

02, 03, and 04 proceeding westward show that the material deposited between 1855 and 1882 had been removed, and that a considerable area of deep water which existed in 1855 on the outer end of these sections had shoaled up from 6 ft. to 8 ft.

We now give our attention to the sectional lines travelling eastwards from the centre-line. Taking first the section between the centre-line and line No. 1, we note that a portion of the material deposited between 1855 and 1882 had been removed, and also that a very large area of the 1855 bottom had been deepened by about 11 ft. This deepening gradually worked eastwards for a distance of 65 chains from the centre-line. The material which had been deposited in the period 1855-82 had been removed, but otherwise there is little difference between the contours of 1855, 1882, and 1927. The foregoing figures and deductions refer to the sea-bottom from high-water mark out to the 24 ft. contour. Further, we find that between the 24 ft. contour and 36 ft. contour there has been a general deepening since 1906 to an extent of from 3 in. to 18 in., the chief exception to this being an area of 35 chains in width immediately north of the spit and in direct line with the Inner Harbour entrance. It is important to note that in the first period, 1855 to 1882, the material piled up between the centre-line and cross-sectional line 04 was much more than could be supplied by the material cut away from the area covered by the cross-sectional lines to the east of the centre-line. The inference seems irresistible that the surplus material was supplied by the littoral drift round the Bluff. The absence of any such accretion or piling-up since 1882 points, in our opinion, with equal clearness to the fact that the breakwater has cut off this source of supply.

Giving attention to the sea-bottom at the breakwater, we find that siltation has taken place on the eastern or seaward side to a width of some 12 chains, and on the western or sheltered side to a width of about 20 chains; the depth of siltation varying from nothing on the western edge to 10 ft. close under the breakwater. The soundings taken in 1906 and 1927 shown on the map of comparative soundings prepared by Messrs. Holmes and Son—Commission's Exhibit No. 3, Plan J—indicate a general deepening between the western edge of the sea-bottom of the shoal just referred to upon the sheltered side of the breakwater and the entrance to the Inner Harbour. In our opinion this also is evidence that the volume of the littoral drift indicated by the accretion which took place between 1855 and 1882 (shown in the comparative contours we have been describing) does not now exist. It should be noted also that the comparative contours of 1855, 1882, and 1927 show a general erosion between the breakwater shoaling and the eastern side of the entrance to the inner channel. Taking into account all the foregoing facts, we are of opinion that the present shoaling of the 1855 deep areas to the west of the Inner Harbour entrance and the shoaling to the north of the sandspit are not due to the drift of shingle or sand travelling around the breakwater, but are due to the erosion of the sea-bottom which has been taking place since 1882 between the breakwater and the Inner Harbour entrance, and possibly, to some extent, by detritus from the flood-waters of the Tutaekuri River. We would, however, point out that at some time in the future the drift around the breakwater may increase in volume, and this is a possibility that should not be lost sight of. This possibility demands that reasonable precautions should be taken when carrying out any proposed harbour improvements to allow for and mitigate its detrimental effects as far as possible.

Mr. Furkert in his evidence testified to accretion taking place at the present time along the Petane beach, and the cross-sectional plans put in by him afford evidence of this accretion. This is somewhat difficult to account for unless it is presumed that the gravel which is held up on the eastern side of the breakwater has been forced to continue its northerly travel in deep water and finally arrives on the Petane beach after a somewhat devious course. Mr. Furkert points out that a similar phenomenon actually takes place in Wellington across the harbour-entrance, and it is also well established that gravel is known to travel in deep water in the English Channel.

There is, however, another explanation, which we consider is most probably the correct one. It requires us to note, firstly, that the foreshore immediately west of the Inner Harbour entrance and for a short distance to the north is protected by the breakwater and the sandspit from heavy south-east and easterly seas, which have not the opportunity of impinging on the beach with the same effect as north-easterly seas. We then note further that this same portion of the foreshore is fully exposed to these north-easterly seas, the result being that the gravel-bank which existed in 1883 on the west side of the harbour-entrance has been cut out and washed in a south and easterly direction until it has met the ebb tidal currents issuing from the Inner Harbour. The net result of these conflicting forces is that the gravel and sand have been finally carried in a north-westerly direction, until they have ultimately been thrown on to the Petane beach, where it is no longer protected by the breakwater and sandspit, and where it has a less favourable trend for north-easterly seas to act upon. To preserve spit, town, and the Inner Harbour entrance, steps should be taken to protect this foreshore where it is now being denuded.

The original formation of the sandspit of 1855-82 was no doubt due to the selective effect of the ebb tide on the drift of sand and gravel as it passed from east to west of the Inner Harbour entrance. These tidal waters as they maintain velocity would hold the lighter material in solution and transport it, gradually precipitating it as the water lost its velocity, and thus forming the sandspit. We have already described the travel of shingle and gravel over the thirty miles of beach from Kidnappers to Whakaari, and the gradual reduction of the shingle in size, as the result of attrition, so by the time Whakaari is reached the material consists almost entirely of gravel the size of peas. The grinding that the gravel is subjected to along the foreshore reduces a large quantity of it to fine mud, which the tidal action and littoral current transport seaward, the discoloured water due to this cause being quite apparent for at least one mile from the foreshore.

We find no evidence of the travel of this mud across the Inner Harbour entrance, and are therefore of opinion that there is no reason to fear siltation from this source in connection with the harbour-works. The grinding process under present conditions results, firstly, in a considerable reduction in the possible volume of gravel and sand to be dealt with; secondly, the sea disposal of the resultant mud.