

towards the end of 1877, when the water on the bar was again deepened by the exceptionally heavy flood which occurred on 4th and 5th November; the improved condition of the entrance holding good until the end of March, 1878. The fact of the maintenance of a depth averaging nearly 16 feet at high water of spring tides for so long a period as three and a half years—namely, from January, 1873, to July, 1876, as above stated—cannot, I think, be regarded as otherwise than most encouraging, seeing that it indicates a much greater approximation to a balance between the forces which tend to heap up the bar, and those which operate to keep it down, than will be found at any other river entrance on the west coast of the South Island. I attribute this favourable state of things mainly to the circumstance previously alluded to, that the direction or trend of the line of coast on which the Buller enters the sea is practically East and West, or, speaking generally, almost at right angles to the line of discharge of the other rivers adverted to. It should be noted that, whilst the embouchures of all the large West Coast rivers are for all practical purposes as much exposed to the southerly and south-westerly as to the northerly and north-westerly seas, the mouth of the Buller is quite sheltered from the southerly and south-westerly quarters of the compass. Such being the case, the power of the sea to cast up the sand, &c., in the form of a bar at the Buller mouth, is much less than at the other western rivers, whilst the fresh-water discharge is much greater.

I must not omit to remark that, whilst the conditions as regards the aspect of the entrance, and the volume of fresh water, are exceptionally favourable, the lengths of the sheltering and guiding breakwaters requisite to insure a permanently good depth will necessarily be great. Upon referring to Drawings 1 and 2 it will be seen that the mouth of the river is incumbered by shoals and banks, flanking the bar proper on either side, so that a depth of 12 feet at low water of spring tides is only reached at a distance of about 6,000 feet seaward of the high-water lines of those tides on the East side of the entrance. It follows, therefore, that works of unusual length will be necessary to form an entrance in a sufficient depth for the regular ingress and egress of such vessels as may be expected to visit the port.

Works recommended.

The works I have to recommend for execution with a view to improve the entrance to the Buller, and also for the rectification of the internal banks and line of channel at the seaward end of the river, are shown by red color on Drawings 1 and 2, detail cross-sections of the respective works illustrating the mode of construction to be adopted being given on Drawing No. 3.

The proposed works may be divided into two groups—viz: those for the improvement of the entrance, which are of primary importance, and those for the internal rectification of the channel, which latter may be undertaken after the outer works have advanced to a sufficient extent to concentrate and train the tidal and flood waters so as to scour and maintain a channel having a satisfactory navigable depth across the bar.

External Works.

These works consist of two training breakwaters or moles, one on each side of the entrance. The west breakwater would commence at the point *C* on Drawing No. 2, and run at the outset in a northerly direction, gradually curving therefrom so that the outer portion shall point N.N.W. until reaching the proposed termination marked *D*, the total length from high-water mark of ordinary spring tides to the end being 4,400 feet. The east breakwater would start from the point *A*, and extend therefrom in a north-westerly direction, curving thereafter towards the East, the outer portion being parallel to the western work, and terminating at the point *B*, the clear water-way or entrance between the breakwaters being 600 feet. Calculation here has shown that this width of 600 feet will be sufficient for the passing seawards of the flood waters without throttling. Should it, however, appear during the execution of the moles, that either a greater or less width of opening is desirable, the lines of the arms have been so laid down that their outer portions may either converge, or be placed further apart, as experience may determine, although it is not probable that any deviation from the width of 600 feet will be required.

A N.N.W. aspect for the entrance has been decided upon, after careful consideration, as being better suited than any other to the circumstances of the case. This direction has been found to afford a longer continuance of deep water on the bar under existing conditions, after the occurrence of freshets, than when the channel has pointed more to the East or to the West; and there are other reasons, associated with facility for entering and leaving the port, which indicate that the permanent entrance should bear N.N.W.

The principle upon which the two training moles or breakwaters have been designed corresponds with that upon which I framed the projected works at Greymouth. The object of the breakwaters is to concentrate the efflux and reflux currents, so that they shall be compelled to run over a definite and fixed track of proper proportions, instead of spreading, and consequently losing their scouring effect, on their arrival at the embouchure of the river as they do at present.

The west breakwater is shown to overlap that on the east side to the extent of 400 feet. This overlap is necessary in this case in order to provide for the normal travel of the beach in an easterly direction, although the transportation of material from this source at Westport will be small when compared with similar forces which are in operation at many of the New Zealand river entrances.