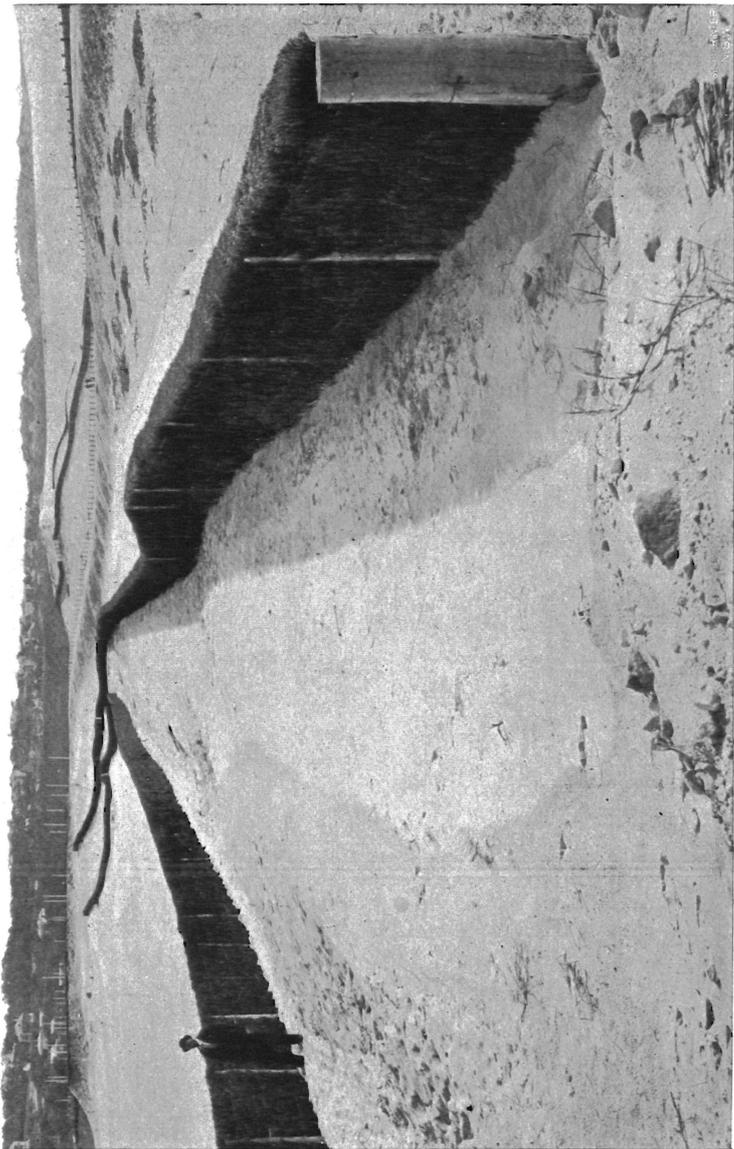


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VIEW OF THE SAND HILLS FRONTING THE SEA AFTER BEING PROTECTED BY
FACINE FENCE FOR TWO YEARS.



SHOWING GENERAL ARRANGEMENT OF FENCES PROTECTING THE ROAD.

At present, when the sand comes in after a big storm it mounts partly up the outer fence, then that fence is raised. This lifting of the fence is found to be necessary about every nine months, but with the embankment just described it is hoped that its further raising will be rendered unnecessary.

FENCES.

The fences used are somewhat similar to those used against drifting snow in Canada. They consist of ordinary split posts, nine inches by two and a-half inches and seven feet six inches long, sunk three feet into the ground. Three pairs of double wires (6 SWG) are run through the posts six inches apart. Fascine bundles five feet long by nine inches diameter of Ti-tree or other approved brushwood fastened with binding wires are placed vertically in the line of fence between the wires, which are then tightened up, thus clamping the bundles very firmly in their permanent position. On the leaves and the fine parts of the brushwood dying, innumerable currents of wind pass through and between the bundles, causing the sand during every high wind to be kept moving, the general effect being its freeing itself from the fences and leaving a trench about nine inches deep on either side parallel with the fence. The work described so far is of a very simple character and its total cost but £2,500, the effect however has been far reaching, and the object of these notes is to draw attention to these very simple means of wrestling with a great natural force. (Photo. No. 4.)

Two years ago we completed the Bondi Road and fences, and at that time there were enormous sand hills extending from near the Tram Terminus forty chains northerly; these varied from approximately thirty to sixty feet high, facing the new road, and not 150 feet from it. The surface of these hills was of a clean sand, uniform in tint and almost white, with not a spot to mar or relieve the monotony and beauty of its glistening surface.

Photo. No. 5 was taken too late, but it still fairly represents the general aspect of these hills two years ago, although if it had been taken earlier the hills would have been shown higher.

It was feared when starting the work that with westerly winds the sand from the higher hills would return towards the sea and swamp the road; a double fascine fence was therefore erected one hundred feet from the roadway on the landward side. This fence proved necessary during the first six months of the road's existence, but the wonderful power of the prevailing south-easterly wind soon began its work; within twelve months portions of the hills had been lowered twenty feet, within eighteen months the fascine fencing on the landward side had become obsolete, and the sand hills instead of rising landward to a considerable height from the back of the fencing had become so reduced as to leave the fences in many places on the highest ground, so that the remaining sand hills nearest the sea were actually being held in position by the fascine fencing.

Last month these fences were partly lowered and partly removed altogether to allow the remainder of the hills to disperse, and in the three weeks following, the sand hills from which they were removed lowered two feet six inches.

The photos. exhibited show what the aspect of the Bondi sand hills is to-day. (Photo. No. 6.) The original vegetation level has been exposed on possibly twelve to fifteen acres, and remains of old tree stumps quite rotted have been brought to light after many years.

The sand hills have an area of about forty acres, and whereas the whole area presented a clean drift-sand surface, it would now be a difficult matter to find five acres over which stones, remains of old timber or black sandy soil are not beginning to appear. The prospects of completely reclaiming this large area of land—all suitable for villa residences and of enormous value—are certainly encouraging. It may take the prevailing winds many years to complete the work, but judging from the experience of the past two years, the desired consummation should be within measurable distance. The question naturally would be asked, what has become of all the thousands of tons of sand? The reply is that it has spread far and wide over the swamp towards Rose Bay, and on the higher lands in the direction of South Head. It has fallen on tussocky swamp land and on the higher lands covered with brush and grass, and the natural growths of all this will soon enable them to conquer the sand by rising above its surface and thus prevent it from drifting any more. (Photos. Nos. 7 and 8.)

Some of the members present may think the matter too simple to be made the subject of a paper. The agency of these fences is undoubtedly a very simple matter, but a claim is made in this case that simple as it is, it has been the means of performing a great work merely by facing the drift-sand immediately it leaves the sea thus blocking the source of supply.

NOTES ON OTHER SAND DRIFTS.

NEWCASTLE.

This drift, situated at Merewether, was, previous to the year 1889, a terrible scourge to a portion of the city of Newcastle. In that year the Mines Department took the matter in hand and appointed Mr. Czerwonka, formerly Chief Assistant Engineer for Sewerage, to take the whole matter in hand. Mr. Czerwonka commenced by planting marram grass along the beach, above high water mark, to varying widths of from half a chain to two chains. He then put in a plantation of various kinds of shrubs and trees supposed to be suitable for an exposed situation, such as *Lagunaria Pattersoni*, which succeeds admirably, Moreton Bay Fig (*Ficus Macrophylla*), Norfolk Island Pine (*Araucaria Excelsa*), *Pinus Maritima*, *Tamarix Gallica*, *Arundo Donax*, *Metrosideros Tormentosa*, African Box Thorn, *Corynocarpus Lævigatus*, and also, *Pinus Halipensis*. Gangs of men up to thirty in number were then employed to level off the sand and plant it with grasses—principally couch. The marram grass has proved a success and as it was continuously fed by fresh sand from the ocean, so it came up through the sand resulting eventually in an embankment along the shore line being raised to a height in places up to fourteen feet. (Photos. Nos. 9 and 10.) By constant care and attention the plantation at the back of

the grass embankment, and the couch grass on the surface of the covered sand hills, thrived with varying degrees of success. The trees and shrubs in the plantation, however, never rise above the level of a protecting fence placed on the seaside, the caretaker stating that, in all these years, the bushes have always presented the appearance of having been cut off level with the top of the fence, *i.e.*, at the level at which they became exposed to the full force of the Southerly winds. The chief points of interest in connection with this drift appear to be the maintenance during the last twelve years of the grassed embankment along the beach. The caretaker states, that once this grass ceases to be fed by fresh sand it dies out absolutely, and if not properly attended to, immediately the grass dies the sand will again commence to drift. In order to cope with this difficulty, *Mesembryanthemum* and *Spinifex*, and other ocean beach grasses are planted amongst the marram wherever it shows signs of dying. With this attention no difficulty with the sand ever appears, and the drift, instead of being a sand waste which it was in the year 1889, now presents a park-like appearance and is covered with grass. It must, however, be pointed out that whereas the Bondi sand drift has been treated at an approximate cost, exclusive of the construction of the road, of under £500, a very large sum has been spent upon the Newcastle sand drift, which is little more than half the size of that at Bondi. In planting this marram embankment, upon one portion of the beach, there was an outcrop of rock and clay, and it was found that the sand, being checked by the marram grass, would find an outlet over this rocky portion and so drift over the land. An artificial bank of sand, rubble, &c., was then constructed over this rock and planted with beach grasses, in order to make the whole grass embankment continuous from end to end, the result proving very satisfactory.

BOTANY.

The commencement of the Botany sand drift (only a few years back) from the Botany tram terminus to the Sir Joseph Banks Hotel, was rather an extraordinary occurrence. It appears to have commenced very suddenly, possibly through the removal of the natural scrub, and the beach grasses being eaten and trodden out by cattle, when it operated to such good, or rather bad, purpose that within two or three years from its commencement it had completely destroyed the Botany Park for a distance of three-quarters of a mile of the shore frontage by uprooting, or covering with sand, nearly the whole of the trees which had been planted, and it also drifted further, on to the tram line, necessitating the constant employment of men, at a very heavy annual cost to the Railway Commissioners, in keeping the tramway clear. In the year 1898, the Engineer for Tramways (Mr. Cowdery), the Chief Surveyor (Mr. Twynan), and the Author were appointed a Committee to report on the best means of dealing with this drift, when a recommendation was made that a double line of fascine fences be arranged along the shore line, similar to that which has been more recently carried out at Bondi Beach. The success of this, so far, in preventing further quantities of sand from drifting on to the park and tram lines has been complete, but the undertaking as a whole has not

been altogether successful on account of it not being the particular duty of anyone to maintain the work. The fences therefore, are in places becoming covered up with sand, whilst picnickers and larrikins seem to delight in setting fire to the fascines. This portion of Botany Bay is extremely rough in bad weather, resulting in damage very frequently being done to portions of the fences during heavy storms, whilst the various creeks, crossing the road opposite to this drift, occasionally strike out new channels for themselves. These fences, in consequence, would be most difficult to properly maintain. In future, however, should it ever be the lot of the author to further deal with this matter, he hopes to see marram grass planted for about a mile along this beach, in the hopes of an embankment being formed similar to that which we are expecting to see at Bondi, and which has already been realised in the case of Newcastle. Without some such further protection the Botany sand drift will never be properly mastered.

MARRAM GRASS ON DRY SAND HILLS.

Attempts have been made in a few places in the vicinity of Sydney, to prevent the drifting of sand on such sand dunes as Kensington and Mona Vale, by the planting of marram grass. In each of these cases the results have been somewhat similar *i.e.*, wherever the grasses have been protected and supplied with a fair amount of moisture, they have flourished, but on the tops of the hills they have invariably died out altogether, apparently through lack of moisture and want of feeding with fresh sand. In dealing with such hills the growth of some permanent vegetation, or shrubs, should be looked for. Marram grass, except under favourable conditions, can in no sense be looked upon as permanent. Some of it, at Newcastle, has lasted from ten to twelve years, but much of it has died out. The most essential feature in this treatment of sand hills is that when once the marram grass dies out or ceases to flourish, other more permanent grasses, such as spinifex, or if possible shrubs, or even Mesembryanthemum should be planted to take its place. In many works of the Department in sand country, especially at Centennial Park, couch grass has proved invaluable for outlet drains and watercourses over sand, and, as it also grows on the tops of high and dry hills, it is a most valuable grass to plant in connection with the reclamation of sand dunes, as when once established, it appears to be as permanent as any other grasses, whilst it is of value for grazing purposes. The Newcastle hills are covered with couch grass, and it is hoped that large areas of the Bondi country will be similarly covered before very many years have passed, but, along the more exposed slopes facing the sea, the strongest of beach grasses are the only ones that can be planted to any good purpose.

It must not be lost sight of that in Australia we have enormous tracts of these sand dunes which some day must be dealt with. These dunes are travelling farther and farther inland and with a bigger population some of these areas will have to be reclaimed and possibly the future engineers to carry out these reclamations may be among the members present to-night.