

a river with the sea must of itself be a cause of the deposit of sediment. Moreover, in many cases the sea itself piles up great part of the sand and gravel of the bar. Heavy river-floods push the bar further to sea, or even temporarily destroy it; storms from the sea, on the other hand, drive it further up the stream.

Some of these facts in the economy of rivers have been well studied at the mouths of the Mississippi. At the southwest pass, the bar is equal in bulk to a solid mass one mile square and 490 feet thick, and advances at the rate of 338 feet each year. It is formed where the river water begins to ascend over the heavier salt water of the gulf, and consists mainly of the sediment that is pushed along the bed of the river. A singular feature of the Mississippi bars is the formation upon them of "mud lumps." These are masses of tough clay, varying in size from mere protuberances like tree-trunks, up to islands several acres in extent. They rise suddenly, and attain heights of from 3 to 10, sometimes even 18 feet above the sea-level. Salt springs emitting inflammable gas rise upon them. After the lapse of a considerable time, the springs cease to give off gas, and the lumps are worn away by the currents of the river and the gulf. The origin of these



Fig. 133.—Shingle and sand-spit (*e*) at the mouth of an estuary (*c*), entered by a river, and opening upon an exposed rocky coast-line (*B.*).

excrescences has been attributed to the generation of carburetted hydrogen by the decomposing vegetable matter in the sediment underlying the tenacious clay of the bars.¹⁷⁶

Conspicuous examples of the formation of detrital bars may occasionally be observed at the mouths of narrow estuaries, as at *e* in Fig. 133. A constant struggle takes place in such situations between the tidal currents and waves which tend to heap up the bar and block the entrance to the

¹⁷⁶ Humphreys and Abbot, "Report on Mississippi River," 1861, p. 452.