

THE ESTABLISHMENT AND MANAGEMENT OF PASTURES ON PUMICE  
LANDS CARRYING SCRUB.

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Volcanic ash showers, differing in ejecting material, and widely distributed by both air and water, form the pumice soils of the Central Plateau of the North Island. The soils have undergone the least possible alteration from the parent rock from which they originated, and they may contain all the elements and in the same proportion as in the original rock, with the addition of decaying vegetation matter. Due to its vesicular nature and the ease with which it breaks down, pumice soils support luxuriant plant growth without the usual period of weathering necessary to reduce average rock material to the soil condition,

A mass of pumice buried in the soil will in the course of time disintegrate or what is commonly called "rot" liberating much of the plant food which is locked up in the vitreous particles. The ability of pumice to support a wealth of plant growth without undergoing a long period of weathering is prominently exemplified on the Rotorua-Taupo Main Highway, where, in the reformation of this road, grass and clovers were sown on newly formed fillings to assist in combating erosion, a topdressing of superphosphate being applied at time of seeding to assist in a more rapid development. Although the soil was merely pumice from a nearby pit, the resultant growth has been excellent and beyond expectations. Similar conditions exist on the Rotorua-Hamilton road near Ngongotaha. Further, one is surprised at times to find swedes of large growth on areas where rubble pumice is abundant, also where the pumice is of a coarse sandy nature and lacking in humus. This remarkable growth on such soil conditions applies to pastures also.

Pumice soils vary in quality and texture in just the same way as the more fertile soils of the Dominion. In texture the pumice soils range from rubble down to coarse

sands<sup>&</sup>/fine silts, and the finer soils are the more fertile. However they may differ in texture they possess the same common features, e.g. they are easy to cultivate in any weather, and do not cake or puddle. Probably there are no easier worked soils in the Dominion. Pumice soils allow heavy rains to rapidly drain away; and when they are well consolidated the excellent capillary action permits the soil water to ascend from below.

Pumice soils are deficient in phosphoric acid and respond markedly to phosphate manuring; they are fairly well supplied with potash and give little or no response to potassic fertilisers. Nitrogen is deficient in uncultivated pumice soils, but nitrogen deficiency is overcome by the luxuriant clover growth obtained through phosphatic manuring. The new pumice soils do not respond to lime,

#### NATURAL VEGETATION GROWTH.

Other than forest lands which are chiefly of the rimu-tawa association and totara, the vegetation of the open pumice country may be either, lichens, moss, mat plants, fern, tutu, tussocks or scrub. The higher parts are for the most part covered with fern and tutu, and the lower lands - undulating to steep faces - carry mainly light manuka scrub with areas of heavier manuka; tussock and manoa scrub cover the flats. The manoa scrub ranges from scattered patches of light growth to areas of dense growth,

#### METHODS OF DEVELOPMENT. OPEN PUMICE LANDS.

Farm development has progressed more rapidly on fern and tutu land than on scrub land; initial pasture establishment has been more easily obtained through the higher fertility of the soil. The method of developing open pumice lands varies with the type of country. On the higher elevations covered with fern and tutu; the most practical method is to cut the tutu close to the ground level then burn, surface cultivate with discs and harrows and sow in a temporary pasture. Sowing is usually done in the autumn

and young fern growth crushed by stock in the spring. In two or three years time the land is ploughed and sown in swedes, invariably with excellent results. After the swedes are eaten off the land is either disced or ploughed to permanent pasture.

On scrub land cultivation must be preceded by cutting and burning of the scrub. Clearing costs can be reduced considerably if the scrub is burnt two years ahead of cultivation work being commenced. There are two methods advocated in the cultivation of pumice lands for pasture establishment, (1) Surface discing and cultivation for seed bed (2) ploughing plus cultivation. The discing advocates maintain that the surface working retains the natural soil consolidation, but experience has proved that a good standard method of preparatory cultivation for pasture establishment is to plough with a lea mouldboard plough 5 inches deep, fallow for four or five months to allow complete weathering and aeration. The fallow is then rolled in the direction of the ploughing; this rolling on the furrow is important in bringing about good consolidation. After rolling the land is then double disced which also should follow the direction of the ploughing. Chain harrows are used to fine the seed bed and to level the surface. The land is again rolled before the seed and fertilisers are sown and finally rolled after the seed has been covered with the chain harrows. Sloughing is essential for the proper aeration of the soil and ploughing, by bringing to the surface the unweathered pumice from below and mixing it with the surface soil, appears to give a much better soil for pasture production than surface cultivation.

#### METHODS FOR AND SOWING DOWN OF PERMANENT PASTURES.

On pumice soils the farmer is fortunate in that, following the clearing of scrub he has different methods at his command in preparing the land for permanent pastures, due to the soil being so easily worked; all are simple and entail no heavy tedious labour and establishment is reasonably quick. The methods can be classed as direct and preparatory.

The direct methods are plus cultivation, or by surface cultivation. Ploughing as the first step is undoubtedly the best. Surface cultivation should be confined only to unploughable lands.

Preparatory methods are: ploughing and sowing in root crops - swedes usually grown - and then to permanent pasture. Sometimes a seeding of 5 to 6 lbs. of red clover is sown with the swede crop and a light seeding of cocksfoot may also be included, or sow direct to a temporary pasture. Heavy pasture growth, especially red clover results in these sowings, which is utilized for hay and ensilage supplies as well as grazing. In two to three years time the land is then ploughed and sown to permanent pasture which makes excellent establishment preceded by a temporary pasture, or a swede crop may precede the permanent pasture. Following the swede crops the land may be either ploughed or surface cultivated. Surface cultivation of swede crop land is quite satisfactory, e.g. the land is well consolidated.

Steep hillside faces can be ploughed with short mould board or hillside plough or surface disced land worked down with the clod crusher and harrows, follow with stock consolidation on the young pastures. Small areas of steep hillside faces can be brought into reasonably good pastures by stock consolidation for a few years and surface sowing.

GRASS SEED MIXTURES: The improved strains of certified grasses and clovers which are now available have played a very important part in the success of permanent pasture establishment on pumice soils; they have produced pastures beyond expectations. Demonstration trials of certified and uncertified strains of grasses and clovers, conducted in localities representative of different soil types, have likewise clearly shown the superiority of certified strains and have demonstrated that none other should be sown on pumice lands. The outstanding feature resulting from the use of certified strains of grasses and clovers is the ability of the proved certified white clover

to raise the fertility of pumice soils and to impart health and vigour to the grasses - especially ryegrass. 'Certified proved strains of white clover have greater ability in this respect than liberal applications of fertilisers. Perennial ryegrass will not thrive on pumice soils without the support of proved vigorous white clovers; inferior strains fail to give this necessary support,

GRASS SEED MIXTURES: (a) PERMANENT PASTURE: - perennial ryegrass 25 lbs, cocksfoot 10 lbs, red clover 2 lbs, white clover 2 lbs = 39 lbs per acre,

(2) Temporary pasture:- Italian ryegrass 25 lb's, cocksfoot 6 lb red clover 5 lbs, white clover 2 lbs = 38 lbs.

These mixtures appear to give general satisfaction; timothy, crested dogtail, paspalum, subterranean clover and Lotus major are frequently included in permanent pasture mixtures, but their inclusion is hardly warranted and they produce little in a sward of vigorous ryegrass, cocksfoot, red and white clover:

TIME OF SEEDING: On pumice soils where soil fertility has been improved by farming, spring and autumn sowings do equally well, but autumn sowings should not be made later than the middle of March. When sowing on first ploughing spring sown pastures make better progress than autumn sown pastures which have the winter weather conditions to contend with.

MANURIAL TREATMENT: As I have already mentioned pumice soils are deficient in phosphoric acid and respond markedly to phosphatic manuring; in fact, in developing new pumice land phosphatic manuring; only is required and superphosphate has proved the best phosphatic fertiliser. It is usual to sow 3 cwt of superphosphate with the grass seed and frequently a second application of 3 cwt is given four or five months after sowing, followed by 3 cwt every year. More frequent applications in the early stages of establishment appear to be definitely warranted and general practice is now to sow with 3 cwt and give a further three applications of 3 cwt

within the first eighteen months of sowing down, followed by 3 cwt a year. This method gives a dense and highly productive ryegrass and white clover pasture. This liberal application of fertilisers may appear excessive to those farming under different circumstances but it has proved its value in developing pumice soils.

MANAGEMENT: The ability of red clover to grow luxuriantly on pumice soils induced pioneer farmers to make free use of this clover in permanent and temporary pastures, ranging from 6lbs to 12 lbs per acre; stock do not relish abundance of heavy red clover feed, and it is not uncommon to find all classes of stock not thriving in midst of plentiful supplies of clover; if mown and allowed to wilt stock eat it readily and consequently do better. This feature combined with the smothering out of ryegrass retarded farming progress. A plentiful growth of red clover in addition to adding fertility, enables heavy stocking to be under-taken on young pastures and which is an essential contributing factor in the further building up of fertility by animal droppings and nitrogen; and increased surface consolidation - all most important. Two lbs per acre has proved sufficient to include in permanent pastures; even this may give excessive growth, making it necessary for active control by stocking assisted by mowing when required, otherwise irreparable damage results in smothering of ryegrass development. Young pastures sown on the first furrow are slow in establishing and have a low autumn, winter and early spring production, but make rapid late spring and summer development, thus coming to a high carrying capacity in a short period. For instance; 90 acres of permanent pasture sown in the spring of 1930 -- a very dry period with continuous strong winds throughout the summer- in the spring and summer of 1931 carried 56 milk cows, 50 head dry stock with 30 additional young stock in month of November. Even with this stocking - feed was too plentiful, and 20 acres of clover growth was topped in October and 30 acres mown and made into ensilage

in late December. This remarkable growth was not merely a first year flush, as in the following years this pasture production was surpassed. Active control of young pasture growth by stocking and mowing is essential for an even and vigorous development of grasses and clover. In attention to this means *only partial success or it may mean failure.*

CARRYING CAPACITY AND BUTTERFAT PRODUCTION:

Well developed farms on pumice land have a carrying capacity of a cow to  $1\frac{1}{2}$  to  $1\frac{3}{4}$  acres, and the best herds average over 300 lbs. of fat per cow. This carrying capacity can be obtained in the third or fourth year after development e.g. Ngakurau Demonstration farm 90 acres 61 dairy **COWS** and additional young stock, 175 lbs butterfat per acre on three year old permanent, pasture established on first ploughing method, 43 acres harvested for hay and ensilage. In 1934/35 season 51 acres were harvested for hay and ensilage supplies.

FARM DEVELOPMENT: The costs of farm development on pumice lands are given in the Department of Agriculture's Bulletin No. 163. The mean development costs for 12 farms for grassing, fencing, water supply, shelter and buildings were £18 per acre. Pumice lands are included in the bush side areas but this deficiency disease has been overcome by the use of limonite-salt licks and cobalt.

Briefly the methods for the establishment of productive pastures on pumice lands consists of adequate and thorough cultivation and consolidation, the use, of certified strains of grasses and clovers, very liberal applications of superphosphate during the first two years and adequate control of pasture growth by stocking and management. These methods give a dense pasture which may then be maintained by annual topdressing and good management.

## DISCUSSION ON TWO PRECEDING PAPERS.

The Chairman summarised the important points in the two papers and threw open both papers for discussion.

Mr. Vosper:

I would like Mr. Glanville to give us some information as to the cost of bringing that particular farm into grass.

E. B. Glanville:

I omitted to put that in my paper. As far as to that particular farm I mentioned, it did not cost a great deal at all. As a matter of fact he ploughed most of it in his bare feet as he could not afford boots for himself, but his grass seed mixture was very costly. His early mixtures cost about £2.15.0 and later he gave £3 for seed mixtures. The approximate cost on gumland is not far short of £18, one would say for cultivation, fertilisers and seed £12, fencing £3 and water doubtful - may be £100 - levelling costs anything from about 15/- to 35/- to £2, it depends on the nature of the country, giving a total of £20 per acre.

G. H. Holford:

Mr., Glanville has given us a very interesting paper; he has not mentioned the use of organic phosphates. A paper which I got two weeks ago indicates that experiments show by use of organic phosphates it is possible to grow clovers and other legumes on acid soils with the use of lime. Secondly it was mentioned that on pumice land so far they did not use lime. I have a feeling as time goes on lime will be necessary; although the use of lime may not be considered healthy at the moment and may not have much effect on the actual productivity of the pastures.

H. E. Annett:

Mr. Holford has taken some of the wind out of my sails. I am very pleased he has referred to the lime question. Why do we use lime? It may be that lime is necessary for other things. I look upon lime as being a fundamental check against disease. In the pumice area Mr. Dalgliesh has pointed out - I am glad to see that Mr. Holford has raised the point - with regard to the response of lime today and that we should include it.

N. H. Taylor:

I have been very interested from the soil point of view. We have listened to two papers dealing with the development of two broad types of poor cropping land, but pedologically they are very different. You have the gumlands which are very old leached soils and derived from various formations - limestone, clay stone or mud stone and against this we have the pumice lands which are young soils. Mr. Dalgliesh pointed out that the pumice soils are poor because they are low in phosphates. Now the point that struck me is the very different points of the management that are necessary to bring these to production. On the old leached soils where the soils have separated into layers there is need for drainage, very great need for lime; on the young soils of the pumice land there is need for phosphates and need for consolidation. I do not agree with your view point, Mr. Chairman, on the influence of vegetation on the soil; it depends on whether material is

returned to the soil, When you get a tree like puriri trees returning bases to the soil then you get a much better soil. The kauri is so outstanding because he is definitely the most inefficient tree we have at returning bases to the surface soil.

H. Woodyear-Smith :

What strikes me is the difference between these two different papers. Mr. Dalgliesh pointed out how swedes can be grown on the pumice country and the use of manure is generally necessary and it is possible to store up a supply of silage. Mr. Glanville pointed out that the country lay wet and cold in the Winter and one wonders whether they would be suitable for cropping - which I do not think they are - and whether they would throw sufficient material to make hay and silage to carry the stock over the winter,

R. P. Connell:

There are one or two questions I would like to ask but before doing so I would like to congratulate both Mr. Glanville and Mr. Dalgliesh. I think Mr. Dalgliesh has been overmodest in the account of his work he has described to us, because a much more impressive picture could be made of the wonderful changes that are being made on that extremely poor pumice country. It is that impression that is behind the question I want to ask Mr. Dalgliesh. How much land of the pumice type that he has been dealing with in his paper remains to be improved and can be improved in the same way that has been tackled with already? The same question I would like to ask in regard to the gumlands. It would be interesting to me anyhow to know whether there is a great deal of country to be improved and roughly what is the area. What I have in mind is this - that in North Auckland Land District there are substantially more dairy cows than in the whole of the Taranaki and the figures that Mr. Glanville gave us show that by the methods described there they are turning that gumland country into more productive farms than the average Waikato, the average Taranaki or Manawatu dairy farms. I quote these three districts as they view themselves as being the best dairying districts and yet this gumland is producing better than those areas under the methods described and similarly we have the pumice country which is easily exceeding the average production of the main dairying districts. In regard to Mr. Dalgliesh's paper there is one further point. I would like to make - on page 2 he states "new pumice soils do not respond to lime." I am wondering whether there is any significance in the inclusion of the word "new." As to the matter of liming I think we need to be particularly careful about the impression we leave as to liming of the pumice soils until we have definite evidence on the matter. I have in mind this fact that we have bush sickness on some of that land and some work carried out at Cawthron Institute certainly points to the possibility that lime will prevent or in some way check the effect of cobalt. So if you are applying cobalt to remedy bush sickness and apply lime there may be on the evidence of result that the lime will inhibit the benefit beyond that given through cobalt.

There is another point that is rather interesting to me in that I have had occasion lately to be paying some attention to volcanic soils in Hawkes Bay. There subterranean clover is of outstanding value whereas here the subterranean clover on the experience they have is relegated to a very inferior

position. In fact it<sup>s</sup> us's is not recommended at all; I think it is interesting to note the difference in the response of subterranean clover in the two areas.

J.M. Smith:

I would like to congratulate the work Mr. Dalgliesh is doing in pumice land. It is wonderful work. In the slides he showed there were in many cases of what he considered good pastures were 75% or more of white clover. I would like to ask Mr. Dalgliesh if this is typical of pastures, whether it is very desirable and if such a high content of clover is usual.

C. S. Dalgliesh:

Gentlemen, with regard to white clover you certainly can have too much. You must have it to establish a farm. It is a matter of management to keep it at the proper level and that is quite easily done. You certainly can have overmuch and if so there is the danger of bloat, and it is a matter of keeping control of your pastures and keeping White clover to a reasonable level. It is not an easy matter to manage pastures on small farms as some people think. On 90 acres Demonstration Farm at Ngakura I was running 60 COWS and yet the pastures were beyond control. I can take you to pumice country where subterranean clover is doing all right. The same with danthonia. We have reasonable pastures of subterranean clover on the pumice country. Probably I have not made that clear in my paper but on new pumice country I would not use lime but if the land has been established for 5 or 6 years I think it is quite probable that we will use lime. The position is altogether different from the new farms. In Westland you cannot farm without lime. My experience on the pumice country is that you do not use lime until you get a good phosphate level. We are deficient in phosphates on pumice country. There is not much use in trying other manures. At the present time the Lands Department have got under way 35,000 acres around by Reporoa, Ngakuru and Tokoroa. About 5,000 acres in Ngakuru and easily another 35,000 to deal with. Around Taupo there is a good deal of country. Around Taupo I have seen country bought in that I did not have very much time for and it is surprising today.

E.B. Glanville:

First of all I would like to mention that production was what can be reached on gumland with proper development and proper management, but unfortunately I must admit that a great part of our gumland development resembles the slide I mentioned poor development. It is not the average production of any particular farm. Regarding the area, Mr. Chairman, I cannot give any approximate figure. There is a tremendous amount of gumland awaiting development in North Auckland but the big trouble there is water. It is just doubtful whether it would be economic to do it, unless some scheme of providing water is devised.