LIKE many other states, Massachusetts is affected by wind erosion and sand dune formation in parts of its area. Massachusetts was perhaps the first state in this country to institute control methods for wind erosion and stabilization of its sand dunes. Sand areas at the extremity of Cape Cod are approximately 6,000 acres in extent. History avers that most of these areas, especially those enclosing Cape Cod Harbor, were originally forested and have been extensively denuded during the country’s colonization period. As far back as 1714 and particularly in 1826, extensive reclamation of sand areas on the Province Land was attempted, for Provincetown, the largest city on Cape Cod was in danger of being swept into the sea.

At the time, Provincetown was a thriving port noted for its fishing and commercial shipping. The strong, raw gales which swept across the Cape then, as they still do, carried sands from behind the town into its harbor, while along the shore the sea washed the beaches away into the water. Towns-

**Figure 1.**—Panorama of typical scene at the Province Land at Cape Cod. A complete change of surroundings to the many tourists who come yearly from inland.

**Figure 2.**—Detail of blowing sand, binding grass and shrub, low profiles and barren coast, that give distinction and unique landscape to the Lower Cape.
folk and tradesmen were justly concerned over the hazard to their town and harbor. They requested the Commonwealth of Massachusetts to appoint a commissioner to investigate the danger and make recommendations. Soon money was appropriated to plant a "curious" grass and laws were passed prohibiting cattle, horses, and sheep from roaming at large and destroying it. This special beach grass had extensive roots which would grow to a great length and depth and hold the sand so that neither wind nor water could take it away. This grass rooted quickly, thus checking the movement of the sand, and from that time on the City of Provincetown has been protected, remaining thus to become one of the spots frequented by summer tourists from all over the world.

Cape Cod, which includes all of Barnstable County, has a topography which ranges from sea level to about 150 feet above sea level, with gently rolling lowlands. Geologists have not been able to find bed rock anywhere at the Cape for this outstretched arm is a moraine left behind by the receding glaciers. It is in reality the right arm of Massachusetts, extending 75 miles out to sea, with its shoulder at Buzzards Bay, its elbow at Chatham, and its finger at Provincetown, virtually beckoning to those on the mainland of the Commonwealth to come to her shores and enjoy nature's bounty and observe the diversified farming that takes place on the Cape.

The soil is generally sandy in texture, with very good drainage. With the exception of the cranberry industry, the agriculture of this section is not intensive, with small fruits, strawberries, and vegetables predominating. However, such crops as sweet potatoes, peanuts, cultivated blueberries, beach plums, and asparagus are grown with success. About 70 per cent of the world's supply of cranberries is grown in Massachusetts with Barnstable County producing over 25 per cent of this. Besides cranberries, the beach plum, and the famous straw-

Figure 3.—The Cape Cod dune areas are constantly under observation for active sand dunes. The use of a saddle horse is imperative in the supervision of the dunes.

Figure 4.—Horsescarts are still used in hauling branches to the active dunes, though the truck is taking their place.

Figure 5.—Light trucks equipped with "jumbo" balloon tires used to haul branches to the active dunes.
berries, Cape Cod has another crop which is native to it, namely, the white variety of turnip. When the light strain of seed is used and the crop properly cared for, the flavor, texture, and quality cannot be equalled.

Of late years, a large percentage of the inhabitants of the Cape have been dependent on the flourishing summer tourist trade for their livelihood.

Wind erosion on the Cape as well as water erosion is very severe. In the region between Orleans and Provincetown any agriculture whatsoever is impracticable. Most of the section is occupied by summer resorts and recreation. The remainder of Barnstable County is fairly well in sod and only the north and south shores show any excessive sand dunes.

The most spectacular wind erosion and sand dune formations are found at the Province Land which comprises the area at the extremity of the arm. Figures 1 and 2 illustrate a typical panorama of the Province Lands. This landscape of low, wind-stunted plants fresh green in summer, wonder-colored in autumn and sparsely covered sand dune formations is a main attraction for the many folk who visit the region. The beauty of the dunes is really an asset and they are not considered, therefore, an economic liability despite their low agricultural potentiality. However, this asset would not remain long if continuous measures were not taken to stabilize the active dunes and keep the shifting sand from burying the highways, beaches, and existing shrubbery. From the very earliest times the state of Massachusetts has had jurisdiction

---

**Figure 6.**—Pine branches used for stabilizing Cape Cod sand dunes until vegetation can be established.

**Figure 7.**—American or native beach grass (Ammophila breviligulata) found commonly on Cape Cod. Circular pattern made in the sand by the drooping leaves is characteristic of this species. *Courtesy of Henricks Hodge.*
over the Province Land and in more recent years, under the direction of the State Department of Public Works and its superintendent of the Province Lands, various methods have been used with success in controlling the shifting sands and establishing permanent vegetative cover. Because of the lack of roads and the inaccessibility of the area by any other form of transportation, men on horseback patrol the whole area and are constantly on watch for active blowouts (Figure 3).

The most severe winds occur during the late fall and winter. As a means of control for the very active sand dunes, pine branches are usually spread on the northwest ("blow" or "live") side of the dune. It is necessary to haul the branches to the dunes either by horsecart or light truck equipped with specially built oversize, low pressure, "jumbo" tires (Figures 4 and 5). These branches serve as a barrier against the wind and as a shelter which catches beach grass (Ammophila sp.) seed (Figure 6). The beach grass seed which usually is quite plentiful, will
germinate and establish the grass during the next season. It is characteristic of beach grass to thrive where there is an occasional deposition of sand over the entire site. If no sand is deposited over the beach grass the plants may do exceptionally well for three or four years and form a thick mass of roots which seems to "choke" off further growth and cause the beach grass to die out. Frequent deposition or drifting-over of sand permits the roots of the plant to establish itself in the new horizons and thus propagate itself almost indefinitely. There are two species of beach grass: European beach grass (*Ammophila arenaria*) originally found along the coast of Europe and later introduced on Cape Cod and on our Pacific Coast; and American beach grass (*Ammophila breviligulata*) which is native along the shores of our eastern coast and the Great Lakes. This latter species differs from the *arenaria* in that it has very short ligules and its leaf blades have a marked tendency to bend or droop. This leaf character makes it easy to distinguish the American species from the European, since the drooping leaves make a very picturesque circular pattern in the sand when they are blown about by the wind (Figure 7).

It is not desirable to make any plantings of trees until beach grass is well established. Usually after two or three years beach grass will have spread itself sufficiently over the sand to prevent any further occurrence of serious blow-outs. When this stage has been reached, pine trees can be planted safely. Three to five year old pine trees planted in

**Figure 10.**—Young plantation of Austrian pine in foreground, for control of wind erosion on Cape Cod. What appears to be "bushes" in the background are tops of living trees. Some have been uncovered and have been found to be 12 inches in diameter at the trunk.

**Figure 11.**—The pine trees once established soon produce an exceptionally large spread of roots near the surface of the ground. With the exception of the top three to five inches, there is normally plenty of water in the sand at Cape Cod.
rows about three feet apart and with
three foot spacing in the row, are used.
The common practice is to plant the
pines in the early spring when there is
sufficient moisture present in the sand.
Trees planted in late fall or winter
have not withstood the cold winds and
usually are winter killed. Various
species of pines, such as Scotch pine
(*Pinus sylvestris*), Mungo pine (*P.
mughus*), and Pitch pine (*P. rigida*)
have been used effectively in establish-
ing permanent cover over the dunes
(figures 8, 9, 10, 11). The Austrian
pine (*P. australiaca*) has been found to be
preferable to the Scotch pine in this
region for it withstands the cold winters
of the Cape much better than any other
tree tried. It has been observed on
different plantations of Scotch pine
which are located on the Cape that
during the winter months the prevailing
northwest winds when laden with sleet
and sand cause a mechanical injury to
the pine branches on the windward side.
This injury is not as great on the
Austrian pine. It seems probable that
one of the reasons why the Austrian
pine can withstand "windburn" due
to the severe winds, is because the bark
on its younger branches and twigs is
considerably thicker.

In certain localities on the Cape,
especially on the Province Lands, where
the wind tends to blow out the embank-
ments of the roads, it has been found

---

**Figure 12.**—The characteristic way in which hog cranberry adapts itself for controlling erosion on Cape Cod.

**Figure 13.**—Scotch Broom planted along roadsides at the Cape to prevent wind blowing away road embankments.

**Figure 14.**—Dusty Miller, found abundantly on the Cape, aids considerably in the natural stabilization of sand dunes.

**Figure 15.**—Black heather, a native plant found covering sand dunes which are fairly well stabilized. *Photo by W. R. Van Derwal.*
expedient to sod a continuous strip, with either hog cranberry (*Arctostaphylos uva-ursi*) (Figure 12) or beach grass, two to three feet wide and parallel to the edge of the road. In some instances a thick layer of native beach grass hay, spread on the active wind-blown road embankment has acted as a protection against further blowing as well as a protective mulch for germinating the seed that is present in the hay and also the seed that is blown from elsewhere. Plantings of Scotch broom (*Cytisus scoparius*) along the roadside embankments have given erosion control and at the same time are improving the appearance of the landscape (Figure 13). Two native plants commonly found on the Cape, which produce a desirable

![Figure 17. Showing the general habit of the beach plum on sand dune. The dead plants in the background resulted from sand deposition. Residents pick the fruit to make a special jelly. *Photo by W. R. Van Dersal.*](image)

cover as well as adding to the aesthetic surroundings are dusty miller (*Artemisia stelleriana*) (Figure 14) and black heather (*Holcus tomentosa*) (Figure 15).

Seed of Scotch broom and such native plants as beach pea (*Lathyrus maritimus*), sumac (*Rhus glabra, R. typhina*), when sown broadcast on the sand in places where the wind is not too intense, germinate and produce a very desirable cover. Considerable success has been experienced in transplanting native bayberry shrubs (*Myrica carolinensis*) (Figure 16) to form a protective, marginal

![Figure 16. A fruiting branch of the bayberry plant found abundantly on the Cape. Residents pick the berries and sell them for about $70 per ton. The thick coating of wax on the bayberry is used in the making of special scented candles. Birds eat the berries and thus obtain considerable heat energy which helps them to withstand the cold. *Photo by W. R. Van Dersal.*](image)

![Figure 18. An exceptionally well-developed podsol soil found at Wellfleet, Mass. The bleached siliceous layer is 36 inches thick in places. The chemically cemented, mottled brown "ortstein" layer found just below the bleached layer is very hard and cannot be easily disturbed with the point of a shovel.](image)
planting which serves as a windbreak in places where the wind has started to expose roots of previously planted trees.

The beach plum (Prunus maritima) (Figure 17) although growing wild in this region, is regarded as a valuable plant since a distinctive jelly is made from the plums. It is common on the older sand dunes and being very hardy, will withstand considerable deposition of sand before it will die. However, the beach plum is a host to many insects which are harmful to more desirable types of trees, and should be used with care, if at all, for protective purposes in sand dune control.

Although it is not very commonly known, the soils of a considerable area on Cape Cod are well developed podsols. It is not uncommon to find a layer four to eight inches thick of highly siliceous material developed in the top soil ("A" horizon) due to the excessive leaching action of the decomposing organic matter that has accumulated on the surface. In one locality at Wellfleet a record thick bleached layer of 36 inches can be observed (Figure 18).
Since the processes of podsolization require numerous decades, the presence or absence of a podsolic profile can be used as a criterion in determining whether a certain dune area has been subjected to a recent wind erosion or whether it is stable. In many cases remnants of podsol profiles show that certain very old, stable sand dunes have been recently blown away. The accompanying pictures (Figures 19 and 20), illustrate a typical area where an old dune has recently been blown away, leaving remnants of the old podsol profile. The arrows point to a well developed humus layer, below which is found a typical whitish-gray bleached siliceous layer. Below this bleached layer is found the characteristic, chemically cemented, mottled brown “ortstein” layer. Dune areas have been found where two or three distinct podsol layers are located several feet one above the other showing that in the distant past well stabilized dunes were covered over with new deposits of sand which in turn became stabilized before additional deposits of sand accumulated over them.