

1925.
NEW ZEALAND.

DETERIORATION OF CROWN LANDS.

REPORT OF THE SPECIAL COMMITTEE APPOINTED TO INVESTIGATE THE DETERIORATION OF
CROWN LANDS IN THE WHANGAMOMONA, OHURA, WAITOMO, OTOROHANGA, KAWHIA,
RAGLAN, KAITIEKE, WAITOTARA, WAIMARINO, AND OTHER COUNTIES.

Laid on the Table of both Houses of the General Assembly by Leave.

To the Hon. the MINISTER OF LANDS, Wellington.

SIR,—

As members of the committee appointed by you to conduct inquiries regarding deteriorated lands in the above counties, we have the honour to state that we have completed our investigations, and now beg to report as under :—

We covered the greater part of the area under review, and for the purpose of obtaining further information and evidence held meetings of settlers at sixteen different centres, and also took evidence from individual farmers *en route*, and from other persons interested or having knowledge of the various questions involved. The meetings were on the whole well attended, and much valuable information was derived therefrom.

(1.) NATURE OF THE COUNTRY.

The country under consideration may be divided into three classes :—

- (a.) Hilly forest country too steep for ploughing, and comprising the greater portion of the area :
- (b.) Forest country containing a large proportion of ploughable land :
- (c.) Open fern and scrub country, most of which is ploughable.

The altitudes vary from sea-level up to about 2,000 ft., and the heights of the hills above the valleys vary up to 800 ft., an average being about 600 ft.

The soils are of the following types : Papa, sandstone, friable volcanic loams, and in places pure pumice, or mixtures of the above. In the Waitomo County there are large outcrops of limestone and rhyolite. The papa soils are the most fertile, but papa country where steep slips badly. The volcanic loams generally, with reasonable treatment, become profitable soils. Sandstone country is generally very steep and does not lend itself so well to treatment. Pumice soils are perhaps the poorest, and are difficult to grass except with special manurial treatment.

The forest cover varied according to quality of soil :—

- (a.) On the richer portions of the land tawa was dominant, associated with pukatea, white-pine, maire, matai, and mahoe :
- (b.) On the easy average-quality slopes tawa was dominant, associated with rimu, matai, miro, rata, and totara :
- (c.) On the poorer, steeper, and harder country were tawhero, rewarewa, and hinau :
- (d.) On the topmost sandstone ridges were black-birch and tawhero, mainly :
- (e.) On the open scrub country the natural vegetation consisted mostly of bracken-fern, associated with tutu and, in places, manuka.

Much of the country was covered by a spongy, peaty substance known as pukahu, most evident in wet tawhero country.

The forests on the whole contained little milling-timber, although here and there some timber has been milled where the access is good.

(2.) NATURE OF DETERIORATION.

The deterioration complained of and markedly in evidence consists largely in a dying-out or in a replacement of the grasses and clovers sown, by various classes of fern, herb, and scrub growths—namely, bracken fern, hard fern, soft fern, wineberry, manuka, fuchsia, tutu, and hutiwai. The growth of these plants on the country does not necessarily indicate that the land is too poor to grow grass, but rather that there is a strong natural tendency for that country to revert back to its natural forest cover. The fern and scrub growths that make their appearance in the clearing soon after the forest has been felled and burnt constitute really the first phase in the succession back to forest. Nature all the time is endeavouring to win back the area to forest, and in a district of fairly good soil and heavy rainfall the advantage is all with the secondary growth. On areas where an intensely hot fire of the felled forest is secured the germ of the forest is entirely destroyed, and it is not until such time as seeds migrate on to the area that we see on these areas evidence of the forest re-establishment. In these latter areas it will be obvious that the grass-seeds sown on the forest-burn will have an almost undisputed reign, whereas that seed sown where the germ of the forest has not been killed will have immediate competition, and unless special judicious management is meted out the grasses sown have no hope of successfully competing with the uprising secondary forest growth. Very few forest-burns within the above counties are sufficiently hot to kill the germ of the secondary forest.

According to the heat of the burn and subsequent stock manipulation, the class of the secondary growth varies:—

- (a.) With a light burn and virtually no stocking, bracken, soft fern, wineberry, fuchsia, and lacebark predominate.
- (b.) Where the conditions are wet and the soil loose, usually carrying a mass of pukahu, and generally at higher elevations, soft fern usually predominates.
- (c.) Where the conditions are somewhat dry and the soil light and friable, and where only light cattle-stocking has been the rule, bracken and hard fern predominate.
- (d.) Where the bracken-fern growth has been largely kept under for some years, mainly by sheep, and where close and continuous grazing has been practised, hard fern and hutiwai are often extremely prevalent.
- (e.) Where the soils are poor, or where the fertility has been reduced by close and continuous grazing, and where an open sward prevails, manuka asserts itself. It may reappear rapidly on country previously carrying manuka, or it may follow as a subsequent association over hard-fern areas.

(3.) EXTENT OF DETERIORATION.

In the district under review there are (excluding soldiers' lands) about 1,990 Crown holdings, with a total area of 874,700 acres. Of these holdings 75, with a total area of 42,905 acres, have been abandoned. The percentage of holdings abandoned is 3·77, and the percentage of area abandoned 4·9. It is impossible to obtain accurate information regarding the area and proportion of deteriorated lands over the whole area. The following statement is compiled from circulars returned by 310 settlers in the various counties, and may be taken as an approximate average and a fair estimate:—

Number of settlers who sent in statements	310
Total area occupied	165,220 acres.
Area felled and grassed	112,250 „
Area fairly clean pasture	68,341 „
Area in second growth	43,909 „
The proportion of the reverted country to area felled and grassed is	39·12 per cent.
The proportion of country in fairly clean pasture is	60·88 „

Taking these figures as affording a fair average over the whole of the Crown holdings in the counties under review, we estimate that the total area of reverted country is 232,500 acres.

(4.) CAUSES OF DETERIORATION.

We consider the factors most potent in the bringing about of this deterioration are as follows:—

- (a.) *The wet climatic conditions prevailing, preventing hot burns—primary or secondary—and favouring a very strong and rapid growth of fern, &c.*

Climate is a big factor in the breaking-in of any hill country in New Zealand. The wetter and the milder the climate the more difficult breaking-in operations become. In the first place, so much depends upon the initial burn, for unless a hot burn is secured the seeds and spores of the secondary growth, well and truly sown on the forest-floor long before the forest is felled, remain alive, and from these seeds and spores plants establish during the winter following the burn. In every shaded place where the heat of the fire has not penetrated, around logs, stumps, and in crevices, are myriads of young ferns, bracken fern, hard fern, and soft fern in the prothallus and young sporophyte stages, and over the burn in general wineberry, fuchsia, &c., may come up quite thickly. Thus right from the offset the grasses and clover sown have to compete with a strong volunteer growth. In a light burn, also, many logs are left on the ground, making stocking by either cattle or sheep difficult or dangerous unless very high costs are entailed in the tracking and logging-up of the burn.

A wet climate not only induces secondary growth, but also makes the control of that secondary growth difficult. Of the kinds of secondary growth that are most troublesome in the above counties, hard fern and soft fern in particular are surface-rooting, and if only a hot fire can be secured over this class the surface stolons are easily killed, and then that particular growth ceases to trouble. Again, shade is not inducive to the spread of any of those grasses and clovers which would migrate and form a turf over the country. Particularly is this true of danthonia. To ensure danthonia to spread, light must be allowed into the crown of the plant; and, without a doubt, where secondary growth is troublesome the cheapest way of removing the shade of the secondary growth is by the firestick. In a wet climate where the firestick cannot be satisfactorily used, then the more expensive implement, cattle, or the slashhook, must be employed to effect the removal of the shade of the secondary growth so that the danthonia and other grasses may spread.

(b.) *Insufficient fencing of the country, so that controlled stocking, particularly by cattle, could not be carried out.*

In most instances throughout the above counties the areas of forest felled at any one time have been on the large size compared with the ability of the settler to fence and sufficiently stock the area felled. As before stated, the germ of the secondary growth survives in most instances the heat of the fire. The grasses sown have this growth to compete with; and it must be said that we have in New Zealand at the present time no combination of pasture plants which in themselves are sufficiently aggressive to swamp out secondary growth. The two great factors in weed-control in our grasslands are (1) the formation of a close and continuous grass sward, and (2) the judicious feeding-down of that sward by different classes of stock. Stock judiciously managed are really the most potent agents in the control of weeds, and particularly is this true of cattle. On the ability or otherwise of the settler to stock his new burn with cattle depends, in nine cases out of ten, success or failure. Most of the ferns take, from spores, two to three years before they form anything like adult plants. During this period the treading of the cattle plays havoc with the young plants, and if only the whole of the surface could be cattle-tramped during the first few years there would be little fern-growth on that area. The presence of innumerable logs and stumps precludes this possibility, but the principle holds good for all parts of the burn that may be tramped by cattle. Cattle, again, consolidate the country and make possible, for grass, pukahu areas and other light spongy soils where, without the consolidation, the grasses simply wither off, leaving the area open to weeds. To effect this consolidation and to tread out the establishing ferns, &c., a heavy cattle-stocking is necessary, and farms have been visited where from one to two cattle to the acre for short periods have been maintained on the new burn during the first two or three years. This gives some idea of the cattle-power necessary on certain areas; and unless the burns are fenced into comparatively small areas such cattle-stocking is an impossibility. Again, many burns are not fenced at all from the neighbouring unfelled portion, and thus the settler has no control at all over his cattle, and as soon as the harder winter conditions come on, or as soon as the feed amongst the secondary growth becomes scarce, the cattle are liable to take to the bush. Again, stock of almost all descriptions will always hang on the warmer slopes or where the feed is sweetest, and it is not until these areas are fenced off from the shady or rougher portions that stock may be kept on these latter places. In order to bring back the deteriorated lands, fencing is an essential. No definite size of the paddock can be given, as this varies according to the size of the holding and to the cattle-power that the settler can bring to bear on any one area at the one time. Roughly speaking, 10 per cent. of the holding would represent the size of a good workable paddock. Thus on a 1,000-acre place the maximum paddock would be not more than 100 acres, and on a 500-acre place 50 acres would represent about the largest paddock that could be effectively worked. The secret of pasture maintenance and improvement, and of secondary-growth control, lies in the ability of the settler to heavily stock the area for a short period—to clear it up rapidly and then to spell. This intermittent hard grazing and spelling is not possible unless the farm is adequately fenced.

(c.) *Injudicious stocking—close and continuous grazing by sheep; failure to spell the country.*

It may be laid down as a fairly definite rule that close and continuous grazing, particularly by sheep, leads to an early running-out of the first-class grasses and clovers, and to an incoming of either low-fertility-demanding and light-loving grasses, such as danthonia and brown-top, or weeds, such as catsear, hawkweed, cudweed, &c., or hard fern, hutiwai, and manuka. In the country under consideration, in view of the light burn and loose nature of the country, it would appear that the stocking has been too much with sheep and not enough with cattle. Once the secondary growth makes headway sheep will avoid those places where it is growing, but will keep close-grazed the grassed areas. The spread of hard fern, hutiwai, &c., is greatly encouraged through baring the grass turf to the ground. Sheep, no matter how forced, will not break into the patches of hard fern, &c. Crushing with sheep, therefore, but adds to the deterioration, inasmuch as, while little damage is done to the secondary growth, the heart is eaten out of the grasses and these become weaker and weaker. Cattle break into the secondary growth, and owing to their not being such close grazers as sheep the pasture grasses are not so weakened. The ewes and the dairy cows are harder on the country than are dry stock, and the former class of stock cannot be forced to crush out secondary growth, or to clean up rough pasturage, in the same way as can the latter. The change to dairying forced on many settlers during the slump has been attended with deterioration of virtually all the steeper and more difficult portions of the farm.

(d.) *Sowing of grasses and clovers not wholly adapted to the country.*

In the early days of felling and sowing country in the above counties the grasses mainly used were rye-grass, cocksfoot, red and white clover, with a good sprinkling in some cases of timothy,

crested dogstail, meadow-foxtail, *poa trivialis*, *poa pratensis*, and alsike. Many settlers still pin their faith to the cocksfoot and other first-class grasses, but there is a big leaning at the present time towards certain of the second-rate grasses and clovers, such as *danthonia pilosa*, brown-top, and lotus major; and *paspalum* on certain of the warmer slopes is advocated.

Excepting where areas have been very carefully farmed, or where the soil naturally is somewhat better, or where top-dressing has been practised, it must be said that the first-class English grasses and clovers are not holding. The rye-grass held good for two or three years and then it dwindled, leaving the cocksfoot as the dominant grass. Under certain conditions of grazing, the cocksfoot, associated with *poa pratensis*, crested dogstail, and white clover (generally with a good deal of Yorkshire fog), persists, and just so long as the surface-soil fertility remains up to a certain standard this sward may be kept almost indefinitely; but under the system of hard grazing, generally close and continuous, by sheep the sward opens up and the pasture becomes a prey to weeds, unless such grasses as brown-top and *danthonia* are present and are spreading over the areas.

In the choice of species of grasses and clovers to constitute the pasture sward the farmer has two alternatives:—

- (i.) To use only the first-class grasses and clovers—mainly rye-grass, cocksfoot, crested dogstail, *poa pratensis*, white clover—and by a system of spelling or by manuring maintain the fertility of the country so that these species are kept sufficiently vigorous to maintain a close cover over the whole of the hillside; or
- (ii.) To use in addition to the above species grasses and clovers which will form a close turf over the country even though the soil-fertility may be considerably reduced—such additional grasses are *danthonia pilosa*, brown-top, New Zealand rice-grass (*microlaena*), *paspalum*, ratstail, lotus major, lotus hispidus, subterranean clover, yarrow, and suckling-clover.

The first-mentioned grasses and clovers, provided they are kept strong and vigorous, will beat the ones below in production, but the cost of maintenance of fertility in order to keep them going will in most cases be extremely high, and often impracticable. More cattle will be necessary, more spelling of the country, which means more fencing, or artificial manures will have to be liberally applied. Once a sward of brown-top, *danthonia*, New Zealand rice-grass, ratstail, *paspalum*, &c., becomes established the country is cheap to maintain, and on hard and difficult country it would appear a sounder proposition to accept the lower-producing yet less costly sward rather than to attempt to supply the demands of higher-fertility-requiring grasses and clover. Few hill-country farmers in other parts of New Zealand have managed to retain intact the first-class English-grass sward. Almost everywhere one sees creeping in one or another of the low-fertility-demanding grasses and clovers. This fact speaks for itself, for there is no doubt that if only the first-class grasses are kept growing strong and vigorous there is no fear of invasion of that sward by the lower-producing inferior grasses. The maintenance of fertility is the decisive factor in regulating the composition of any pasture turf. Where the costs of fertility-maintenance are high it is better to accept the second-rate lower-fertility-demanding grasses and clovers; and where soil conditions are poor, and fertility upbuilding and maintenance is impossible owing to the topography and inaccessibility of the country, the acceptance of these second-rate grasses is the only safe course.

(e.) *Depletion of fertility.*

According to the standard of fertility maintained so will the composition of the pasture vary. The first-class grasses and clovers require a high standard of fertility; the second-class grasses and clovers a lower standard. Any farming practice that tends to reduce fertility has a deleterious effect upon the pasture sward. In the above counties, while the fertility due to the humus of the forest and the potash lasted, the rye-grass, cocksfoot, clovers, &c., grew luxuriantly. We feel that a good deal of the deterioration in the older pastures is the result of a gradual reduction in the surface fertility of the soil, brought about by close and continuous grazing, and by the natural loss of plant-food by leaching, due to the constant rain and loose nature of the soil.

Indirectly, the following causes also are to some extent responsible for the deterioration:—

(f.) *Boom and slump periods.*

During the war period, and onwards to the height of the land boom, labour, grass-seed, and fencing-wire, and also stock, were very dear. This deterred many settlers from going on with improvements and purchasing stock, and those who went on with improvements during that period did so largely on borrowed money and greatly increased the indebtedness of their holdings. When the slump came many settlers were forced to sell their stock at heavy loss, and were unable, owing to lack of funds or credit, to purchase other stock, and in consequence second growth was allowed to grow unchecked. Even settlers who had their farms stocked received such low returns from them that they were unable to afford expenditure on improvement and maintenance.

(g.) *High maintenance costs, these being in most cases too high for the unfinancial settler to keep up and live.*

The felling of the natural forest, the surface-sowing of the seed, and the fencing is by no means the last cost in the farming of hill country, and particularly is this true of virtually all the country in the above counties. The cost of maintenance is a most important economic factor to be considered, for it is not until the costs of maintenance have been accurately gauged that one can get any idea of the net earning-power of the land. In the older forest country, such as that of the Wairarapa,

Hawke's Bay, Gisborne district, and that between Palmerston North and Taihape, when the forest was felled and the land grassed and fenced the settler's troubles were virtually at an end, as there was little or no secondary growth to contend with, and that which did come away was comparatively easily dealt with. From these lands, therefore, production has been maintained, and the maintenance costs have kept comparatively low, and could in most cases easily be met. In the case of the lands under our consideration the conditions are very different: the running-out of the grasses sown, and their replacement by fern and other rubbish, meant an early reduction in the profits of these lands, and throughout maintenance costs were steadily increasing. Where capital was available and judiciously applied the maintenance costs could be met before deterioration went very far, but on those farms where little or no money was available for maintenance the conditions went from bad to worse.

Any country troubled with secondary growth, and where that secondary growth cannot be regularly burnt, is expensive to get into grass and maintain. To ensure a pasture sward on any hill country the secondary growth, where any appears, must be periodically removed until such time as a close turf of permanent grasses and clovers is secured.

No grass turf will thrive well under dense shade, and particularly is this true of danthonia. On second-class hill country, until secondary growth is got rid of, a danthonia sward undoubtedly should be the objective. This means that in one way and another all shade-making growth must be cleared off. Where possible, the cheapest and quickest way of effecting this is by firing the area. Thousands of acres in New Zealand have been brought into danthonia by means of the firestick. Each fire lets in more light, and the danthonia spreads, and in many cases no reseeding is necessary. In the case of the country under consideration it is not possible regularly to fire the areas, and consequently sunlight has to be let in by more expensive methods—namely, by the use of cattle or with the slash-hook. The danthonia or the brown-top sward existing at the present time on other hill-country areas of the North and in the South Island may be said to have been got very cheaply, and in many instances practically at no cost to the farmer at all. Over the country we are considering the danthonia sward will cost a good deal to become general, because of the cattle necessary, and inability to burn. Also, there is more resowing of seed necessary, and an inclusion of other grasses in the mixture that will tend to cover the ground until such time as the danthonia spreads and becomes general. Danthonia even under favourable conditions is slow to spread, and in very few places has a sward of this grass been secured in under ten years. Sowing of danthonia alone, therefore, is not a sound proposition where the return of secondary growth is rapid. Crested dogstail, brown-top, and lotus major particularly, besides other grasses and clovers, should accompany all danthonia sowings made in the above counties. The seed of certain of these is expensive, which again adds to the maintenance costs of keeping that country clean.

(h.) Lack of knowledge of local conditions.

There is no doubt that the peculiar local conditions prevailing in the above counties upset the calculations of many settlers, even those of wide experience in the breaking-in and farming of other hill country in New Zealand—Hawke's Bay, Wairarapa, Rangitikei, &c. The forest indications and the early productivity gave promise that the country would break in well and would rank equal to or better than much hill country in other parts. The settlers went to work and felled the forest, and sowed the same seed-mixture as they were accustomed to in the district of their previous experience. Stocking was carried out in much the same way—namely, largely with sheep—and little fencing was done. Even where areas were well fenced the importance of cattle was not recognized. After some years the English grasses went out, *as they also have done in most other hill country in New Zealand*; but instead of the vacant spaces in the pasture being seized upon by danthonia, brown-top, &c., which has happened in most other hill country, these became filled by pasture weeds, hutiwai, ferns, and scrub. We think failure to foresee this eventuality, and lack of capital to meet the eventuality when it arose, have helped in the present deterioration.

(i.) High rental values and high unimproved values.

The overestimation of the capabilities of the country, and the high goodwills paid on transfer since about 1908, have in many cases led to excessive rental values being credited to the land, and in consequence an excessive percentage of the returns that could otherwise have gone into improvements when the secondary growth was in its initial stages had to be swallowed up in meeting rent.

(j.) Difficulty of providing winter feed.

The difficulty of wintering stock at the present time, with so much steep country and so much still in the unstumped condition, is very manifest in certain blocks of country that were visited. Failure to carry sufficient cattle over the winter for the spring requirements is a big factor in the country having reverted so badly. The buying of cattle in the spring and having to sell again in the autumn, according to evidence given, resulted in a direct financial loss to the settler. The heavy death-rate of stock recorded in certain places is due in the main to their foraging in dangerous places, as the feed of the safer country gives out during the winter. It is essential that these losses through having to buy in the spring and sell in the autumn should be eliminated as much as possible by growing winter feed on any ploughable areas available, and by conserving feed by shutting up certain paddocks in the autumn.

(k.) Aspect and steepness of country.

The shady slopes and the steep, rough places are the first areas on the burn to revert to secondary growth. Both are alike in that stock avoid grazing there while they have access to sunny slopes or to easier country along the foothills.

(l.) Lack of formed access.

Bad access in the past, and in some cases at present, contributes to the settler's difficulties, increasing costs of development and expenses of running the farm.

(m.) Lack of capital.

It was almost universally said in statements made by settlers that lack of capital was responsible for the greater part of their trouble. Cheap money was said to be the crying need of the country. They realized now that more fencing had to be erected, that more cattle had to be kept, that more seed had to be sown, and that manure, where possible, had to be applied. The question of raising money for the purchase of these was the great stumbling-block, for in many instances the land was already heavily loaded and lending institutions had tightened up considerably. A good deal of money must yet be spent on the country, and in the case of badly deteriorated areas there is little inducement given for the investment of private money. Undoubtedly the tightening-up of the money-market to these settlers has deterred much good work from being accomplished.

SIZE OF HOLDINGS.

(Part A, Order of Reference.)

(a.) In the case of the unploughable hilly land we consider that many of the holdings are too small to enable the settlers to make a reasonable living, and that the same class of land can be improved and worked more economically in larger holdings, the capital expenditure in the matter of fencing, building, &c., being considerably less per acre on larger holdings. We are of opinion that in the case of the land above described the minimum area generally should be large enough to winter about one thousand mixed sheep and one cattle-beast to 5 acres. We recommend that provision be made for the reclassification of these lands, and also of the freehold lands of similar description held under title subject to Part XIII of the Land Act, 1908, with a view to allowing an increase in the area of holdings where desirable. In the case of the ploughable lands, either bush or other country, we consider the present areas are sufficient. It would, however, be a great benefit to the settler who has at present only steep, unploughable land if he could secure in addition a piece of ploughable land. This would enable him to carry stock through the winter which he requires in the spring to keep his country in order.

In regard to areas of holdings which by reason of their poor quality and extreme steepness cannot at present be profitably improved, it would not be advisable in most instances to sever such portions, which are usually steep, high country at the back of the holding, and if severed would have no access. They would also be liable to become a breeding-ground for pigs and noxious weeds. The settler would control them as far as pigs and noxious weeds were concerned, and derive benefit from them as a source of supply of fencing-material and firewood.

The planting of these portions by the settler might be worth consideration.

We think, therefore, the best policy would be not to sever steep and unprofitable portions from the holding, but to reduce the rental of the unprofitable portion to a nominal figure and allow the settler to retain them.

There are instances where these rough and poor portions adjoin Crown reserves, and where good fencing boundaries on severance would be obtainable. Provision might be made for severance in such instances.

ACCESS AND COST OF ROADING.

(Part B, Order of Reference.)

(b.) Part of the lessees' difficulty has been, and is still, due to bad roads, or none at all, and the distance of the holdings from railway-stations or distributing-centres. This adds to the cost of everything that goes on the place; and, where top-dressing is found to be profitable, good roads will lessen the cost of and encourage the use of manures. They would also in many parts enable fat lambs to be sent to market without waste, by motor-lorry, and thus enable the farmer to secure larger returns. It is considered that increased road subsidies to certain counties should be made. Some witnesses suggested that the payment of "thirds" should be continued for longer periods, and this would help to some extent.

The road-access question has always been somewhat of a stumbling-block. In an earlier period it was considered advisable to delay roadmaking to enable the settlers on the land to earn money; but in this class of country, where larger holdings should predominate, it is probable that a better policy would have been to do most of the roading before selection, as the settler usually has enough to do on his farm. Prior to 1913 it was not customary to load for roading at a greater rate than 5s. per acre, but in rough country this sum is quite inadequate. Provision has since been made for increasing the loading.

The area of occupied holdings, taking in both improved and unimproved land, in ten of these counties is approximately 2,792,000 acres, and an approximate estimate of the cost, including bridges but excluding metalling of completed roads, is £3,020,000—much of them done more cheaply than at present. To complete unformed portions £1,740,000 would be required: this gives an average of £1 14s. per acre of occupied land. Some of this high cost is due to having to carry the roads through private and Native land as well as Crown land to reach the occupied Crown land. Prior to the war, roading-costs, without metalling, ran from £150 on the easiest country to £1,200 per mile on the roughest. These costs may now be safely doubled.

This gives an idea of the large sum required to road this class of country, and indicates the necessity of economy in the mileage. This does not mean that properties should always be large; they may be small on roads that are necessary, but extra roading should be avoided, if larger subdivisions will lessen it, where the class of land does not justify the rating necessary to pay interest on loans and maintenance. Many settlers urged the need of greater financial assistance than the present limit of £5,000 loan-money towards metalling in undeveloped counties where road-metal is scarce and consequently costly.

The improving of communication in these backblocks would assist in making the social side of the life more attractive, and induce more married men with families to take land; at present the lack of good roads, and the difficulty in obtaining adequate educational facilities, make residence on this class of land hard for the womenfolk.

We would recommend that in newly settled districts like these under consideration, where a large amount of developmental work has to be done, where roading is difficult and costly, and metal scarce, it would be reasonable to give local bodies a larger limit of borrowing-power from the State Advances Department than older-settled districts, and a more generous contribution in the way of subsidies for metalling—say, £2 for £1, instead of £1 for £1 as at present.

It is hopeless a settler trying to succeed without a 12 ft. road to his property, and the Government should provide this or say definitely that it will not do so. In the latter case some compensating arrangement should be made with the settler who has been patiently waiting for his access for so many years; in some few cases, twenty years after the land has been alienated, some of the roads are still unformed.

SUITABILITY OF THE LANDS FOR SETTLEMENT.

(Part C, Order of Reference.)

(c.) In view of the large amount of capital already spent in felling, grassing, and roading, &c., caution should be used before abandoning any of this class of country.

In our opinion, a small portion of the poorest and roughest country is not worth trying to farm. At the same time, the second-class grasses have not yet had sufficient trial, and it is desirable that work of an experimental nature be carried out on this class of country by the Crown. In the meantime the disposal of this class of land should be held in abeyance.

The question of deterioration has been dealt with in paragraph (4).

NECESSITY FOR REVALUATION.

(Part D, Order of Reference.)

Revaluation is advisable in consequence of the change in circumstances since many of the lands were selected. When this took place in many cases the difficulty of maintaining fertility and controlling second growth, and the liability to reduction in carrying-capacity, were not generally recognized, as the forest indications were similar to those in districts where country turned out well and was broken in with much less difficulty. Costs of development have also increased out of proportion to the returns. Bushfelling, for instance, has risen from £1 5s. to £2 or over, and fencing in the same proportion to £2 or more per chain.

One factor that induced high valuations was the goodwills that in instances were paid on transfer. Tenants complained of want of uniformity in Crown rental valuations.

Generally, the rental values previous to 1908 are not unduly high, and it is not apprehended that much reduction will be necessary in the case of blocks opened prior to that date. In the case of blocks opened subsequently to that date, values of some blocks should probably be reduced considerably.

The fact of the country being opened up more, and the experience of intervening years, will render practicable more uniform and reasonable valuations. The lowering of rents on revaluation will not amount to enough to remedy the situation altogether, but it will afford a measure of relief to many harassed settlers.

Among the causes justifying low rental valuations on these lands are the liability to second growth, and the high cost of maintaining pasture through the loss of cattle used for crushing in earlier stages; the lower price for bush wool; and the lack of formed access, making the cost of everything high at the start, thus bearing hardly on men of small means. There is also the liability of failure of burns in a wet season. The cost of medical attention is another item that occasionally bears heavily on pioneer settlers. Much of the lands under consideration was cleared and sown when costs were much lower; but since about 1912 development charges have been rising rapidly, and it is now estimated that to properly fell, sow, fence, erect buildings, and otherwise improve bush land will cost about £6 or more per acre.

POSTPONEMENTS AND REMISSIONS OF RENT.

(Part E, Order of Reference.)

We are of opinion that in many cases remissions of rent for any period up to five years will be required, and also think that actual remissions for a period would be better than postponements of larger amounts for longer terms. Such should only be given subject to the amount remitted being spent either on fencing, manuring, seeds, clearing, or other land-improvement to the satisfaction of the Department. In many instances the settlers are so heavily involved that any assistance is futile until a large proportion of their indebtedness is written off. Any assistance given should be contingent upon the mortgagees, State or private, reducing mortgages or remitting or lowering the rate of interest. In granting assistance of any kind the merits of each individual case would have to be carefully considered.

EXTENT TO WHICH CROWN TENANTS HAVE MORTGAGED THEIR HOLDINGS.

(Part G, Order of Reference.)

In the district under review there are, excluding soldiers' land, about 1,990 Crown holdings, with a total area of 874,700 acres. Of these holdings 75, with a total area of 42,905 acres, have been abandoned. The percentage of holdings abandoned is 3·77, and the percentage of area abandoned 4·9. It is impossible to obtain accurate information regarding the area and proportion of deteriorated lands and the financial position of settlers over the whole area. The following statement is compiled from circulars returned by 310 settlers in the various counties, and may be taken as an approximate average and accepted as a fair basis for estimation :—

Number of settlers who sent in statements	310
	Acres.
Total area occupied	165,220
Area felled and cleared	122,250
Area fairly clean	68,341
Area in second growth	43,909
	£
Government loans—Stock	9,275
Land	226,996
Private loans—Stock	67,679
Land	221,818
Advances on land per acre over total area (165,220 acres)—	£ s. d.
By State Departments	1 7 6
From other sources	1 6 10
Total indebtedness per acre on land	£2 14 4
Advances on stock, per acre—	£ s. d.
By State Departments	0 1 1
From other sources	0 8 2
Total indebtedness per acre over total area (165,220 acres)	£3 3 7
Advances per acre on total area of felled land (112,250 acres)—	£ s. d.
By State Departments	2 0 5
By private firms	1 19 9
Total indebtedness per acre	£4 0 2
	£0 13 7
Total indebtedness per acre on 68,341 acres fairly clean land, including stock	£ s. d.
	7 14 0
	Per Cent.
Proportion of the reverted country to area felled and grassed	39·12
Proportion of the country fairly clean to area felled and grassed	60·88

Money lent by the State, if on the same ratio as above, on an area of 874,700 acres, would be £1,209,000; and from private sources an almost similar amount, £1,174,000, is involved. This makes a total of £2,383,000; and to this must be added £493,500 for stock mortgages. Besides money lent on Crown holdings, different Government Departments have securities in the same districts on freeholds and other tenures, so that the Government is concerned with this phase of the question as well, where it guarantees such funds.

(5.) METHODS OF DEALING WITH SECONDARY GROWTH.

(Part F, Order of Reference.)

There are four main methods of dealing with the secondary-growth problem, which methods more or less overlap and are interdependent the one on another. These are—

- (i.) The use of cattle and necessary fencing to control the cattle-stocking.
- (ii.) Resowing with low-fertility-demanding grasses.
- (iii.) Top-dressing with artificial manures, spelling, &c.
- (iv.) Direct manual labour in cutting, burning, &c.

The use of cattle, the need of fencing, the advisability of using low-fertility-demanding grasses have been previously discussed. The wonderful results that have followed the top-dressing of worn-out grassland in many parts of New Zealand have led to a general idea that in top-dressing lies the salvation of the secondary-growth grasslands of the North. There is no doubt that top-dressing, rationally carried out, will prove of great value, but just how, when, and where top-dressing should be done is hard to answer satisfactorily. Top-dressing of weak grassland and of any portions that are moderately well grassed appears to the committee to be sound under nearly all circumstances. Top-dressing will increase the feed produced and thereby increase the stock carried. Top-dressing increases

palatability, and therefore it acts as a draw to stock. If stock can be drawn on to secondary growth in increasing numbers by top-dressing, then top-dressing becomes a most important factor for the control of secondary growth. On certain of the steep country where the pasture has virtually gone, several applications of manures will have to be made before a marked improvement of the country is shown. This will involve a heavy expenditure, which the settler in his present condition can hardly stand. Manual labour is necessary to deal with manuka, wineberry, &c., that cannot be kept down by stock.

(6.) COSTS OF GETTING REVERTED COUNTRY BACK.

Costs of getting the reverted country back into profit are extremely difficult to arrive at, as so few settlers have tackled and successfully grassed large areas that had reverted. The costs of regrassing also depend very largely on the seasons experienced and on the class and density of the growth to be dealt with. There is no doubt that if the country were swept over by a Raetihi fire the costs of getting the country back into grass would be considerably reduced. As the seasons are at present, a good deal will have to be spent actually in the cutting of secondary growth.

	£	s.	d.		£	s.	d.
Felling manuka, wineberry, &c. (£1 5s. to £1 15s. per acre)	0	2	6	to	0	3	6
Seeding	1	5	0		1	5	0
Fencing	0	7	6	to	0	15	0
Average cost per acre	£1	15	0	to	£2	3	6

Given a really dry burning season, a great portion of the reverted country could be brought back to profitable condition for little more than the cost of grass seeding and repairs to fencing.

Each succeeding year up to about the sixth year there will be a small recurring cost for the felling of reappearing manuka, &c. Every four to six years hard-fern patches will in all probability need burning and a further sowing of seed. With danthonia, lotus major, and brown-top spreading into the patches, these costs will probably be greatly reduced as time goes on.

Certain of the bracken-fern areas are being brought in by crushing with cattle, but the expenditure in connection with cattle losses is almost impossible to estimate on the data secured. Top-dressing as a factor in control, with manures and cartage at their present figures, will mean a high annual expenditure on the land. For the first application only little extra stock might be carried on the poorer, steeper, run-out portions. Two hundredweight to 2½ cwt. manure per acre applied to the land annually would cost about £1 per acre. The first two to three years of top-dressing the poorer run-out lands must be regarded as a necessary expenditure to get the land back to form. Once the sward is well established again, top-dressing, to be an economic practice, should then pay for itself and show a profit in the increased stock carried. On the better papa slopes and on any fairly well grassed country top-dressing undoubtedly would pay for itself right from the offset.

FURTHER RECOMMENDATIONS.

1. *Extension of Time to Freehold O.R.P. Holdings.*—The time allowed under the Act to freehold a number of these holdings will shortly expire, and some settlers stated that under their present financial circumstances they are unable to exercise the right of purchase. We recommend that consideration be given to extending this right for a period of, say, ten years.

2. In addition to remissions of rent for specified periods, other financial assistance is necessary. In a great many cases many settlers have not been able to meet their obligations as far as their rent and interest is concerned. We recommend that a special fund should be provided to assist settlers in the purchase of commodities such as fencing-wire, grass-seed, manures—all of which are essentials in the bringing-back of these lands.

3. *Royalty for Destruction of Pigs.*—There were in some districts numerous complaints about the depredations of wild pigs in destroying lambs and rooting up good pastures, and we recommend that the payment of 1s. per snout, already paid in some districts, should be made general throughout the whole district under consideration, and for the whole year round.

4. *Free Railage on Manures.*—Much could be done to help settlement on these lands if settlers were enabled to manure. The cheaper the landed costs of manures the more will be used; and to encourage their greater use we recommend that manures be carried free of charge on the railways for *bona fide* settlers in the areas under consideration.

5. *Fencing Boundaries adjoining Crown Reserves.*—We recommend that some consideration be given to settlers whose lands adjoin Crown reserves in the matter of boundary-fences. This consideration could be given by an allowance in the rental, or by actual financial assistance in the erection.

6. *Research Work.*—We recommend that the Government assist generally by carrying out research as outlined below; and by lectures, field demonstrations, pamphlets, &c., do all in its power to gain and disseminate knowledge on the best and most profitable ways of farming these lands.

It was patent at the meetings and on the settlers' farms that the settlers themselves were seeking to gain information as well as to give. This problem of grassing steep forested country is comparatively new to the pastoral world, and the wonder of it is that so much of our hill country has been

so successfully grassed. Up to the present the settlers themselves have worked out their own salvation. When the land was taken up originally neither the Department of Agriculture nor the Department of Lands had any exact information to give on grassing and managing the hill-country lands of New Zealand. Recently experiments have been started in a small way in the Whangamomona County, and, while these in themselves are excellent, yet the whole question of hill-country farm management and farm economics should be the subject of an exhaustive research by the Government. Experimental work on hill country is not a matter of small plots: whole paddocks, and in certain instances whole farms, should be taken over and treated and kept under close supervision by scientific men trained to the work. Some of the leading problems calling for investigation are—

- (i.) Study of exact conditions that determine dominance and succession in secondary growth:
- (ii.) An exact study of all known pasture species on the various soil types, and a trying-out of new and additional species, should be undertaken:
- (iii.) Thorough study of the economics of cattle as a means of secondary-growth control:
- (iv.) Study of general methods of management:
- (v.) Costs of maintaining the country:
- (vi.) Study of methods of fertility upkeep.

The hill grasslands comprise some 11,000,000 acres, approximately 75 per cent. of the total deforested lands in New Zealand. Of this area during the last eight years, according to official statistics, approximately 1,100,000 additional acres have reverted to fern, scrub, and secondary growth. To try to stay this deterioration, expenditure on research work is amply justified. Necessary funds and men should be forthcoming so that this work is in no way hampered, and provision should be made not only for the immediate future, but for a period extending over not less than ten years, so that a sustained effort at carrying out this important piece of work could be made. A few good men forming a small branch of the Fields Division of the Department of Agriculture, working in conjunction with the field officers of the Lands Department, could do invaluable service to the country at the present time.

POSSIBILITIES OF THE COUNTRY.

The report, as set out above, is necessarily bristling with the word "deterioration," and the committee feels that some injustice may be done the country as a whole without some word as to the possibilities of the country once it is shown that the area can be successfully brought back to grass. Generally speaking, it may be said that strong growth of secondary scrub, &c., tells of possibilities in the country rather than of impossibilities. The very factors that favour strong secondary growth alike favour good grass-growth once the sward is established, and once the secondary growth is controlled. The country generally is well watered, and healthy for both sheep and cattle. A surprising feature in the deteriorated grasslands of many of the counties is the really high carrying-capacity of the land actually carrying grass. We think it is not too much to say that, once the country is sufficiently fenced and the secondary growth cleaned off, one to one and a half mixed sheep per acre, besides cattle, is not too high a carrying-capacity to expect over the majority of the country. With manuring, more could be carried. For some years the cost of maintenance will undoubtedly be high, but as the country ages, and as stumps, logs, pukahu, &c., rot away, difficulties and maintenance costs will gradually decrease—that is, just as long as the areas remain in occupation and the settler handles his country properly. Here and there are to be seen in a fairly clean condition successfully managed farms which stand out in contrast to much of the other land in the vicinity.

G. H. BULLARD, Chairman.
 F. O. CAMERON.
 E. P. FOWLER.
 P. KELLER.
 E. BRUCE LEVY.
 E. B. ROBERTON.

APPENDIX.

HILL-COUNTRY GRASSLAND.

NOTES BY A. H. COCKAYNE.

HILL-COUNTRY grassland can be divided into two great groups—that where the objective of management is to maintain and increase the percentage of the best grazing-grasses, such as rye-grass, cocksfoot, *poa pratensis*, crested dogtail, and clovers, and that where the objective is to secure and maintain as complete a grass sward as possible irrespective of what grasses it may be composed of. In the first case the objective is to keep out as much as possible grasses, such as danthonia and brown-top, which when dominant are not conducive to high carrying-capacity of wet stock. In the other case the objective is to avoid dominance being secured by objectionable vegetation, such as one or other of the ferns, or scrub growth. Old-established hill pastures where the best English grasses are in the ascendancy are comparatively rare except on certain very fertile soils. The larger percentage of our well-grassed hill pastures are danthonia-dominant, particularly in the drier regions, and brown-top as the dominant element is conspicuous over wide areas where the rainfall tends to be fairly heavy and the ground is not exposed to extreme drying-up in the summer. The present general system of management is tending towards increasing the dominance of danthonia and brown-top over much country that should be supporting a larger percentage of the better English grasses. Better cattle-manipulation, rational subdivision to enable areas to be summer-spelled, and the use of phosphatic top-dressing are the three main factors that are involved in the management of country where danthonia and brown-top are tending to reduce the percentage of wet stock that can be carried. In the drier parts of the North Island, where fern and scrub are gaining the upper hand, methods tending to an increase in danthonia are the keynotes of management; burning, sowing with danthonia, self-sowing of danthonia by sheep from danthonia country, and frequent burning of the danthonia itself are all useful. Later on, when the country becomes danthonia-dominant, efforts should be made to convert the pasture into mixed English grasses and danthonia by all those methods that tend to soil-fertility increase. The problems of the management of our danthonia and brown-top dominant grasslands are as important as those involved in the management of our truly deteriorated hill pastures, and call aloud for extensive and well-directed research work. It has to be remembered that our danthonia and brown-top dominant grasslands have mainly developed from the surface sowing of the lands with grasses that now only represent a fraction of the herbage, the sown grasses giving out more or less rapidly and their place being taken by others more fitted for the lower soil-fertility that has been brought about largely through the exhaustion of the surface fertility present after the initial burn. Over wide areas of the North Island, however, the initial sowing with the so-called best English grasses had not been followed on their thinning-out by an invasion of such grasses as danthonia and brown-top. It is country of this description that is represented in such a county as Whangamomona, where a few years' luxuriant growth of the sown grasses has been followed by invasion, in varying degrees of intensity, of objectionable second growth, most of which probably represents initial stages of reversion, with forest as a final phase. Somewhat similar experiences have not been unknown over many areas that are now well grassed, in counties such as Pohangina and many others; but in all these, very extensive and at the time apparently destructive secondary fires have swept the country from time to time, but they have been of great value, grass recovery having been quicker than secondary-growth recovery. It is rather significant that in a country such as Whangamomona no really general severe burning of the whole country has been experienced; and (although this is pure surmise on my part, until such has taken place I am afraid secondary growth will tend to increase rather than diminish.

The problem of secondary-growth suppression is, however, extremely complex, and varies enormously with regard to the dominant type of vegetation that has to be dealt with. In one place it may be hard fern, in another bracken, in another water-fern, in another manuka, in another wine-berry or fuchsia. Our knowledge of the exact conditions that determine dominance and succession in secondary growth is extremely meagre, and exact research work in this connection is a fundamental prerequisite in the formulation of control methods. It is hardly expected that the Commission can be in a position to state definitely what methods are necessary to suppress second growth on those areas where the initial sowing with English grasses under ordinary accepted methods of management is not followed by permanent replacement by such grasses as danthonia and brown-top. The fact that such large areas of country are rapidly becoming ruined for successful pastoral occupation indicates that the present methods are unsatisfactory. As the evidence gathered together must have been secured in the main from farmers who have not been able to cope successfully and economically with secondary growth, it is clear that any recommendations they may have made can only be in the nature of surmise rather than the result of successful experience. Even in those cases where pasture-permanence has been more or less maintained—a condition that occurs scattered through the whole area under discussion—the exact reasons why partial success has been secured are obscure. The problem appears to present two distinct phases—namely, firstly, what should be done in order to enable present holders to hang on, as it were, to their holdings; and, secondly, the actual try-out under controlled conditions of all methods of secondary-growth suppression, in order to work out an accurate

system of management that may lead to permanent and successful occupation of the land. It must not be forgotten that, as regards holdings that have almost wholly reverted to secondary growth—and this is particularly true of hard fern—there are no examples on a large scale where elimination of the secondary growth has been secured by the adoption of any definite set plan of operations. Many surmises with regard to methods of control are in the air. These can be divided into the following groups :—

(1.) *Increasing the number of cattle grazed.*

At the present time Whangamomona County has about one cattle-beast to every 12 acres of originally sown country, excluding the dairy cows that are occupying the majority of the better-grassed plots. In such a county as Weber, where grassland is good but mainly of the reverted danthonia and brown-top type, one cattle-beast to about 8 acres of sown grassland is kept. It would appear as if the number of cattle necessary to effect any control on second-growth country would have to be largely increased, when it is seen that even when the country is in excellent grass one cattle-beast to every 8 acres to 10 acres is necessary. In Weber County, although there is a cattle-beast to every 8 acres, the relation of cattle to sheep is one to fifteen. The relation of run cattle to sheep in Whangamomona County is about one to eight. Grassland farmers in the North Island have been in the habit of using the figure between cattle and sheep as the index, whereas it is the relation between cattle and number of acres that is the real index that determines whether sufficient cattle are being employed. On good grassed country one cattle-beast to every 8 acres to 10 acres, and even less, tends to increase the number of sheep that can be kept. For instance, in Patangata County, the highest sheep-carrying-capacity county in New Zealand, one cattle-beast to 6 acres of grassland is kept, approximately half the sheep being wet ewes.

The following table gives some stock figures for certain counties in the North Island :—

Number of Stock carried per 1,000 Acres of Sown Grassland.

County.	Dairy Cows.	Other Cattle.	Sheep.
Waitomo	57	160	650
Whangamomona	28	90	700
Kawhia	44	220	730
Ohura	50	160	800
Kaitieke	30	120	1,100
Makara	70	70	1,400
Castlepoint	2	160	1,700
Akitio	6	150	1,700
Uawa	15	140	1,800
Weber	4	130	1,800
Patangata	12	170	2,000

One point that appears fairly clear is that an increase in the amount of dairying carried out leads to a very rapid deterioration of the hill country : in other words, the dairy cow is a useless factor in the control of secondary growth. The ewe, again, in contradistinction to the wether, is a factor that exerts an influence in the direction of increase in secondary growth, and much country at present partly used for wet sheep is quite unsuitable for the purpose, having permanency of the grass sward other than by manuring in consideration. However, both the dairy cow and the ewe are potent sources of immediate revenue, and their elimination on holdings where secondary growth is rapidly gaining the upper hand would render the immediate returns from such holdings quite insufficient for the owners to remain in occupation unless their finance was in good shape—a rare circumstance even at the present time, when meat, wool, and butterfat are all on a high level.

On land where the sheep-carrying capacity is low owing to the large percentage of ground being occupied by secondary growth, increasing the number of cattle, unlike on good danthonia country, must tend to reduce the number of sheep kept, and, as the yearly grazing-value of a store cattle-beast is low, would cause a reduction in the gross annual returns. A surprising feature in the deteriorated grasslands of Whangamomona County is the really high carrying-capacity of the land actually carrying a grass sward. In that country 108,000 acres of forest have been grassed, and I should say at a guess more than 40 per cent. is occupied now by secondary growth. There are probably less than 50,000 acres of actual good grass, of which 3,000 dairy cows will be occupying at least 9,000 acres, which means that the actual grassland itself is carrying virtually two sheep to the acre. Were it not for this fact one would have the very gravest doubts as to whether it were worth while either to try and assist the present holders or to suggest any extensive research and experimental work into the question of secondary-growth suppression on such country. I think it is fair to assume that an increase in cattle would tend to reduce second-growth invasion, and if such is the case the practical aspects require careful consideration. On country that is moderately clean the extension in the use of cattle would not result in any great yearly loss ; but it is essential that a thorough study of the economics of cattle as a means of control should be immediately made, so far as possible, with reference to all the varied types of country. This study should secure the basis for

a series of experiments on the effects of cattle-stocking at varying degrees of intensity, and the acreage cost of keeping the cattle; where breeding can be done; where cattle can be kept throughout the year; and where cattle have to be periodically bought and sold. The relation of fencing to the density of cattle-stocking, and the variation in the acreage cost of necessary fencing according to the size of the holding and the acreage density of cattle kept, are important. With fairly reliable information under these heads it might be possible to outline methods for the Government financing of cattle-purchase, with a reasonable expectation that the costs would be finally recoverable. Personally, I might add that I do not consider that a mere increase in the cattle kept will be found economically sound except where the holdings are comparatively large. Fencing-costs, reduction in sheep carried, the increased cattle-density necessary over that of large holdings, and the necessity of often having to buy on a high market and sell in a low one, preclude cattle being the sheet-anchor of control on small holdings.

(2.) *Introduction of grasses and clovers more likely to be permanent and resist second-growth invasion than the standard English grasses.*

Roughly expressed, it may be said that the hope of every holder of second-growth invaded country is that the country will turn into danthonia grassland, as has been the experience on much of the surface-sown hill lands of the North Island. Danthonia, however, belongs to the class of grasses known as light-requirers, and cannot possibly obtain the upper hand when shaded. Danthonia will not endure even a moderate amount of shade, and is likewise not particularly tolerant of an extremely wet climate. A wet climate is, on the other hand, of great benefit to the development of secondary growth. Again, provided it is not shaded, danthonia prefers well-consolidated rather than loose land. Generally speaking, all the conditions for rapid danthonia-spread are absent from the country that has so badly reverted to second growth, and unless methods favouring its development can be adopted into the region in question there is no reason to believe that danthonia will become generally dominant unless the amount of burning done can be vastly increased. On sunny faces, provided fern and scrub growth is kept out, danthonia is always likely to become established and spread, irrespective of whether it is intentionally sown or not. It is generally admitted that intentional sowing will lead to more rapid establishment than where no sowing is done, but actual sowing of danthonia, particularly in combination with other grasses, is often extremely disappointing. Burning, by removing shade, frequently has a marked effect on danthonia-spread, and in fact, in the past, has been one of the main factors that has led to its dominance over wide areas.

The establishment of a close and continuous sward of some grass or combination of grasses is essential in the suppression of secondary growth, and the fact is being strikingly demonstrated that the only type of grasses that are likely to be suitable in this respect are those that are capable of spreading on soils of low surface fertility. The main grasses that come to one's mind are danthonia (work on the fertility and shade factors with regard to the different forms of the pilosa, racemosa, and semiannularis groups may yield very significant results); brown-top and its forms; ratstail; tall oat-grass (perhaps on account of its suitability for loose soils); paspalum; and perhaps tall fescue. It would appear as if it were essential to try and make one or other of these grasses the dominant one on second-growth country, so that wherever any thinning-out takes place the likelihood is that the vacant spaces will be seized on by grass rather than by undesirable vegetation. Other grasses, such as crested dogstail, poa pratensis, and microlaena are all likely to prove useful. Rye-grass most certainly should never be sown on burnt-out patches of secondary growth, except perhaps where the soil-fertility is still high and the value of cocksfoot is more than doubtful. Generally speaking, the philosophy that has been adopted in the past on initial sowings is that the mixture should contain a combination of the better grasses which keep going for a few years, and a certain amount of such grasses as danthonia and brown-top to occupy the ground rendered vacant by the thinning-out of such grasses as rye and cocksfoot. Whether this reasoning is really sound or not I rather have my doubts. Unfortunately, in much of the present deteriorated country only rye-grass/cocksfoot mixtures with a small proportion of crested dogstail and clovers have been sown, and the sowing of combined high-fertility elements and low-fertility elements together on the initial burn has not been under any exact observation. Were I advising on the sowing-down of initial burns of Whangamomona country at the present time I should be inclined to exclude all rye-grasses and cocksfoot, and make brown-top/danthonia, crested dogstail, paspalum, poa pratensis the only grasses I would use, and white clover (the question of wild white clover is one that must be investigated on hill pastures), suckling-clover, lotus major, and perhaps subterranean clover. I would likewise be inclined to sow a certain amount of fog, particularly if the burn was not a really good one.

Quite apart from the mixtures to be used on land where the original sowing has been replaced by secondary growth comes the question of the formation of the seed-bed and whether the seed should be mixed with manure. One can divide the types of vegetation on which reseeding should be done into hard fern, bracken fern, water fern, manuka, and particularly pasture that is thinning out but may not be seriously invaded by second growth. On this last type of vegetation a seed-bed cannot be secured by burning, and I would, in attempting to renovate such a sward, advise the sowing of brown-top and crested dogstail with about 1½ cwt. of super per acre on the dark faces, and brown-top danthonia, crested dogstail, and paspalum together with manure on the sunny faces. Lotus major and perhaps subterranean should be the main clovers used. In the sowing of second growth of all kinds a seed-bed formed by burning the growth either standing or with some prior treatment depending on its type naturally would take place, and I would again make what are generally looked upon as the poorer grasses and clovers the only ones to be used.

One of the outstanding difficulties of the introduction of grasses and clovers on to second-growth country is the fact that all the kinds of any value are exceedingly high in price, and if any heavy seeding is carried out the cost would be excessive. The present experimental areas in the Whangamomona district are of very great value in this direction, and present indications are that brown-top can be established easily, rapidly, and with quite a light seeding.

The following are the approximate prices per pound of grasses and clovers likely to prove valuable: Brown-top (say), 3s.; *danthonia pilosa* (say), 2s.; *danthonia semiannularis*, 2s.; crested dogtail (say), 1s.; *paspalum* (say), 1s. 6d.; *poa pratensis* (say), 1s. 6d.; ratstail (say), 2s. 6d.; lotus major, 3s. 6d.; subterranean clover, 6s.

The question of a cheapening of these seeds is a matter of great importance, and the matter of financial assistance by the Government in enabling a combination of farmers to grow their own requirements should be considered. I do not mean the growing of the seed in the districts themselves, but the actual having of a seed-growing farm, say for brown-top, in whatever district is most suitable; financial assistance to secure supplies of *danthonia*-seed, and the like. A careful study of the present experiments in operation should prove most valuable in working out what mixtures are best, and a considerable extension of the work in progress should be undertaken.

(3.) *Phosphatic top-dressing of second-growth grassland.*

The wonderful results that have followed the top-dressing of worn-out grassland in many parts of New Zealand have led to the general idea that in top-dressing lies the salvation of the second-growth grasslands of the North. There is no doubt that top-dressing, rationally carried out, will prove of great value, but just how, when, and where top-dressing should be done is hard to answer satisfactorily. Top-dressing of weak grassland and of any portions that are moderately well grassed appears to me to be sound under nearly all circumstances. Top-dressing will increase the feed produced and thereby increase the stock carried, and increase in stock-carrying capacity is perhaps the most potent factor of all in the control of second growth. There are, however, certain points that have to be considered. Firstly, the amount of material necessary may have to be fairly large, and repetition of application necessary before any decided advantage is secured—this means that top-dressing will be expensive; secondly, the most striking immediate results will be secured from the better-grassed areas. As these areas will mainly be on the flats and lower slopes, top-dressing them will tend to keep stock only on the top-dressed areas, and unless fenced off the tendency will be for stock not to penetrate at all the higher slopes, and second growth may in this way be increased rather than diminished. This is perhaps a more important point that is generally considered. The cost of hand distribution of artificial manure need not be considered, as the ordinary labourer of the farm can in all cases do all that is necessary. In point of fact, methods whereby the actual manual work of the owner can be devoted to the control of second-growth suppression have not as yet been given the attention they deserve. It will be noted that the three great generally-suggested methods of control—namely, increasing cattle, the sowing of low-fertility-demanding grasses, and top-dressing—are all expensive and require considerable capital, whereas the one method of management that does not in many cases require any additional capital—namely, actual mechanical control by hand labour—has as yet not been vigorously applied. It is remarkable that on many holdings considerable manual work is willingly undertaken against vegetation that is of no moment whatever, particularly against foxgloves, whereas against the really serious invaders the farmer is content to put forward suggestions of getting something else to do the work for him—namely, cattle, grass-seed, and artificial manure. I have mentioned with regard to cattle the necessity for extended scientific investigation, and the same holds true with regard to resowing, top-dressing, and manual treatment. The work should not be carried out on any one special experimental farm, but adequate funds should be available to put under trial conditions on many farms all possible methods of management. In addition to the actual money required for cattle, fencing, seed, and manures, expert scientific supervision is necessary, and extra assistance should be provided for Mr. Levy. I would also suggest that a very complete study of the economics of hill-country grassland farming should be carried on simultaneously with any experimental work undertaken, and for this purpose the formation of a small branch of the Fields Division should be formed devoted to the study of agricultural economic problems, amongst which, to begin with the question of the economics of second-growth country should be carefully studied.

(4.) *What should be done to relieve the present unsatisfactory condition of many holdings.*

In the foregoing I have indicated the four great methods of secondary-growth suppression that have been suggested—cattle, resowing with low-fertility-demanding grasses, top-dressing, and direct manual labour. With regard to the efficacy of these methods, under what conditions they should be put into operation, their costs and probable returns, very little of any definite value is known, and accordingly the foundation of a policy of assistance is sadly handicapped. Why have the holdings gone back? is the question that requires answering, and probably in ninety-nine cases out of a hundred the holder will say, "Through lack of sufficient capital to adequately work the holding." Just what capital is required to keep such grassland in good order? Does it vary per acre according to whether the holding is a small or large one? Would in many cases the money required be greater than any ultimate value of the land? Personally I consider that the country has gone back on account of several reasons. Firstly, the original sowings, being mainly rye/cockfoot, were quite unsuitable for any but the flat land and more fertile portions of the lower slopes; secondly, it was not recognized that the cost of maintaining such country in grass was much higher than currently supposed. The

non-recognition of this fact led to excessive values being credited to the land, and in consequence an excessive percentage of the returns had to be swallowed up in rent, rates, and interest on fictitiously high values.

I would suggest that a survey of the deteriorated holdings be made, and that they be divided into the following classes :—

- (a.) Holdings that in their present condition cannot produce sufficient money annually to defray their annual financial obligations :
- (b.) Holdings that in their present condition can return sufficient to defray financial obligations, but cannot support in a reasonable manner the holder and his family :
- (c.) Holdings that in their present condition can defray annual expenses and support the holders, but sufficient is not left over to put back into the properties to maintain or improve them :
- (d.) Holdings that in their present condition can support all their financial obligations and enough to maintain and improve them.

The first type of holding should be abandoned, or in certain cases be combined with other holdings. The second type of holding should have the interest charges lowered. The third type of holding should have liberal assistance given, provided the holders are deficient in capital. Nothing should be done with the fourth type of holding.

No doubt a considerable number of holdings will have to be abandoned, and be taken over later by other owners who have good properties, and by their aid may be able to break in the country. I should like to add here that excessively small holdings have been in the past a potent factor in failure to maintain a grass sward on much hill country.

I would suggest that the following main principles should be adopted in the giving of assistance :—

- (1.) No Government rent to be charged for land in forest or which has completely reverted to second growth.
- (2.) Expenditure on fencing, seeds, and manures used for reasonable improvement purposes to be accepted in lieu of rent.
- (3.) Methods adopted where mortgages are reduced, when it is clear that they, in combination with other charges, exceed the present value of the land, and where the land cannot in its present state provide for annual payment and allow a holder sufficient money to live in a reasonable manner.
- (4.) Expenditure on fencing, seeds, and manure to be accepted in lieu of a certain portion of the interest charges, arrangements being made whereby such interest waived may afterwards be recovered if the land is sold at a profit.
- (5.) Advance of Government money for the purchase of cattle.
- (6.) Free railage of manure.
- (7.) All cases where assistance is to be rendered to be investigated by a competent Board representing the interests of the Government, the State Advances, the Public Trust, private mortgagors and owners, before any assistance is given.

In all cases the probability of the land finally fully recovering all costs that may be incurred should be carefully considered, and, where expenditure is held to be justified, all those interests that have an equity in the holding should share in the expenditure before the Consolidated Fund is called upon. Rent-remissions, mortgage reductions in themselves will not improve the country. Their equivalent must go back into the land if stability of occupation is to be secured.

Approximate Cost of Paper.—Preparation, not given ; printing (675 copies), £18 15s.

By Authority : W. A. G. SKINNER, Government Printer, Wellington.— 1925.

Price 6d.]

non-recognition of this fact led to excessive values being credited to the land, and in consequence an excessive percentage of the returns had to be swallowed up in rent, rates and interest on hypothecated land values.

I would suggest that a survey of the deteriorated holdings be made and that they be divided into the following classes:-

- (a) Holdings that in their present condition cannot produce sufficient money annually to defray their normal financial obligations.
- (b) Holdings that in their present condition can return sufficient to defray financial obligations but require support in a reasonable manner the holder and his family.
- (c) Holdings that in their present condition can defray annual expenses and support the holder, but sufficient is not left over to put back into the properties to maintain or improve them.
- (d) Holdings that in their present condition can support all their financial obligations and enough to maintain and improve them.

The first type of holding should be abandoned or in certain cases be combined with other holdings. The second type of holding should have the interest charge lowered. The third type of holding should have financial assistance given, provided the holders are efficient in capital. Nothing should be done with the fourth type of holding.

No doubt a considerable number of holdings will have to be abandoned and be taken over later by other owners who have good properties and by their aid may be able to break in the country. I should like to add here that excessively small holdings have been in the past a potent factor in the failure to maintain a grass ward on much hill country.

I would suggest that the following main principles should be adopted in the giving of assistance:-

- (1) No Government aid to be charged for land in forest or which has completely reverted to second growth.
- (2) Expenditure on building, roads and fences used for permanent improvement purposes to be repaid in full or partly.
- (3) Land on which where mortgages are advanced, when it is clear that they in some direction will other charges exceed the present value of the land and when the land cannot in its present state provide for annual payment and allow a holder sufficient money to live on.
- (4) To be awarded in lieu of a certain portion of the interest on the mortgage, such interest waived may

- (5) Advance of Government money to be repaid by a Government Board.
- (6) Free rental of land.
- (7) (A) Cases where assistance is to be granted to be referred to a Government Board representing the interests of the Government, the local authorities, the local trust private mortgagees and owners before any assistance is given.

In all cases the productivity of the land finally fully recovered all costs that may be incurred should be carefully considered and where expenditure is not to be repaid all losses should be paid by the holder. In the case of the Government Board, the Government should be the only body to the holder should be repaid in full or partly. The Government should be the only body to the holder should be repaid in full or partly. The Government should be the only body to the holder should be repaid in full or partly.