SAND DUNE RECLAMATION.

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Foreword.

Though the reclamation of sand dunes is going on in many parts of New Zealand, little is heard of the work, except for an occasional write-up in the daily press.

Localities in the Auckland district where the operations are in progress are the Kaitaia dunes on the Ninety Mile Beach, Te Kopuru to the South West of Dargaville, the Kaipara South Head, Muriwai area and the Waikato Heads. On the East Coast there is Te Kao in the far North, Ruakaka to the East of Whangarei, and the Mangawhai-Parkiri area between Bream Head and Cape Rodney.

It is to the Te Kopuru area in particular that this description refers.

The Te Kopuru dunes differ from the general type of dune in that they are what is known as "cliff dunes". Drift is probably a better description as they are in all cases areas of drifting sand which have "blown out" from the old elevated dunes fixed by the native vegetation.

In the most familiar type, the beach dune, there is a constant supply of fresh sand from the beach but at Te Kopuru such is not the case. The drifts are separated from the beach by a sandstone cliff of an average height of 150 feet. At only one place in the area under consideration is the beach sand escaping up a gully to the top of the cliffs.

It is a curious fact that on the whole of the Pouto Peninsula, i.e. the land below Dargaville enclosed by the Wairoa River, the Kaipara Harbour and the Tasman Sea there is almost no rock harder than soft sandstone. The one exception is Green Hill, a small dasite cone on the banks of the Wairoa River opposite Tokatoka. The rest of the peninsula is built up of alluvial deposits and sand of varying ages from the old manure podsol localities where the kauri grew, to the narrow low dune edging the beach. In between these two there is on the inside a belt of very fertile consolidated sandy loam and on the outside a strip of recently fixed sand that will "blow out" if the surface cover is broken. It is extensive "blow-outs" in this latter belt which form the drifts with which we have to deal.

It would seem that the land has been raised and lowered several times. Along the seaward side, both outcropping from the beach below highwater mark and from the cliffs are beds of lignite. They range from a few inches to 20 feet thick. In some of the beds timber is still to be seen in an excellent state of preservation. One can distinguish kauri (Agathis australis), totara (Podocarpus totara), monoao (Dacrydium kirkii), puriri (Vitex lucens), rata (Metrosideros robusta), and possibly kawaka (Libocedrus plumosa). Incidentally the lignite makes excellent fuel and saves cutting a lot of firewood.
During the 1938 season the average speed of trucks employed was 12 m.p.h. This included loading and unloading time. As most of the work was on the beach the local carrying company usually supplied an old truck for the work. A modern truck would have been faster. But in the present season a good deal of the work has been done with modern trucks, including the six-wheeler mentioned, and thus the cost is being reduced.

Once the marram is on the truck it is carried as near as the truck can go to the planting location and then transferred to a sledge. Sometimes the sledge can go right to the planting area but usually it is only to the edge of the drift, either at the foot of the cliffs on the windward side or to the ‘sand-fall’ to leeward.

The last stage is then by packhorse, and about 10 bundles are enough for the average animal.

Thus it will be seen that transport cost is a serious item in cliff dune reclamation, especially in our case where road access is limited. In the 1938 season it accounted for about 40% of the cost of establishing the marram nurseries. It is, in fact, the ‘raison d’etre’ for planting the nurseries at all.

For planting the marram a narrow graft spade is used. It has a blade 18 inches long and is about 3 inches wide at the point and 6 inches at the top. Two men do the planting, the first making the holes and the second inserting the marram and firming the sand around it.

The planting hole is made by pushing the blade of the spade into the sand and working the handle backwards and forwards until the point has penetrated about two feet. This makes a hole which is wide enough to take a bunch of marram to a depth of 18 inches. The sand is then firmd with the foot in the same way as planting trees. Planting can only be done in damp sand as when the sand is dry the hole collapses and fills as soon as the spade is removed.

It is usual to run the planting lines at right angles to the direction of the prevailing wind and to “stagger” the plants in each succeeding row.

In earlier work it was the custom to plant either one or two plants per hole at a spacing of 4 feet by 4 feet or 2,700 per acre. However it has been found that better and quicker results can be obtained by planting a bunch of plants so that the standard bunch of twelve plants has been adopted. By putting in a number of plants the death of one or two does not affect the work and blanking in the following year is to a large extent eliminated. In other words, the higher initial cost proves a better proposition than repeated annual blanking. Of course the filling of blowouts has still to be done, sometimes year after year.

It also seems that in “bunch planting” a sort of mutual shelter effect is obtained to the benefit of the newly planted stock.
For the planting of a drift, as distinct from nursery planting, the four foot spacing is still used. Contract work is usually employed the price paid being from 8/6 to 10/- per 1,000 “spots” planted. The variation in price is necessary, as in some places there may be long runs of good sand and in others, short runs, steep faces, hard sand and other obstacles. Therefore a contract price is let according to the conditions obtaining over the greater part of the area to be planted.

It will be seen that at 8/6 per 1,000 spots a pair of men have to plant just under 4,000 per day to make wages. This is within the capacity of experienced men when the “going is good.” On bad sand, where 10/- is paid the pair must put in 3,200 and unless conditions are very bad this is reasonably easy.

Tallying the planting is a bit of a problem and must follow up the planting fairly closely, say every second day. The work tallied must be well marked and preferably “tied in” to some natural feature with compass and chain, otherwise any mark put in by the tallyman can be moved back by the planters so that several lines of holes are tallied twice.

Once the marram is planted it very soon starts to grow and put out roots. The root growth in particular is remarkable. About four months after planting, the roots can be traced for six feet from the plants and are seen to be radiating in all directions. They have a very strong binding effect on the sand as can be seen after a spell of heavy wind.

The procedure in planting the marram nurseries is the same as in the general planting with the exception that $2\frac{1}{2}$ feet x $2\frac{1}{2}$ feet spacing, 6,500 per acre is used. Many small nurseries are put in on each drift and are scattered about in the places most favourable to rapid growth. The reason for planting many small plots is to decrease as far as possible future transport. It is often worth while to plant marginal strips in the lee of drifts to serve the dual purpose of a nursery and the temporary arresting of the drift.

Though some marram can be dug from the nurseries when they are a year old, it is better to wait until the second year before commencing “plucking” for the final planting. But after that nurseries can be gone over year after year, for even if all the visible plants are removed the marram still grows from the roots. It is noticed that the best marram comes from the vicinity of good lupin plants, it probably benefiting from the nitrogen fixing powers of that legume. Thus it will be seen that the nursery should always be two or more years ahead of the main planting.

Once the marram is planted it is necessary to wait two or more years before commencing sowing the lupin. The reason for this is that lupin needs a certain amount of shelter for its development and the marram cannot provide this until the second or third year of
growth. Some blanking in the marram is always required too. It may be due to the newly planted stock being buried, or blown out, or dying off, though the latter happening is rare.

Once the marram is established the lupin is spot seeded, seed being either broadcast or hoed in.

In the former method, the seed is dropped into the tufts of marram, toetoe, pingaeo or other shelter. Here it has a chance to get a start in life and once it attains about nine inches of root depth it is fairly certain to reach maturity. But should there be much heavy wind before this, many of the seedlings will be killed, usually by the roots being exposed.

The second method of planting is with a hoe. In this, a two man job, one man hoes out a small hollow in the lee of the tufts of marram and into the holes the second man drops a pinch of seed. Then the wind is left to cover the seed, which it soon does.

Naturally it is not necessary to plant in the lee of every single bunch of marram on the drift. My own system is to sow in belts of about half a chain wide, sowing at, say, every second tuft of marram in every second or third row.

Between the belts there a may be a space of one, two or three chains, according to the amount of exposure to the wind.

The hoe system of sowing is as liable to wind injury as the other. During the 1938 season the lupin sowing was done in the spring, mainly in October. In early November there was a period of very strong, dry Easterly wind, and this played havoc with the newly germinated lupin. Strong winds were experienced from various quarters right up till New Year and as a result there was a very poor “take” of lupin.

It is usual to sow in the spring as the work forms a convenient means of rounding off the planting season and the lupin germinates more rapidly in the warm sand.

But because of the wind which is to be expected in the spring, Autumn sowing has a certain amount to recommend it and it is intended to do some experiments on these lines in the current season. Soaking the seed to encourage germination will be tried.

Though a few lupin plants flower and seed in their first year of growth, the majority seed in the second and third years and it is from these that the seed is collected for future sowing.

Collecting the seed forms a convenient occupation for some of the men after the end of the planting season. They are paid 9d. per lb. for clean seed and each man is given a quota. The total amount to be collected is governed by the amount of marram that will be ready for sowing over in the following Spring. About half a ton is the usual harvest for this particular station but on large works the amount would be much greater.
It is in the second year after the planting of the lupin that the results of the labour expended really begin to show. Lupin at one year old usually forms rounded bushes about three feet high. Walking between the bushes is easy. But in the second year of growth the bushes expand remarkably, reach five feet in height and spread over the ground until they have a diameter of twelve feet or more. An area which could be easily traversed by walking between the bushes in the first year is likely to be almost impenetrable in the second season. The bushes seed during that Summer, and the first seed which ripens early in January, will germinate in the following Spring and the tangle becomes thicker than ever. The original plants seed again in their third summer and in the following winter a good many of them die off. It is then that the influx of other plants is noticed. Fleabane and some of the thistles are the most common. Many other plants such as inkweed, and various grasses like cockspur and prairie grass also appear. In fact the whole thing is an eye-opening demonstration of Nature’s provision for seed dispersal.

Once the third year of the lupin is reached, tree planting can be started if any is to be done. But it must not be imagined that further growth of lupin has ceased. The second generation appears and some of the original plants continue to grow but with reduced vigour. However the general growth does not seem to be as heavy, so the conditions are most favourable for the trees.

The scheme of tree planting is as yet not beyond the experimental stage at Te Kōpuru. Only small areas have been put in so that no really representative cost data can be supplied.

Though most of the trees are planted on the fixed sand it has been found expedient to grow them in a nursery located in the fertile consolidated sandy loam belt referred to earlier.

The trees in the nursery this year have made remarkable growth in spite of the very dry summer. P. pinaster planted early in October has now (end of April) made excellent headway and reaches 9 inches in height. P. muricata is not so good, but P. radiata is up to 12 inches and looking very healthy. But these are dwarfed by E. botryoides, which in individual trees reaches 2 feet and averages 18 inches.

Tree planting lasts from May to July. It has been found desirable to get the trees in before there is the slightest suspicion of dry or warm weather so that all the trees should be planted out before the end of the latter month. In many case the mortality rate is a good deal higher than in ordinary soil.

Nursery practice is the same as that followed elsewhere. Adequate wrenching has been found to be essential, as in the free nursery soil the trees would otherwise develop a spindly root system.

In planning the layout of the various species the main factor to be considered is the amount of exposure to which the trees will be
subjected. Basically the idea is this; on the windward side of the newly fixed drift is planted a belt of wind-resisting trees. *Pinus pinaster* is chosen for this work. Its purpose is to break the force of the wind and though the outer rows of trees will never be anything but stunted wrecks, each succeeding row will be a little higher and a little denser than the last until at the lee side of the belt they reach normal size. Next to the *P. pinaster* is planted a belt of *P. muricata*. This species, being a denser and more bushy habit of growth than the former, makes a further barrier to any wind that may filter through the maritime pine. This procedure is necessary as the *P. pinaster*, loses its branches rather early in life.

Next to the *P. muricata* is planted the species that is really desired to grow. These at Te Kopuru are *P. radiata*, *Cupressus macrocarpa*, *E. botryoides*, etc. *Pinus palustris* was considered but was rejected on account of the excessive amount of line-cutting that would be, necessary before the trees could attain sufficient height to breast the lupin.

Such is the theory worked on, and the reader probably has visions of even rows or belts of trees running for miles along the coast. But local topography renders this impossible and the result is a series of intermittent plantations rather than a continuous belt of trees.

Besides the drifts proper there are numerous small plantable areas between the "sandfall" and the legal boundaries. Here the eucalypts and most of the *P. radiata* will be planted. Several such areas are now carrying trees up to 20 feet high at six years old. *P. radiata*, *P. muricata* and *Cupressus macrocarpa* are growing well. A point noticed frequently with the insignus pine is that it will not tolerate salt gales. The trees grow well until such time as the leader emerges from the surrounding cover. Then the first bad "blow" nips it back. Another leader is produced, to suffer the same fate and yet another until the tree is completely ruined.

Having discussed the theory, let us review the practice. First of all it is necessary to cut lines through the lupin and here we have the biggest problem to cope with.

The lines are cut in the Autumn, just prior to the planting. Then the trees are planted in the usual way. But early in October the lupin has grown to such an extent that it is necessary to re-cut the lines. The growth of the lupin continues most vigorously and towards the middle of December a further light linecutting is required. The trees can then be left for the summer. They do not make a great deal of growth for a start and indeed, for the first year, are somewhat disappointing. With the advent of Autumn again and the prospect of blanking up the original planting, a third linecutting is necessary. Then in the months of June and July the blanking is completed. Comes Spring again and further linecutting, either once or twice; but by then the original trees have started growth and by
1-year old Marram shown in dark bunches, the newly planted in light colour.

Planting a Marram Nursery; the bunches of Marram are smaller than normal on account of the sheltering nature of the site.
Christmas, will have put on anything up to 18 inches of new growth and still more by the end of the summer.

If the trees used for the blanking are well established no more linecutting will be necessary but it is sometimes found necessary to open up the lines once more.

It will thus be seen that the cost of linecutting is a serious item in the establishment of trees on the sand dunes, so that any method of reducing the cost is desirable. And this brings us to the relative merits of one and two year old trees.

In the past, most of the planting has been done with two year transplants. About the only advantages of this type of planting stock is that, being large, it does not require too much linecutting before it tops the lupin. But there are many disadvantages. The nursery cost is much greater, handling charges are higher, likewise the planting costs, and the "strike" is generally poor, often as low as 50 per cent.

With one year seedlings the opposite is the case. As they take longer to breast the lupin, more linecutting is necessary, but to balance this the trees are cheap to produce, easily handled, quickly planted and the "strike" is generally good, being 80 per cent. or over. And so it is a matter of finding out which is the cheaper in the long run. Costs are being carefully kept but as yet it is too early to give figures or offer any positive conclusions, for the stage when the trees under consideration are above the lupin, has not yet been reached.

And so we have covered all phases of the work from the bare drifting sand dune to the embryo forest. Though public opinion is a bit sceptical as to the practicability of the tree planting, it is unanimous as to the worth of the sand fixation work. It is most encouraging to be told that "It is a great work that you people are doing."