

Since the aneroid barometer came into use barometrical measurements of altitude have become very common, but I am not aware of any scientific work in which the subject is treated at all fully.

The officers of the United States Survey, engaged on the survey of the western slopes of the North American continent, are reported to have made careful and elaborate investigations, and to have constructed hypsometrical tables suitable for all altitudes above the sea-level, but I have not been able to obtain any work containing an account of the results they have arrived at. Whether facts similar to those I have detailed above have been previously noted I have not been able to discover, and my chief object in presenting these notes to the Society is, if possible, to elicit information on the subject.

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ART. VIII.—*On the Reclamation of Land devastated by the Encroachment of Sand.* By C. D. WHITCOMBE.

[*Read before the Wellington Philosophical Society, 25th September, 1872.*]

THE subject of reclaiming land devastated by the encroachment of sand is one of the greatest importance to the settlement of Taranaki; in fact, to the west coast of this island in general, if not to the eastern portion of it.

It is now admitted that the bars at the mouths of rivers are principally formed of sand driven along the coast or washed in by the sea; that where there is a bar it will be found that the soil is loose, both at the bottom and on the sides where the river discharges; and that with rocky bottom and sides there is generally no bar.

At New Plymouth we have a drift following the prevailing current and set of the tide, from north to south and from south to north we have the shore drift blown along coastwise by the prevailing winds; besides these, there is the large amount of detritus carried down every river by every rain, and which is increased to a maximum by the process of first clearing a loose virgin soil. These three operations combined must tend to create and maintain bars, generally of a horse-shoe shape, at the mouths of our rivers (unless the tidal pressure is transverse to the flow of the river, and much stronger than this latter), infinitely to the prejudice of navigation.

Again, the effect of the drifting of sand in large quantities is gradually to choke up the smaller streams, backing their waters, and causing the formation of swamps and marshes along the line of their course; and finally, if left unchecked, the sand drifts further and further inland, creating ever-increasing areas of desert land. Anyone who has observed the rapid encroachment of the sand in this province, will at once own that within very few years damage has been done to an enormous extent in all the three modes pointed out

above, and will not think the subject one undeserving the attention of the Legislature.

In France the subject has long since been legislated on. By the 41st section of the law of 16th September, 1807, the government was empowered to make grants of sand-lands to individuals, under certain prescribed regulations for planting them; and also to undertake itself the work of reclaiming the soil, whether by plantation or otherwise, as might be considered necessary. Under certain circumstances, when the encroachment of sand on the property of any individual, without sufficient efforts on his part to arrest it, threatened to do any public injury, the law of 7th July, 1833, might be brought into operation, under which the said lands were valued by arbitration, and the government, paying the amount of valuation to the proprietor, took over the land, and dealt with it under the law of 1807. Later still, the government has adopted another auxiliary means of dealing with the matter, and now, through the intervention of the *Conseils Généraux* of the Provinces, makes grants of seeds of pines, etc., to the districts troubled with sand, and also makes grants of money to cultivators who have succeeded in arresting the sand over a certain area by means of the *oyat*.

Now as to the means generally adopted. The first place to commence plantation on is the generally level space between high-water mark and the foot of the downs, or sandhills, over which the sand, propelled by the wind, travels without stoppage. It is well not to operate on too extended a surface at once. The plants which are more especially suited to this purpose are those which not only can grow in the driest sand and live in an atmosphere impregnated with saline exhalations, and even with salt sea spray in high winds, but, above all, those whose roots have the property of spreading closely and compactly for considerable distances, and whose stems possess a toughness which preserves them for a lengthened period.

The following is the system which has been generally adopted in sowing: Take one-third (rather in number than in bulk) of seeds of the trees and shrubs you intend to sow, and to this add two-thirds of seeds of plants of as rapid a growth as possible, whose stems will shelter for the first few years the ligneous plants, and prevent their roots from becoming bare and exposed. The sowing should be thick and broadcast, and the seeds covered by a light harrowing. Then, to lessen the mobility of the soil, branches of trees, fresh cut, with their leaves on, or, in default of these, branches of broom or furze, are spread and fixed on the surface by means of pegs; these afford a shelter from the drifting effect of the wind and from the rays of the sun. If branches, etc., cannot be procured in a sufficient quantity, the following plan is adopted: Fascines of a tolerable thickness are united in lines and disposed chess-board fashion (like Maori *taro* beds), and the sowing is made. In a few years a

first line of plantation is made, and reclamation of sand-land proceeds rapidly behind it.

Cuttings are also made use of, especially of the *Tamarix gallica*, or tamarisk. The topinambour, or Jerusalem artichoke, is also very valuable, as also are the larger sun-flowers and the whole tribe of mesembryanthemums. The following plants are also worthy of notice, and may be employed with great advantage, viz. — *Eryngium maritimum*, or sea holly; *Convolvulus soldanella*, or sea bineweed; *Glaucium luteum*, or yellow-horned poppy; *Euphorbia pepelis*, or purple spurge; furze, broom, and the sallow, may be also sown, though the former is far from advantageous in a plantation of trees, choking the young plants. But, for rapidly arresting the march of sand, and fixing it, the following plants have been found most efficacious, viz.—*Arundo arenaria*, or sand-reed, known in France as the “Oyat des Côtes du Nord”; *Elymus arenarius*, or sea grass, and rye grass. The *oyat* is infinitely superior to all the others. The best tree to sow is the *Pinus maritima*.

The season for planting or sowing must be that in which there is the greatest continued supply of moisture to allow time for growth of seeds, or striking of cuttings. New Zealand I consider peculiarly favourable as to climate for the reclamation of such lands.

I have by me some peculiarly valuable reports of M. Alexandre Adam, who undertook the reclamation of downs in the Pas de Calais on a very large scale for the *Conseil Général* of that department. They were sent me as a special favour by M. M. Vilmorin Andrieux, of Paris, who are friends and Paris agents of this gentleman. They cover from 1864 to 1869, both years inclusive, and are, I am informed by M. Vilmorin, unprocurable now, and invaluable from their information. From them I have obtained many of the details I have given you. He proceeds by sowing *oyats* and *Pinus maritima*, and conducts the matter with a view, not only to expenses of reclamation being covered, but to the reaping of a large profit. As the pines grow up they are thinned out, and forest trees, especially oak, birch, elm, and ash, planted. Within the first line of plantation seeds of these trees are sown together with the *oyats* and pines.

I may add that the poplar is found very valuable, both for sowing, planting, and multiplying by cuttings. In some places, where the sand was very deep and dry, M. Adam found that instead of sowing it was preferable to take large cuttings of poplar, set them one yard deep in the sand and two yards apart every way; these almost invariably struck, even on the highest sandhills, and in the most exposed situations where nothing else would grow. I trust this information will be found of service, and that some grounds may have been shown for urging on the Legislature the importance of following the example of the French legislature, who, by their wise action,

have caused the reclamation of hundreds of thousands of acres of land from a state of desolation to fruitfulness. Everyone can see with their own eyes the rapidity with which, on the other hand, land is drifting in this province and elsewhere in the colony from fruitfulness to desolation.

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ART. IX.—*Directions for Raising and Spreading Ammophila arundinacea and Elymus arenarius.* By J. C. CRAWFORD, F.G.S.

[*Read before the Wellington Philosophical Society, 23rd October, 1872.*]

IF the seeds of these grapes are simply scattered on the sandhills there will be great waste of seed; much will be blown away and lost, particularly if sown where the sand is actually in motion.

1. If there is any good land at the place a nursery ought to be fenced in and a quantity of plants raised there as a stand by. When well established a number of these plants should be broken up every winter and planted out, but care should be taken to replant in the nursery, and to keep it permanent.

2. In sowing beds in the open, particularly late in the season, moist and sheltered places should be selected, and the seeds trodden in or slightly covered.

3. When the plants are fairly grown and form large bunches a number of them may then be broken up into several hundred plants each, and planted out. They must be planted deep so as to have a good hold of the ground, otherwise many will blow out. It is also advisable when planting to cut off the tops of the leaves, as the plants do not then suffer so much from the wind before getting rooted and established. I use, for planting, a small spade, and make a slit, well opened, the full depth of the blade.

4. It is advisable to commence planting in hollows surrounding the sandhills and gradually to work round them.

5. It will take a year or two before the plants make much show, afterwards planting out must go on all through the winter season.

6. The planting out of these grapes requires thought, judgment, and constant attention, otherwise a very small result will be attained.

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ART. X.—*On the Taieri Floods.* By G. M. BARR.

[*Read before the Otago Institute, 12th March, 1872.*]

MANY schemes have been suggested for the prevention of the floods which have been so disastrous to property on the Taieri plain, but those which were generally recognized as the most practicable have usually been estimated at so