

that the entrance is subject to continual change both in position and depth, the latter being, of course, greatest when the channel is near the west head, seeing that the outrun of the fresh which is found sufficient to force for itself a direct track through the spit also creates a channel of more than usual depth. 7 feet at low water having been found when the entrance has been in this direction.

The rise of ordinary spring tides is at least 6 feet: it has been known to reach 11 feet, the latter height, must, however be regarded as quite abnormal. The capacity of the tidal compartment with a 6-foot rise is 45,500,000 cubic feet, to which should be added, during a portion of the ebb, the fresh-water discharge, which amounts to 150,000 cubic feet per minute under ordinary conditions. The scour due to the passage through the entrance of this volume of tidal and fresh water, forms the natural and normal agency available for the maintenance of a deep-water approach to the Patea River. During floods and high tides the quantities named above would be greatly increased, consequently, in designing the works which I shall presently describe, precautions have been adopted to prevent the creation of a gorge on such occasions, or the formation of currents that would be prejudicial to navigation or to the works.

Prior to the commencement of the works, a considerable portion of the crest of the sandspit was less than 2 feet above low water of spring tides; it followed, therefore, that much of the tidal and fresh waters so essential for the preservation of a deep entrance escaped across the top of the spit, and were thus lost for scouring purposes at the bar, the embouchure of the river when the spit and boulder-bank are submerged forming a waterway of 1,500 feet in width. Again, during the period from half flood to half ebb, the water from the crest of the surf ran in over the spit and fell into the channel, one portion running downwards, the other upwards: the former creating a current directly opposed to the incoming flood, and to the track of any vessel entering the river, the latter serving to check the velocity of the outgoing current on the ebb. Moreover, as pointed out by Mr. Thomson, when the channel is near the boulder-bank, it is very difficult for sailing craft to enter the river, "because, although the prevailing wind is on the port beam coming over the bar, yet the instant they cross, they have to haul up, bringing the wind ahead, the loss of speed and the broadside sea rolling in over the spit tending to drive the vessel ashore." Mr. Wood, the Harbourmaster, called my particular attention to these facts, as illustrative of the difficulties with which vessels trading to Patea have to contend, and, consequently, of the need which exists for improving the entrance. Although the wind is generally fair for vessels going to sea, they are nevertheless subject, under the adverse influences described, to the risk of being driven by the swell on to the eastern shore or boulder-bank.

The result of all these impediments to free navigation is that but few vessels frequent the port, and those only of the smallest draft. It is no uncommon thing for vessels to be detained off the entrance from three to four weeks, and occasionally longer, unable to get into the river. It was stated that one which had come in just prior to my visit had been so detained outside for no less than five weeks. It is not therefore a matter of surprise that Wanganui is at present to a great extent the port for the Patea District, which apparently is one of great natural fertility. The development of the settlement is said to have been hindered by several causes, of which the want of a harbour is the chief.

Works in Progress.

At the time of my inspection no harbour works had been executed at the entrance, although a contract had been entered into by the Board for the construction of an arm upon and somewhat seaward of the boulder-bank, as shown by full green colour on Drawing No. 1. Under these circumstances, and as time was important, I recommended prior to leaving the colony that the position of the work then about to be commenced should be modified, by placing it on the line indicated by brown colour. According to the latest information which has reached me, this work had been carried forward to the extent of about two-thirds of its length (*i.e.*, two-thirds of the length coloured brown), the general result being that the entrance channel across the sand spit had been materially straightened, and the sand removed from the top of the spit to the extent of about 3 feet.

Recommendations.

The governing principles to be kept in view in designing an improved entrance for the Patea River are: First, to fix the position of the channel, so that the whole of the tidal and fresh waters may run continuously through a properly proportioned outfall; second, to carry the works well seaward, so as to remove the outfall as far as practicable from the disturbing action of the waves on the sand bottom, which action takes place to the fullest extent at the beach line, and diminishes as the depth of water increases; third, to modify the direction of the channel or sailing course, so that vessels entering would not be checked by a foul wind until well within the river, or driven to leeward by surf as formerly.

Works Recommended.

The works I have to recommend are shown by red colour on Drawing No. 1. They have been designed to meet the above conditions to the fullest practicable extent, having regard to cost. The modes of construction suggested for the more important portions are shown on Drawing No. 2, and will be found to contemplate the erection of structures as economical in character as it would be prudent to adopt, having regard to the trying conditions to which they will be subjected.

Extent of Works at the Entrance.

Upon referring to the drawing it will be seen that the works I have to recommend for the improvement of the entrance consist of an east and a west pier on the sea front, with a root and dépôt to each; also a guide pier, with an embankment at its rear so arranged as to form a wave basin, and two parallel rows of half-tide training sheeting extended along that portion of the river which is abreast of the sand-hills.

East and West Piers.

The east pier would commence at the seaward termination of the work in progress, and extend from thence in a S.S.W. direction for a length of 930 feet, terminating at the Point C. The root of the