

for long lines of seaweeds, which the wash of the waters carries up the beach and has to leave because the sands of the upper and drier part take most of the waters off by absorption. Here and just below are often found accumulations of magnetic iron sand and garnet sand, which the return-flow was not strong enough to carry back down the beach with the other lighter sands. (See page 170.) (2) The *beach-slope*, the outer surface of the beach-formation, the stratification being parallel to it. When sand-made, its surface is marked with faint channelings of rills from the return-flow, and more faintly with wave-like outlines of the upward wash. (3) The *under-water slope* — the continuation of the beach-slope downward beneath the water made by the undertow and perhaps coarser in material than the part above. It is the place for boring Mollusks, Sea-worms, and Crustaceans. Stones and coarse shells that may be dropped by the flinging breakers on the beach-slope are pretty sure to be carried back by the return-flow for another chance of transport, because the plane of rest is underneath them and not through their centers of gravity; and for the same reason the stones of experimenters on beach-action usually go the unexpected way — seaward.

The grinding carried on over the beach reduces the sand to finer sand, and especially the grains of feldspar and of all minerals softer than quartz. The undertow carries these seaward, where the current distributes them over the shallow bottom. In this way deposits of fine earth, clay, or mud are forming near those of coarse sand or gravel. Tidal flats of mud or sand in estuaries, when lying exposed above low water, are likely to receive ripple-marks, foot-prints of passing animals, raindrop prints, mud-cracks, and to secure, when the tide turns, their burial beneath other sands and thus their preservation. Under the tearing action of the heavier seas, the summit-ground may be put temporarily into the beach-slope, or large portions of a beach may be torn away and reconstructed; and, since the volume of the return-flow would be at the same time augmented, the beach may become temporarily steeper and coarser. Along most windy shores it requires only one of the extraordinary storms that come at long intervals to destroy much of the work of a century.

5. *Extension of beaches into points or spits, and barriers.* — A beach is, in the long run, essentially permanent in form and structure, unless a coast is undergoing change in level or in other respects. But in regions of frequent storms, the storm-made waves and currents give the sands a set or drift to leeward. When, in this way, the line of a beach reaches in its leeward extension a shallow bay, the drift of sands, still continuing, will build out a point where the current loses velocity against the stiller water of the bay; or, if the water is not too deep, it will extend a barrier of beach-sand across the bay, cutting off an inner shallow portion from the ocean, leaving only a single oblique entrance, which the tides had kept open. By such means the south side of Long Island, and a large part of the Atlantic coast south of New York, has been supplied with its beach-sand barriers, and also, inside of the barriers, with a long range of sounds.