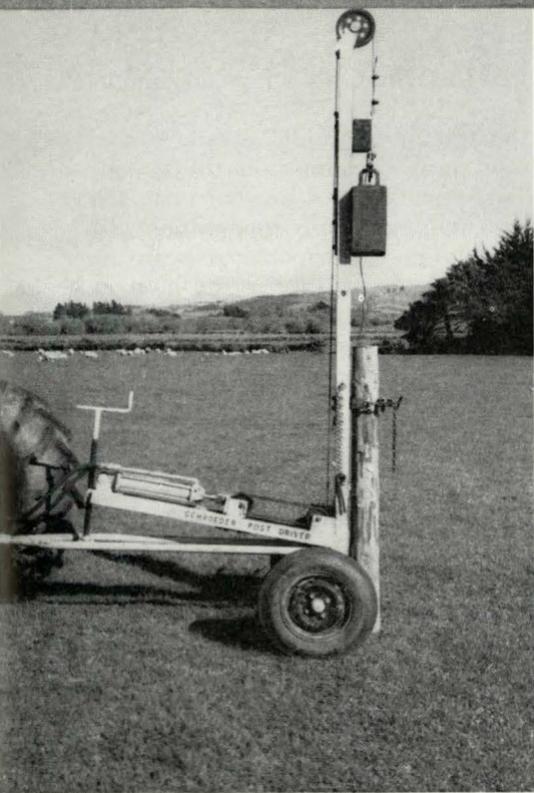
The maximum depth of driving is no greater than the range of lift of the tractor linkage arms.

SCHROEDER POST DRIVER

Made by Schroeder Engineering, Hororata.

Price (Hororata): tractor-mounted £170, trailed £220. If the tractor is not already fitted with a two-way hydraulic control

Left: The Schroeder driver, trailer model.
Right: Good operators can drive straight lines.
Below: The Schroeder driver, mounted model.



valve this will cost an extra £26 to £28. Only a few later model tractors have this.

In the standard models, the tractor hydraulic system is used to operate a remote hydraulic ram mounted on the driver. Through a seven-sheave pulley-set one foot of movement in the piston causes 7 feet of movement in the wire rope which lifts the monkey to the top of the column. A trip bar releases the monkey from the hook on the end of the rope. The monkey falls and is followed by the weighted hook as the hydraulic piston rod is reversed. The hook re-engages the eye on top of the monkey and it is again lifted. The monkey can be released at any height.

The rate of working of the hydraulic ram depends on the capacity of the tractor pump and the pressure at which it supplies oil. It therefore varies with different models of tractor. The maker is considering altering the hydraulic cylinder size to speed the present rate of working.

Trailed and mounted versions are available. The trailer model is recommended for hillsides. One has been built as a self-contained unit with the hydraulic pump (£38 with reservoir and fittings) driven by an 8 h.p. engine (£81).

Weight of monkey—3cwt.

Drop to top of 6ft post—4ft.

Observed rate of working—16 strokes per minute.

Chain and screw post clamp.

The hydraulic cylinder and controls can be easily dismantled from the driver and used on other implements (e.g. discs).

The wire rope (£2/3/-) lasts for about 80 hours' use.

TOMPKIN POSTMASTER

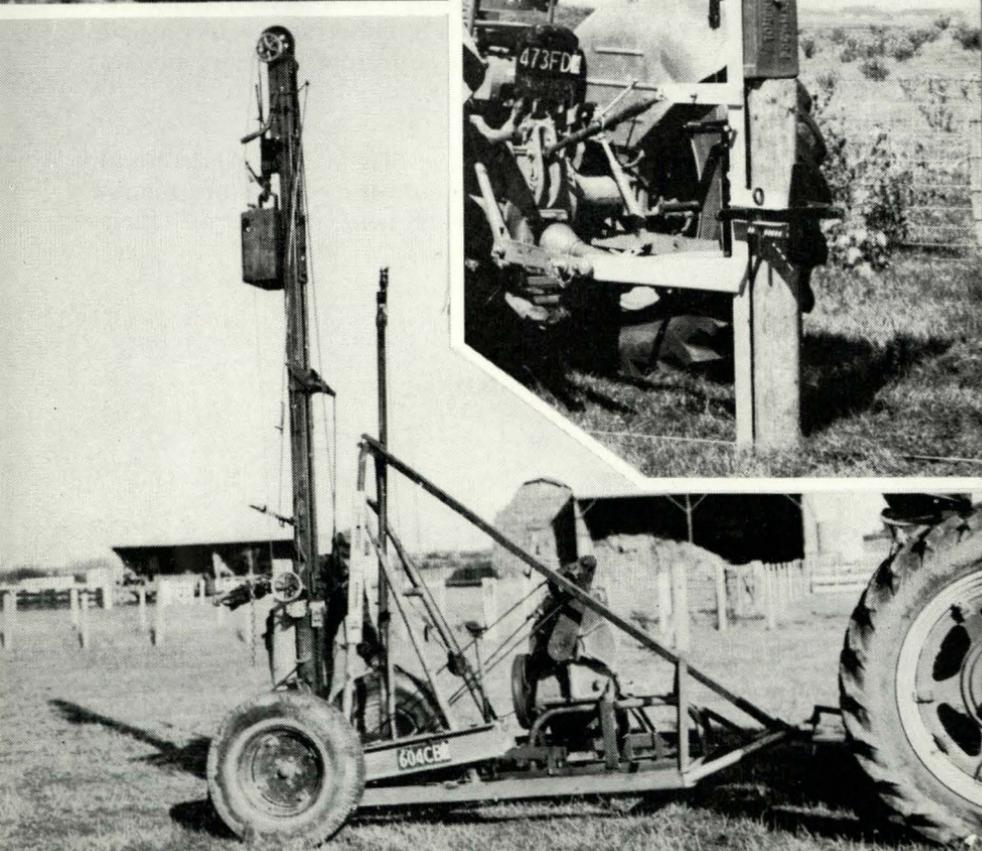
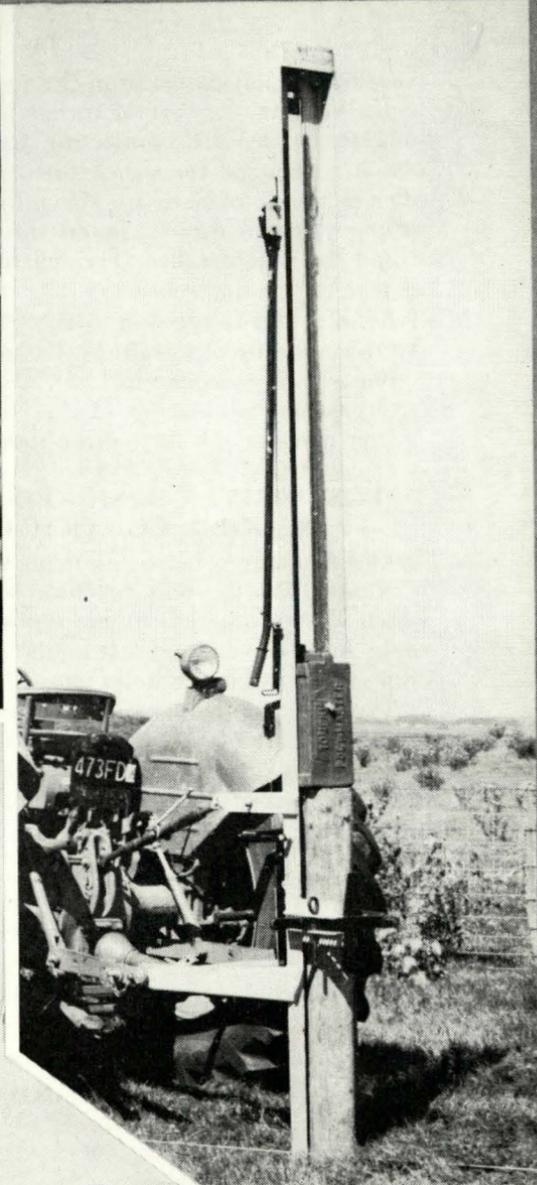
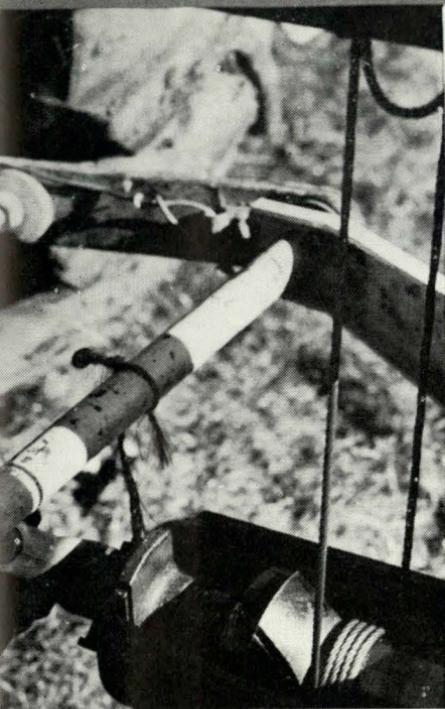
Made under licence by the Hawera Engineering Co. Ltd., Union Street, Hawera. Price £147/10/- f.o.r. Hawera. Dealer estimates £5 freight to Christchurch.

A shaft connected to the tractor p.t.o. passes freely through the centre of a small winch drum, and through a small clutch ring to a flange which is keyed to the shaft. This flange can be moved along the shaft by a hand-clutch lever. In the engaged position it is held against the clutch ring which in turn bears against the winch drum and rotates it. A thin wire rope under

Top left: The Tompkin winch.

Right: The Tompkin Postmaster.

Below: The Gold post driver. Note the continuously rotating crank.



constant tension passes from the top of the monkey over the top of the column, for several turns around the winch and back up to a tensioning arm projecting from the monkey. When the clutch is engaged the winch turns, the rope is wound on to and off it as the monkey rises. When the clutch is released the winch drum is free to rotate around the drive shaft running through it and the weight falls. The height of the drop is variable.

Weight of monkey—130lb.

Drop to top of 6ft post—3ft.

Observed rate of working—35 strokes per minute.

Bar and pin post clamp.

Occasional adjustment of the clutch and cable is needed.

This machine has the lightest monkey of those seen.

POST DRIVER DESIGNED AND OPERATED BY R. GOLD, CONTRACTOR, DARFIELD

This machine is not being made commercially, but is included because it was the only machine seen of the lift and drop type which was automatic. While a post was being driven, Mr Gold could hand-drive standards to the previous posts, pull wires, or chip and crowbar the holes ahead.

A petrol engine drives an ex-army radar screen reduction gear box. The continuously revolving crank arm works a wire rope and pulley system which raises and drops the 3cwt monkey in the manner of many well-drilling rigs.

Acknowledgement

I would like to thank John Dunn of the N.Z. Agricultural Engineering Institute for his advice, and the contractors, manufacturers and manufacturer's agents who showed me their machines.

TORDON AND SWEET BRIER

Mr R. M. D. Johnson of "Mt. Torlesse," Springfield, has recently received this letter from the Canterbury Fields Superintendent of the Department of Agriculture. We thought it would interest runholders.

Dear Mr Johnson,

THE USE OF TORDON—SWEET BRIER AND GORSE CONTROL

Your recent enquiry at Head Office re the use of Tordon for Sweet Brier and Gorse control has been referred to me for reply.

As you are doubtlessly aware, "Tordon" is available commercially in three formulations as:—

Tordon 75-T: a mixture of Tordon and 2,4,5-T.

Tordon 50-D: a mixture of Tordon and 2,4-D.

and Tordon 2G: a granulated form of Tordon and inert filler.

The two mixtures are in liquid form intended mainly for coverage spraying purposes. Tordon 2G granules are for dry application and normally applied as "basal" treatments though they can also be used as broadcasted applications.

Of the three formulations, Tordon 75-T as a coverage spray and Tordon 2G granules are the two normally employed for Brier and Gorse control.

It is generally agreed that weedicides used in scrub control and which incorporate Tordon, prove most effective when applied to actively growing plants, i.e., during those months and seasons of the year when soil moisture and temperatures are conducive to active plant growth.

This is especially so in so far as coverage spray treatments are concerned but is not quite so critical in the case of basal applications of granules.

Department "time of application" trials on Sweet Brier have indicated that coveraging spraying with Tordon 75-T is most reliably effective if confined to the months of October and November, though in favourable growth seasons and localities, period may be extended either earlier into the spring (from mid-September onwards) or later in the summer (up to mid-December). The critical factors involved are (a) adequate and preferably full-leaf development to provide maximum surface area for herbicide contact and absorption by leafage and (b) most active growth within the plants.

Moreover, sprays applied within these periods suppress "hip" formation whereas, later applications may not do so.

In coverage spraying, complete spray coverage is desirable but the amount of spray solution required per acre to achieve this will depend upon the density of the infestation and size of plants concerned.

In a dense stand of medium-sized bushes, when spraying with ground equipment, this would probably involve not less than 125 to 150 gallons spray solution per acre.

The recommended rates of application for Tordon 25-T (0.75lb acid equivalent of Tordon and 2.0lb a.i. of 245-T per gallon) is four (4) pints per 100 gallons of water and applied to full coverage.

Regarding the use of Tordon 2G granules on Brier; these are very suitable and convenient for "basal" treatments but are likely to prove most effective and reliable when applied in the late winter-early spring (August-September) at about the time that plants are making their initial spring growth and when root growth and absorption is very active. Tordon appears to be taken up into Brier more readily by root absorption than by leaf absorption and hence the weedicide is very effective as a "basal" treatment.

As Tordon has a long-lasting or residual effect in the soil, the granulated form can prove very effective when applied at other times of the year but I would consider August as being the optimum time for application and would not recommend application in the late autumn to mid-winter period.

Moreover, basal treatment is likely to prove most reliable when applied to plants that possess distinct individual root crowns as distinct from the "thicket" type of growth and also where the minimum amount of extraneous plant growth or "trash" is present round the "crowns" of the plants. (This latter is usually the case in late winter-early spring.) Any excess of trash protecting the "crowns" of the Brier usually ends in disappointing results.

Tordon 2G granules contain 2 per cent of active ingredient and the recommended rate of application is two ounces of granules per 6-inch of "crown" diameter.

Opinions differ as to whether or not these granules should be applied to the crown of the plant, or spread evenly out to the "drip line" of the bush. Where there is any evidence of "suckering," the "drip line" technique would be advisable otherwise, the granules may be merely applied to the "crown" and to the ground immediately surrounding the "crown."

Tordon 2G granules can be effectively applied by broadcasting, from the air if necessary, but this method of application adds greatly to the cost of an already expensive treatment and would not be recommended except in special circumstances.

In so far as the use of Tordon in relation to Gorse control is concerned, and from the evidence of limited trial work, October, November, December, February and March coverage sprays with Tordon 75-T, have proved effective but January treatments have not. The Tordon material also proved relatively more reliable than 2,45-T.

From the evidence so far available, October, November and December appear to be the optimum time for coverage spraying of Gorse with Tordon 75-T using the same strength of spray solution as recommended for Sweet Brier.

It is not generally recommended that chemicals should be used for the control of Gorse where more orthodox farming practices such as burning, bulldozing, cultivation, oversowing, top-dressing and controlled grazing etc., in appropriate combinations, can be employed to give reasonable results. Though even in these instances chemical treatment might be recommended, subsequently, for the suppression of any regrowth Gorse.

Yours faithfully,

A. R. DINGWALL
Fields Superintendent.

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Postal Address:

Box 56,
Lincoln College,
Christchurch.

Telephone:

62-839 Christchurch