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DR. HAMILTON: There is one point Mr. McGuinness has not made any reference to and that is the area saved for hay and silage. I think it would be fair enough to say that the East Coast area has about the highest variability of rainfall in the Dominion. At the same time it makes the smallest amount of hay or silage of any district in the Dominion. Why is some attempt not made in this district to put by a considerable surplus of hay or silage which could stop the dissemination of flocks or herds when the droughts come along?

MR. MCGUINNESS: Very little silage is made but there is a certain amount of hay. Actually less than 10% of the area in question is classed as flat and these are more or less continuous which means that many properties have no suitable land for haying purposes.

MR. BLAIR: Mr. McGuinness mentioned that some of the fat lamb breeders at the end of tupping put in vassectomised rams to sort out the dry ewes and then presumably sell those dry ewes to the freezing works. Can Mr. McGuinness tell me if any of those supposedly empty ewes were actually at killing time found to be in lamb? I have culled a few ewes using similar methods and then found them to be in lamb.

MR. MCGUINNESS: My experience, too, has been that a percentage have been proved in lamb. In all cases those ewes we culled went to the butcher. We find the ram marks in lamb ewes particularly in small paddocks where the sheep are concentrated. We do not rely solely on the raddle marks but use our judgment as to whether the ewe appears to be in lamb. Doubtful ewes we hold until we are satisfied that they are empty. By the combination of methods we do not now get a very high percentage of error.

#### HILL COUNTRY PASTURE PROBLEMS.

by

P. W. SMALLFIELD, FIELDS DIVISION, DEPT. OF AGRIC., WELLINGTON.

Most of the problems now faced by hill country pastoralists are not new; they have occurred in varying degrees ever since the early settlers started to clear, burn and surface sow the bush clad hills or depastured their flocks on the natural tussock grasslands of New Zealand.

In reality of course the problems of the extensive pastoralist are much older than farming experience in New Zealand. They are the immemorial problems of exploiting grassland containing no clovers, where overstocking and burning (to increase palatability and destroy unwanted vegetation) which may lead to pasture depletion and soil erosion must be balanced with understocking which may result in reversion or lack of feeding value.

In most countries the extensive grazier has not maintained the carrying capacity of his grassland, for through force of circumstances he has been obliged to overstock. His efforts have been most successful where climatic and soil conditions have allowed the grazier to adopt more intensive methods and so by pasture sward improvement build up fertility. Where this has not been possible regulatory measures governing stocking, burning and spelling have generally been necessary to conserve carrying capacity.

In New Zealand pasture sward improvement by more intensive methods offers a solution for maintaining and improving the carrying capacity of much of the North Island surface sown hill country whilst the stability of large areas of South Island high country tussock grazing areas may require regulatory procedure to govern stocking, spelling and the control of the rabbit pest.

#### Surface Sown Pastures:

There is a very general impression that when the major part of North Island surface sown hill country pasture lands were established

that the initial pastures had a much higher carrying capacity than they do today and that only in comparatively recent years has a marked decline in productivity set in. However, the available evidence seems to show that except for the high carrying capacity of the first year when the bulk of the feed produced consisted of turnips, rape, Italian and false perennial rye, the main bush burn areas did not carry much more stock, or in some areas as many stock in their early years as they do today.

Between 1901 and 1921 when North Island sown grass increased by 4 million acres (of which probably 3 million were surface sown) total sheep increased by only 2.6 million (of which 1.5 million were breeding ewes) and cattle by 1.6 million (of which half a million were dairy cows.)

From the time of the earliest surface sowings the pastoralists were confronted, except on certain restricted soil areas of high fertility, with the disappearance of the ryegrass, cocksfoot and clovers which they sowed and with the invasion of secondary growth as bare ground appeared. In the areas not subjected to excessively high rainfall the invasion of danthonia saved large areas of surface pastures whilst in the very high rainfall areas unsatisfactory burns and rapid reversion were common.

It may help us to understand the problems confronting the hill country pastoralist if we first consider briefly the development of surface sown pastures between 1900 and 1925 by which time most surface sowings were completed and then see what has been happening since 1925 both as regards regression in carrying capacity in certain areas and progression in others, for undoubtedly the practices which have led to progression in certain areas may indicate the steps by which regression in other districts may be halted or turned.

The Settlers' Handbook of New Zealand (1902) sets out the grass mixtures recommended for surface sowing in the various Land Districts at rates varying from 20 lb. to 30 lb. per acre. The mixture generally recommended was somewhat as follows:-

Cocksfoot .. .. .	5 lb.	
Perennial rye .. .. .	10 "	
Italian rye .. .. .	3 "	
Crested Dogstail .. .. .	1 "	
Meadow foxtail .. .. .	2 "	
Timothy .. .. .	2 "	
White Clover .. .. .	1 "	
Cowgrass .. .. .	1 "	25 lbs.
Rape .. .. .	2 "	2 "
		<u>27 lbs. per acre.</u>

On land not of the best quality farmers were advised to increase cocksfoot, decrease perennial ryegrass, omit foxtail and timothy and add chewing fescue 1 lb., danthonia  $\frac{1}{2}$  lb., *Poa pratensis* 1 to 2 lb., *Lotus corniculatus*  $\frac{1}{2}$  lb. and *Lotus major* 1 lb. Commenting on the Auckland bush lands the handbook states - "It is unfortunately a fact that a great deal of these bush lands will not hold the grasses usually sown for more than three years . . . weeds and rubbish take possession of the land and carrying capacity is reduced to a minimum. This difficulty should in a great measure be met by sowing a judicious mixture of grasses when the land is first laid down . . ."

Further difficulties were encountered as settlement was pushed into the highly elevated and heavy rainfall areas for the Handbook goes on to state - "There are tracts of high range bush lands (Te Ranamoā in Kawhia County, high range country in Hokianga and high forest lands in Rotorua county. Here experience has shown that good results are obtained by letting the felled bush lie for an extra season, then under-scrubbing any fresh growth, together with close topping. These high forest lands are subject to heavy rainfall. The bush lands have a heavy cover of decayed foliage and mossy growth; this holds the wet like a sponge, and does not dry sufficiently in the season to

ensure a good burn. The grass seed when sown apparently takes well, but with summer heat the deposit burns up and the roots of the grass not having reached the solid earth die out, with the sequence that another burning and sowing is essential . . . "

The ephemeral nature of the ryegrass, cocksfoot clover pastures sown on bush burns continued to be stressed throughout the 1900-1925 period. First by Clifton, who welcomed the invasion of danthonia into surface sown swards, stating - "These natives (danthonia and microlena) unostentatiously and by the settlers unwelcomed replaced those earlier but fleeting guests designated under the generic name of English grasses . . . " Then by Cockayne who emphasised the need for permanence in surface sowings, by stating - "In fact, the whole object of surface sowing is the production of a pasture that will permanently produce a good yield of herbage suitable for grazing stock. Unfortunately, a good proportion of our bush burn pastures on inferior ground yield heavily for the first few years after sowing and then seriously deteriorate in carrying capacity. In many cases this is due to the use of too large a proportion of short-lived grasses, whose place is afterwards taken by plants that are suitable to the conditions but are not of any value from the pasture point of view . . . Many surface sown pastures on land unsuited to ryegrass have seriously deteriorated in carrying capacity after the first few years, through the mixture being composed mainly of this grass . . . " Cockayne stressed the importance of the inclusion of crested dogtail and danthonia in surface sown mixtures, drew attention to the use of browntop, Lotus major and Lotus hispidus and the folly of sowing anything but the best seed and the fact that poor land required a much more expensive seed mixture than good land.

Even with the authoritative recognition of the need for the inclusion of low fertility demanding grasses in bush burn mixtures, the average settler continued to sow mainly ryegrass, cocksfoot and clover along with rape and turnips. Much of the ryegrass sown was false perennial which rapidly disappeared and large areas were sown with "cheap" bush burn mixtures consisting largely of worthless seed. The ultimate result where the country did not quickly revert to secondary growth or did not consist of really fertile soil was that the pastures ultimately established consisted of danthonia, browntop, sheeps fescue, yarrow and other low fertility demanding grasses.

Possibly this emphasis on low fertility swards may be considered rather overstressed; for combined with these low fertility demanding species in all the more fertile portions of the hills were usually found some of the higher fertility demanding grasses and clover such as cocksfoot; ryegrass, white clover, etc. But my insistence on the swards of low fertility demanding grasses and the absence of clovers does apply to probably the majority of hill country and it is these pastures of danthonia and browntop without legumes which present the real problem of hill country farming.

Between 1925 and the present day very little surface sowing has been carried out but the problems of reversion, erosion and decline in carrying capacity have become more prominent. The problems of reversion and erosion can be seen but the actual decline in carrying capacity on the poorer hill country is difficult to measure from available statistics.

Since 1925 the North Island as a whole has shown great development in sheep farming as is set out in Table I.

TABLE I - NORTH ISLAND SHEEP NUMBERS 1925-1945 (30th APRIL).						
(in thousands, '000 omitted)						
					1925	1945
Breeding ewes	..	..	..	..	7,464	11,890
Dry ewes	..	..	..	..	536	431
Wethers	..	..	..	..	1,659	1,387
Rams	..	..	..	..	198	332
Lambs	..	..	..	..	3,862	5,068
Total Sheep (i)	..	..	..	..	13,720	19,105

- (i) Total is corrected to show actual total and not addition of column which is to nearest thousand.

The rate of increase has varied in different districts and has been greatest in those areas devoted to intensive grassland farming. The position is shown in greater detail in Table II where aggregates of counties ~~XXXXXXXXXX~~ have been grouped as regions.

R e g i o n	Breeding Ewes		Increase or Decrease		
	'000 omitted 1925	'000 omitted 1945	Actual '000 omitted	Per Cent	
Northland .. .. .	364	585	+ 221	+ 60	
South Auckland .. .. .	180	571	+ 391	+ 217	
Cape Colville .. .. .	33	66	+ 33	+ 101	
Waikato .. .. .	118	909	+ 791	+ 667	
Central Plateau .. .. .	76	291	+ 215	+ 281	
Western Uplands .. .. .	510	1,009	+ 499	+ 80	
East Coast .. .. .	1,325	1,253	- 72	- 5	
Taranaki .. .. .	131	331	+ 200	+ 153	
Rangitikei .. .. .	1,229	1,954	+ 725	+ 59	
Manawatu .. .. .	625	1,132	+ 507	+ 81	
Hawke's Bay .. .. .	1,667	2,394	+ 727	+ 44	
Castlepoint .. .. .	288	297	+ 9	+ 3	
Wairarapa .. .. .	547	649	+ 102	+ 19	
Featherston .. .. .	367	444	+ 77	+ 21	
North Island (see (i), Table I)	7,464	11,890	+ 4,426	+ 59	

(Note: The North Island increase 1920-1945 is 104%).

A full discussion of the causes of the increases and decreases in each district would involve introducing a mass of statistics covering changes in area occupied, land under pasture and crop and cattle numbers, but broadly speaking the main changes in carrying capacity as measured by ewe numbers are due to changes in carrying capacity of grassland rather than in the area farmed or changes in the proportion of cattle to sheep carried. There have, of course, been such changes; land development in the Central Plateau area, Northland and the Waikato have in some measure been responsible for the increased carrying capacity whilst in the Western Upland fairly large areas have gone out of occupation. But in the main the increased carrying capacity has been due to the use of phosphatic fertilizers and lime on pastures or ploughed land and to the introduction of clovers (usually accompanied by light topdressing) on hill country. In none of the regions tabulated in Table II can the changes in carrying capacity of purely hill country pastures be wholly dissociated from the changes taking place on ploughable land, but it can be seen that whilst the areas consisting mainly of ploughed grassland have increased remarkably in carrying capacity, that areas consisting mainly of surface sown grassland have increased only slightly or decreased.

In the Waikato in 1925 ten acres of sown grassland had a carrying capacity of two milking cows and one ewe, whilst in 1945 the carrying capacity has risen to four milking cows and six ewes, which illustrates the phenomenal increases that have occurred on intensively farmed grassland.

In contrast the East Coast region shows a decline of 72,000 ewes since 1925 and the main decline has been in the northern area where the rainfall is high and the country poor and steep. There is less reversion in the southern part of the region where the rainfall is lower. Erosion is serious in this region due largely to nature of the country and rainfall but overstocking with sheep has helped to aggravate the process through pasture deterioration. In the past fifteen years, the farmers, however, have attempted to improve their grassland farming methods by increasing beef cattle to the extent of about 65,000 head.

The Castlepoint region which consists mainly of surface sown

country shows a fairly stationary position and the increase of 9,000 ewes has occurred mainly on the less steep hills and ploughable flats.

The Hawke's Bay region which covers generally better soil areas than the two preceding regions and has a rainfall of approximately 40 inches per annum has shown a remarkable increase in carrying capacity and this has been largely due to the introduction of subterranean clover since 1932 and the development of topdressing.

In the Western Upland region which roughly covers the extended limits of what is loosely referred to as the King Country and which has been subject to considerable unfavourable comment regarding reversion has yet shown an increase in carrying capacity of about half a million ewes since 1925. This has been partly due to the more intensive farming of the ploughable areas, the development of land in previously bush sick areas and the general adoption of improved management methods on surface sown hills and the introduction of Lotus major into many hill country pastures.

Although the causes of the changes in carrying capacity of hill country pastures in the regions cited are very complex the following examples give some idea of the main trends.

- (a) Danthonia swards: On high and poor country where there is little or no flat or undulating land associated with it and on which cattle can be wintered, the surplus summer growth of danthonia has still to be controlled by burning if the danthonia is to remain productive. This annual burning, accompanied by slow sheet erosion in the autumn and winter has gradually lowered the pasture productivity until the unequal struggle of fighting manuka invasion has caused much of this class of country to be abandoned or partially abandoned and such areas are generally falling in carrying capacity.

On the other hand where areas of high country danthonia or danthonia and browntop are associated with lower land where cattle can be wintered and the surplus summer growth removed and fern invasion crushed by cattle, the general decline in carrying capacity is not so marked and is generally, under a high cattle to sheep ratio, being maintained.

- (b) Danthonia, browntop and clovers: It is, however, where subterranean clover in the drier areas and Lotus major in the wetter are associated with danthonia and browntop that carrying capacity shows the most marked increase. The real problem of course is how to introduce and maintain those plants in association with the grasses. Over large areas of the higher rainfall areas topdressing, although desirable, is not essential for the maintenance of Lotus major and its introduction is an essential feature of pasture development in the wetter areas. Its introduction is not just a matter of an aeroplane scattering Lotus major seed; it is a matter of patience and careful planting. I am reminded of one King Country property I did know fairly well where the surrounding farms were pure danthonia and browntop, subject to reversion and only produced store sheep whilst on the farm mentioned Lotus major was everywhere associated with the grasses and practically all lambs were fattened. The farmer had over a period of fifteen years introduced Lotus major by in the summer and autumn months carrying with him Lotus major seed on his daily rounds and sowing the seed on all loose ground that caught his attention. This sowing of Lotus major seed accompanied by a high proportion of cattle to sheep was instrumental in converting the farm from store sheep to fat lambs and raising the carrying capacity.

In a similar manner subterranean clover and light topdressing has been instrumental in raising the carrying capacity and fattening quality of large areas of Hawke's Bay danthonia swards.

The above analysis of pasture sward changes is, of course, complicated by reversion and erosion problems but the only real hope of controlling those is to build on a basis of better pastures.

REVERSION:

Reversion was one of the first problems of the pastoralist on surface sown hill country and particularly so when he first pushed his way into the elevated high rainfall districts. It is the problem that still receives most attention and is manifest by the prominence given to the difficulty in securing scrub cutters to clear manuka reverted areas on danthonia hill country.

Reversion has always been worst in the high rainfall areas and where over large areas there still exists an uneasy balance between pasture and reversion. Where hard grazing allows the encroachment of hard fern and as this encroachment proceeds carrying capacity is reduced until the point is reached where bracken fern enters and completes the reversion. Then the land may be rejuvenated by re-sowing after a bracken burn and the cycle of hard fern encroachment slowly starts again.

Since Levy's work in the 1920's on secondary sowings after manuka and bracken burns, there has been a marked improvement in the handling of reverted country and much land that has been allowed to completely revert will be capable of rejuvenation after felling and burning the heavy second growth manuka. Actually quite good pastures can be established after such burns and with the fire clearing all old logs the burn is clean and subsequent pasture control is often much easier than it was after the original bush burn.

Although hand cutting is necessary for clearing and re-sowing completely reverted country, hand labour alone can never control reversion; cattle and better pasture swards are the only solution.

CATTLE:

Cattle are essential for the maintenance of hill country pastures. The surplus summer growth must be eaten down in the autumn and bracken reversion crushed out. Over most of the surface sown hill country areas there is a general recognition of the need to maintain a high proportion of cattle to sheep.

Cattle statistics are not nearly as complete as sheep statistics and whilst total beef cattle figures may be calculated for each Island, figures on a regional or county basis can only be roughly assessed. Generally speaking North Island hill country pastures require at least one cattle beast to every ten sheep shorn to keep the pastures in a satisfactory condition for sheep but even this proportion is not sufficient in the high rainfall areas. Table III gives the estimated number of beef cattle per 100 sheep shorn by Land Districts between 1920 and 1944.

TABLE III - ESTIMATED NUMBER OF BEEF CATTLE PER 100 SHEEP SHORN BY LAND DISTRICTS, 1920-1944.

<u>Land District:</u>	<u>1920</u>	<u>1925</u>	<u>1930</u>	<u>1935</u>	<u>1940</u>	<u>1944</u>
North Auckland	32.72	24.03	15.41	15.96	17.64	16.21
Auckland	32.39	21.68	16.04	14.12	13.30	10.84
Gisborne	7.81	9.75	9.43	11.86	12.43	13.18
Hawke's Bay	6.64	6.72	5.30	5.59	7.99	6.80
Taranaki	13.79	10.38	9.96	9.10	9.23	7.68
Wellington	8.11	7.92	7.11	7.02	8.19	7.44

The proportion of cattle to sheep in North Auckland and Auckland Land Districts is highest in those counties where paspalum is common or there are large areas of wet alluvial land where the only alternative to dairying is cattle fattening. It is next highest in those counties where surface sown hill pastures are dominant, especially in the high rainfall areas and lowest in the counties where sheep farming is dominantly fat lamb production on ploughed grassland.

The figures from the Gisborne Land District which is a typical surface sown grazing area are worth looking at more closely. The figures in Table III must be treated with some reserve for the boundaries

of the district have been changed in the period. Opotiki county was added in 1925 and Wairoa County taken out in 1940. A more reliable view of the position can be secured by considering Matakaoa, Waiapu, Uawa, Waikohu and Cook counties which have been in the Land District the whole period. The general trend in these counties is, however, the same as for the Land District, namely a general improved movement in the proportion of beef cattle to sheep shorn and generally typical of the position in areas where surface sown pastures predominate. The details for these counties are given below:-

County:	<u>Estimated No. of Beef Cattle per 100 sheep shorn.</u>				
	1925	1930	1935	1940	1944
Matakaoa	8.19	7.86	12.69	12.21	13.34
Waiapu	8.92	8.86	11.91	12.41	13.00
Uawa	8.78	7.33	11.41	11.46	11.03
Waikohu	11.21	11.91	13.29	13.22	14.78
Cook	10.46	9.62	11.62	12.13	12.84

In Hawke's Bay the number of cattle per 100 sheep shorn varied in 1944 from 7.75 in Weber to 4.43 in Waipukurau. In Taranaki and Wellington the variations were on much the same lines as Auckland being highest in the counties in the high rainfall districts having a large area of surface sown land, i.e. in 1944 Ohura County had 15.72, Whangamomona 14.44 and Kaitieke 14.19 beef cattle for every 100 sheep shorn.

As has already been stated the difficulties of the hill country pastoralist are greatest where a sufficient proportion of cattle to sheep cannot be maintained owing to the problem of winter feeding. Lack of adequate winter feeding results in losses and in having cattle too poor in the spring to undertake their legitimate work of crushing fern. Two lines of approach to overcome this problem suggest themselves; first, the development of better pastures on all the easier country and the search for edible shrubs for hill country planting which might be utilised for wintering cattle. It is fairly obvious that it will never be generally profitable to resort to the provision of hay, silage or fodder crops for feeding beef cattle.

#### EROSION CONTROL:

Erosion control is obviously one of the most immediate and pressing problems of hill country and will involve pastoralists in expensive works covering the stabilization of land in the upper gullies through the erection of debris dams, spaced tree planting and the development of closer pasture swards. Ultimately the money for the works will have to come from the increased carrying capacity brought about by better pasture swards, so that the control of erosion depends essentially on the development of better pastures.

#### BETTER PASTURES:

The development of better pastures on surface sown hill country is a slow and difficult business. The mere scattering of seed and fertilizer which in itself is costly on high and broken country will not always give the desired result. Fertilizers alone without the introduction of clovers generally have little effect. Each step in improvement must be planned so that the results of increased carrying capacity can be made to pay for the next advance. Much more research work is urgently required on the problem of introducing clovers into danthonia and browntop swards and no work if even moderately successful could pay the country a more handsome dividend.

To introduce and maintain clovers over large areas of high and broken hill country may seem an insuperable problem but when we see what some hill country farmers have already done in this direction and also look back on the advances in grassland farming which have been made on ploughed grassland over the past thirty years, I do not believe that the problem is at all impossible of solution. In the intensive grassland farming districts improved carrying capacity has always more than paid for the cost of more intensive methods and I feel that

it will do so over very large areas of hill country.

#### TUSSOCK GRASSLANDS:

The tussock grasslands which developed in the absence of grazing animals have naturally reflected the burnings and heavy grazing to which they have been subjected for nearly 100 years. Over large areas of lowland tussock grazing and burning have converted the pasture to danthonia with a consequent increase in carrying capacity whilst over large areas of high country burning, over-grazing and the destruction caused by rabbits has led to serious deterioration and in places to actual depletion of the natural vegetation.

The problem of deterioration and depletion of the South Island tussock grasslands was first officially discussed by Clifton in the Department of Agriculture's annual report for 1909 when he wrote as follows:- "Over a great part of Otago the most marked feature is the denudation of the country. It is said on all sides that when stock first occupied that district, native grasses grew with luxuriance, that grass was cut for hay on the hillsides where now nothing remains but the bare soil and shingle boulders. The agents of this denudation are given by long resident farmers and pastoralists as in the first instance, fires at all seasons whenever the grass would burn, followed by overstocking, intensified by the advent of the rabbit. For years this deterioration process has gone on, and it is still proceeding. . . . The importance of this subject cannot well be over-estimated. The denudation of the soil applies to an enormous area of country throughout the pastoral districts of the South Island and more particularly to the lands generally described as the waste lands of the Crown and held under grazing leases. The chief proposal is that grazing should not be continuous on such lands, that on each run a portion should be left unstocked to permit the natural grasses to recover and re-seed, and that on lands where denudation is apparently complete, an attempt should be made to re-seed with certain selected grasses. . . ."

The problem of the deterioration and depletion of the tussock grasslands has been under close study since Dr. L. Cockayne made an exhaustive study of the problem in the early 1920's and again emphasised the necessity for spelling and natural rejuvenation but the cost of fencing in relation to the returns for the land has so far precluded any general action in this direction. Present work being conducted at Molesworth Station which has been retired from sheep grazing by the Lands Department should provide evidence of the utility of spelling and natural rejuvenation.

Some idea of the trends in carrying capacity of tussock grassland over the past 25 years can be gained by reviewing the sheep statistics of McKenzie County where high country sheep farming utilises the greater part of its 1½ million acres. Here it requires slightly over two acres of tussock grassland for each sheep shorn. The number of sheep (which fluctuates round about half a million) rose gradually between 1920 and 1930 and remained fairly constant until 1940 and since then has shown a tendency to decline. A closer illustration of the fluctuation in sheep numbers may be gained by considering the sheep numbers on groups of stations covering (a) sub-alpine land where the main product is wool and (b) general extensive sheep farming where the products are wool, store and breeding stock.

TABLE IV - NUMBER OF SHEEP ON ELEVEN SUB-ALPINE AND ELEVEN EXTENSIVE SHEEP STATIONS - MCKENZIE COUNTY

		<u>Sub-alpine</u>	<u>Extensive</u>
1920	...	57,812	26,716
1925	...	61,920	25,557
1930	...	73,163	30,343
1935	...	68,649	28,532
1940	...	65,471	27,600
1945	...	59,214	25,422

The reasons given for the increase between 1920 and 1930 are greater control of rabbits and consequent improvement in pastures and a rise in the number of merino sheep. Falls between 1930 and 1940 are attri-

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buted to snow losses and a swing away from Merinos and the decline since 1942 is again attributed to snow losses, labour difficulties and a continual decline in the proportion of merinos.

The fundamental problem of the extensive pastoralist on tussock grassland is to maintain carrying capacity and if this is to be achieved it must involve the effective control of the rabbit pest, the cessation of burning and the periodical spelling of pastures. The problem is a complex one due largely to the tenure under which the land is held and its low productivity which makes it difficult to finance necessary sub-divisional fencing, to the need on many runs for the provision of winter country to avoid excessive snow losses and to the difficulty of securing labour for the arduous and specialised work of high country stations. Further, the works necessary to arrest decline do not promise very adequate financial return; they do not promise as in the North Island increased carrying capacity and increased returns which will cover the financing of the necessary improvements.

#### SUMMARY:

In this paper I have made no attempt to review in detail the problems of hill country grasslands, for to do so would have occupied more than the full time of your conference, and in my attempt to simplify the problems I fear that I have committed many errors of over- and under-statement.

While my knowledge of the tussock grasslands of the South Island is rather meagre I have seen sufficient of the surface sown grasslands to believe that the adoption of more intensive methods of grassland management do offer the only practical solution for the problems of deterioration, reversion and erosion in the North Island. While such practices cannot be carried out over the whole of the surface sown area, the area on which they can be carried out is greater than is generally imagined. Lotus major and subterranean clover may yet do for the hill country farmer what white clover has done for the grazier on ploughed grassland.

#### DISCUSSION ON MR. SMALLFIELD'S PAPER:

MR. SEARS: I was very interested in Mr. Smallfield's paper. I agree with him that the problem is to maintain hill pastures for the wintering of cattle. Two possible solutions hinge round the use of the bull-dozer. In the South Island they bull-doze tracks into selected areas and increase accessibility to stock. Ploughing and more concentrated stocking convert it to an intensive grazing area. The other method used more in the North Island is to use bull-dozers to provide more dams at higher levels and access to them, and thus encourage more even grazing of the hill country. It is on these little plateaux formed as a result of such excavation that we can build up intensive grazing areas. I would like Mr. Smallfield to give us his views as to the improvement by that method.

MR. SMALLFIELD: Most of my contact with the bull-dozer method was in connection with topdressing. I think with Mr. Sears that the whole business of hill country problem centres round the wintering of cattle and I do think that we could do much more than we are doing in trying to find whether there are any edible shrubs which could be grown on the hill country to help in the wintering of cattle. I am sure there must be shrubs that could be used for that purpose. I do not think that in normal times the beef cattle man will grow hay or silage for feeding. For wintering cattle you will have to rely on rank pasture and such edible shrubs as can be grown on hill country.

MR. LYNCH: One point of view is that we should concentrate on the more fertile sections and build that up rather than endeavour to improve the hill country as a whole. What does Mr. Smallfield think of the possibilities of that method of approach, assuming that we can get fertilisers?

MR. SMALLFIELD: I think the point about fertilisers is that if you are going to get your money back you must apply them to your best