

in the design, construction, or maintenance of harbour works. Mr. Holmes reply was that, as far as he was aware, Mr. George Nelson had no practical experience in harbour construction and maintenance. (See Notes of Evidence, page 266.) It will be noted that Mr. Nelson is quite wrong in his statement that the spit is composed of silt, and that the formation of the channel would present no difficulty whatever. (See evidence of T. W. Martin, dredge superintendent, page 359 *et seq.*)

Messrs. Cullen and Keele in their 1912 report (see Exhibit 14, page 3) comment upon the dredging through the sandspit, and contend that there is no evidence of sand-drift, and that the sand is coarser than that occurring off the breakwater and the beach south thereof, and that they find upon examining records of previous surveys that the present conditions of the bottom off the moles, as shown by contours of equal depth and soundings generally, are unchanged outside the 3-fathom (18 ft.) contour since the date of the first survey in 1855.

In regard to sand-drift, the evidence submitted to your Commission shows that the spit has altered its shape considerably, as shown by a comparison of the plans showing the contours of equal depths in 1855, 1882, 1895, 1906, and 1927. We submit that these alterations can only be due to sand-movement, and that the movement of this sand will continue and cause siltation in the channel, unless an Inner Harbour improvement scheme included the provision of moles designed to protect the sandspit from the effects of cross-currents of heavy seas or a heavy ocean swell. In regard to the sand the spit is formed of being coarse, this was not borne out by the sample of fine sand submitted for our inspection by Mr. J. D. Holmes as having been recently dredged from the spit by the grab dredge "J.D.O." This sample was also stated by Mr. T. W. Martin to be similar to that he had dredged up in 1911 with the ladder dredger "Whakarire." In this connection we use the words "movement of sand" as distinct from littoral sand-drift. In conclusion, Messrs. Cullen and Keele say, "We fully recognize the heavy breaking seas there would tend to fill in the cutting on the sides, and that some maintenance dredging may always be necessary; favourable factors are that the bottom consists of heavy and compact dark sand, and that big breaking seas are not of frequent occurrence"; and they continue that, in their opinion, it is feasible to dredge and maintain an entrance channel. Their estimated cost for dredging the channel to a depth of 35 ft. is £12,900, and that the annual maintenance would cost £7,276 (see Exhibit 14, page 6). In their 1925 report they give the estimated cost of dredging as £25,310, and the cost of maintenance dredging £13,500, less cost of maintenance to quays and cargo-sheds (say, £1,500), leaving cost of maintenance dredging £12,000 per year.

Mr. F. W. Furkert, M.Inst.C.E., Engineer-in-Chief of Public Works, in his report of 1924 deals with the question as follows: "It would be a comparatively easy task to dredge material such as exists along the line of this cut, but the amount to be removed would be very much greater than indicated simply by a consideration of the proposed length and cross-sections. Assuming the channel to have been dredged, its maintenance would involve considerable expense." (See Exhibit 19, page 6.)

Mr. R. W. Holmes, M.Inst.C.E., in his evidence on page 194, points out the difficulty in getting a full load with the use of a suction dredge, and estimates that it is necessary to dredge twice as much as the contents of the hopper before it becomes full. (This will necessarily increase the cost of dredging.) Mr. Holmes, however, recommends the use of a suction dredge fitted with a cutter in preference to a ladder bucket dredge, and concludes (page 195), "In view of the large scouring action which has of recent years taken place outside the Inner Harbour not only in the deep hole but also along towards the west shore, I have not the slightest hesitation in saying that once a channel is opened through the bar, that the scour from the Inner Harbour combined with the action of the propellers of vessels using that channel will keep it permanently open." On page 211, Mr. R. W. Holmes, states, "It is anticipated that the sides of the dredged channel will fritter down and some of the sea-bed will drift across." The removal of such material from the channel will come under two headings—one of purely maintenance and the other of construction—and he continued that the point at which he would consider construction dredging would cease would be the point where the mariners considered they had a sufficient width and depth of channel for navigation in ordinary weather. In regard to the width of channel required in ordinary weather, the evidence of the navigation experts is that they would require the full bottom width of 600 ft. Mr. Holmes's contention is that you could leave the sides on a steep side slope, allowing the sides to fritter away and lodge in the channel, reducing the original 600 ft. width. This accretion he would remove by dredging and charge to maintenance. Your Commissioners do not agree with this suggestion. On page 266, Notes of Evidence, Mr. Holmes states that a batter of 1 in 5 in the construction of the outer channel would be sufficient, and that the charge of doing same would be charged to capital, and further states that he would not expect any maintenance expenditure on 600 ft. channel in the first three years.

Mr. J. D. Holmes, M.Inst.C.E., Ass.M.I.Mech.E. (page 94), produced sample of material taken from the vicinity of the area dredged by the "Whakarire." On page 104 Mr. Holmes gives the quantity of material to be dredged from the outer channel to a depth of 34 ft. as 985,000 cubic yards at 1s. 3d.—£61,500. Page 301: Batter of slopes in channel taken as 1 in 3. Page 310: Mr. Holmes states that he thinks there is a general tendency for the whole sea-bottom to erode away in a westerly direction over the patch between the breakwater and the Inner Harbour channel.

Messrs. Holmes and Son consider that the "Kaione" suction dredger fitted with the cutter-head would be suitable for dredging through the sandspit, and would be able to work more continuously than a ladder bucket dredger such as the "Whakarire." They therefore have recommended the Harbour Board to purchase the "Kaione."

Mr. J. P. Maxwell, M.Inst.C.E., in giving evidence before your Commission (page 355) expresses the opinion that to dredge the proposed channel through the spit is a mistake, as he considers it will allow the seas to sweep in, and the shipping would not be able to use it under such conditions. He further states that he could not indicate the extent to which silting might occur, but undoubtedly the easterly drift would tend to shallow it to the same depth as surrounding area. On page 356 he states