(*d.*) Sand-drifting.

By sand-drifting, as opposed to dune-wandering, I mean the blowing of a flat layer of sand along the ground-surface. It is sand-drifting which leads to dune-building, dune-wandering being a secondary phenomenon.

During gales extensive drifts take place, the sand coming from naked dunes, especially from hollows where the wind has full power (see Photo. No. 18). These drifts are particularly dreaded by owners of sand areas, since when merely an inch or two in thickness they quite destroy any grassy sward on which they fall. The drift also, when once it has commenced, continues to advance with even moderate winds, the distance reached being determined by the sand-supply. Contrary to the advance of a wandering dune, the sand drift is extremely rapid, acres at a time being covered with a layer of sand, thus killing all the grass during one heavy gale. Sand drifts, though the worst dreaded form of invasion, are of considerably less moment in the long run than dune-wandering, and can be much more easily stopped. It is the stopping of such which are nearly always shown as examples of how to control dunes in general—a quite misleading object-lesson.

(G.) LAND FORMS OF THE DUNE AREA.

(*a.*) Dunes.

(1.) *Dune Ridges.*

The foredune is a typical example of a dune ridge, and has already been described. Partly sheltered by the foredune are the interior dune ridges. These are most irregular in form, and much cut into and denuded by the wind. They are the *Kupsten* of the German writers, a word derived from the Lithuanian "kùpstas," meaning a small hill. These chains of hills resemble miniature mountain ranges with their prominent or rugged peaks, rounded tops, saddles, deep or shallow gullies, and at times quite precipitous faces. Frequently the parallel chains have lateral connections. Near the coast they are but semi-stable, the plant-covering usually only occupying half their surface, and in many places are so bare as to be a transition to the wandering dunes.

Fixed Ridges. (See Photo. No. 33.)

Ridges absolutely fixed by nature are to be found only at the inland termination of a dune area. They are generally much more rounded and offer less play for the wind than the ridges just described. Possibly in many instances they are of considerable age, dating back to a time when the land was lower, the sea coming further inland.

(2.) *Isolated Hills.*

Sandhills not forming chains may be either portions of such separated by wind-action, or they may have originated directly on a sand-plain, or elsewhere, after the primary hills were destroyed or had wandered on. Sand-binding plants are chiefly responsible for the origin of these secondary hills. Sometimes they are formed upon a decaying dune itself, which in this manner may be rejuvenated.

(3.) *Wandering Dunes.* (See Photo. No. 19.)

The wandering dunes are the greatest feature of the dune landscape, and the land-form to be most dreaded. It is they which in populous lands have devastated the adjacent country, burying villages, and even churches, as in Norfolk, Cornwall, Aberdeenshire, Gascony, and elsewhere.

Wandering dunes are broad, high masses of sand extending over many acres, so gently sloping on the windward side as to be apparently flat in places, where they are quite firm to the tread. On the leeward they are very abrupt, so much so, where absolutely sheltered from the wind, as to merit the title of "sand-fall," the extremely loose sand moving with the slightest touch, or, when wind moves the surface of the dune, forming long trickles which fall to and accumulate as talus on the ground. The quite smooth surface, destitute of all plant life, stretching for hundreds of yards, and more or less of a glistening whiteness, forms a striking spectacle. The surface is here and there traversed by wind-troughs, but over wide areas there may be a quite even surface, broken only by long lines of sand-ripples. At the angle formed by the ascending slope and descending sand-fall is often a sharp ridge, the result of the eddy (see Photo. No. 19). In other cases the angle may be rounded, a sign of contrary winds.

Wandering dunes have a twofold origin. On the primeval dune area they arose from the coalescence of a number of dune ridges (see Photo. No. 20). It can be seen that this is an easy matter; the unequal rate of advance of contiguous dune ridges will bring it about, for one thing, the lowest portions moving the fastest and leading to a crescent-like form, the horns advancing in the same direction as the wind. Then, too, winds from different directions causing irregularity of the direction of the movement play their part. A rapid undermining of plants on the windward side of a dune also (Photo. No. 21) causes an accumulation of loose sand, thus giving material for burial of plants and filling up of hollows. According to Jentzsch (15, p. 81), it takes 100 dune chains, each 6 m. high, to build a wandering dune 60 m. in height. With the general flattening and increase of sand surface there is less shelter than in the area of sand ridges and isolated dunes; the wind catches the surface fairly, increasing in intensity as it ascends, and the natural establishment of even sand-binding plants becomes impossible, while those present are rapidly exterminated. *It is therefore useless to attempt artificial planting on many wandering dunes without shelter of the proper kind.*

Between the true wandering dune and the dune complex are all kinds of transitions, many of the dunes of the latter, although quite small, being altogether unstable, and both wandering and drifting. A dry season, burning the vegetation, the presence of cattle—these, singly or combined,