

3. An entrance so planned and such absence of obstruction in the channel that the tide level at the port is at least as high as that at the entrance.

The questions of the velocity of the ebb current and the period of time of the tidal flow are, within limits, local in character, the great aim being to secure by regulated control such conditions that the shipping normally frequenting the river shall be navigated without let or hindrance, predetermined depths of waterway being automatically maintained. Granted an adequate backwater and maximum depths once secured, the ideal of a channel self-maintained by the scour of the ebb is the goal to be attained.

Dredging is the usual mechanical expedient by which waterways are improved or created. The advent of the modern suction dredger has transformed problems which baffled engineering science even thirty years ago. These machines are now constructed capable of lifting 10,000 tons of sand from a depth of 70 feet below low-water line in fifty minutes. Estimates of cost of dredging operations depend so largely on local conditions that the figures often current are delusive. It must be borne in mind that hopper measurements of spoil average about twice that of the material *in situ*.

A typical instance of waterways across sandy flats is that of the Dee from Chester to the sea. The present route of the Dee is in great degree artificial. The natural channel of the river anciently hugged the Cheshire shore of the estuary, following a serpentine course and having a depth of 6 feet and upwards. In 1732 an Act was obtained ostensibly for the improvement of the river. Under the powers so conferred a straight canal was cut from Chester to Connah's Quay. At the same time extensive land reclamations on both sides of the stream were carried out. In all about 7000 acres were thus "inned". The result was the decline of the river as a trade route. With the object of increasing its depth a series of jetties were subsequently built, projecting at right angles from the Cheshire side, the Flintshire shore being mostly embanked. The effect of these jetties was to set up a swirling action at the extremity of each jetty or groyne. At such points deep pools were thus