

reported; whilst the red irregular line indicates the sea-bottom in 1927. All of these are taken on the line of the channel entrance, including the channel between the moles. A study of these lines and comparative sections will show how specious is the claim that Sir John Coode and Mr. Culcheth report in favour of a deep-sea Inner Harbour.

Messrs. Bell and Scott: These men reported in 1884 on Mr. John Goodall's harbour (breakwater) scheme, and, whilst they had some criticism of Mr. Goodall's scheme on details of construction, their report was, on the whole, favourable to the scheme. We have been carefully through this report of Bell and Scott in a search for anything that might substantiate Mr. Jull's claim that the writers had reported in favour of a deep-water Inner Harbour, and we can find nothing to justify the claim.

Messrs. Cullen and Keele: These Australian engineers visited Napier in 1912 and again in 1925. They reported after each visit. In 1912 they recommended the Inner Harbour as against the Breakwater Harbour, and in 1925, in answer to the Napier Harbour Board's specific request that they should advise the Board which of the two harbour schemes they recommended, they definitely recommended the Breakwater Harbour. That is their final recommendation, made after their second visit to Napier, after further study of local conditions and with a further thirteen years' experience of the use of the breakwater at their disposal. They accompany their recommendation with the explanation that their previous recommendation was made under a misconception, based on misinformation on a material point. We therefore include Messrs. Cullen and Keele among the experienced harbour engineers who have recommended the Breakwater Harbour; we submit that no other course is either fair to them or reasonable as an indication of their considered opinion.

We find it hard to take Mr. Jull's answer seriously.

We submit the following list of qualified engineers with harbour experience who have definitely reported in favour of the Breakwater Harbour, as against the Inner Harbour as a harbour for overseas vessels: Mr. John Goodall, M.Inst.C.E.; Mr. F. W. Marchant, M.Inst.C.E.; Messrs. J. P. Maxwell, M.Inst.C.E.; Cyrus J. Williams, M.Inst.C.E.; and J. Blair Mason, C.E.; Messrs E. A. Cullen, M.Inst.C.E., and T. W. Keele, M.Inst.C.E.; Mr. F. W. Furkert, A.M.I.M.E., M.Inst.C.E.

We now desire to set out a statement of the reasoning by which we have arrived at the foregoing answer to the question put to us.

INNER HARBOUR OR BREAKWATER HARBOUR FROM AN ENGINEERING POINT OF VIEW.

Broadly stated, our conclusion on the matter of the claims of the Inner Harbour is that the Inner Harbour scheme stands condemned because it is based, as to one of its essential parts, on a work that transgresses a fundamental principle of marine engineering. The work which we refer to as an essential part of the Inner Harbour scheme is the outer entrance channel, extending approximately one mile out to sea from the entrance moles. This channel, lying as it does in what is practically the open ocean, is, we are fully satisfied, contrary to marine-engineering principles and practice, and, as it supplies the means of entrance to and egress from the Inner Harbour, its defects and weaknesses become the deciding factor in the scheme as a whole.

We wish to make it clear at this point that we are now speaking of the outer channel as planned and designed by Messrs. Cullen and Keele, and (with modifications) adopted by the Board, and their consulting engineers, Messrs. Holmes and Son. This is an unprotected channel without any mole or moles. In our answer to the immediately preceding question set out in paragraph 12 hereof, we stated that it was *practicable* to construct a harbour suitable for the requirements of the district, and we had in view then a harbour approached by a channel protected by moles, making it an artificially enclosed channel. Our finding that a harbour so constructed was practicable is in accord with the finding of, for instance, Mr. F. W. Marchant, M.Inst.C.E., in his report of 1906, on page 2, where he says, "*Given sufficient money, there is no doubt that a useful harbour could have been made at the spit on the lines now proposed.*" His accompanying proposal included the formation of a breakwater or mole to protect the outer channel, on its eastern side. In principle, the unprotected channel proposed by Messrs. Cullen and Keele, and apparently adopted by Messrs. Holmes and Son, is adversely criticized by three such eminent Harbour engineers as J. P. Maxwell, Cyrus Williams, and J. Blair Mason in their report dated 1909. They say, "Even if it were practicable at a reasonable cost to cut an unprotected deep channel through this bar inwards, of which we have some doubt in the face of the fact that it is exposed to the heaviest seas, there is no doubt that in heavy weather it would be *liable to be obliterated*, wholly or in part, in which event the port would be closed until the channel reopened, which would be an intolerable inconvenience."

As to engineering practice, the knowledge of all expert witnesses before us and the records of harbour-construction throughout the world were searched for a parallel case, but no parallel case was forthcoming. Our attention was called to many channels cut through sand bars and banks, but in every case it was found that they were protected by the natural formation of the coast or by moles and breakwaters. Messrs. Holmes and Son, the Napier Harbour Board's consulting engineers, in their evidence referred to numerous harbours approached by channels. We pressed them for position, description, and details of one unprotected channel in any way comparable to that proposed at Napier, and consideration was eventually narrowed down to three which Mr. J. D. Holmes put forward—viz., Vizigapatam, in India; Brisbane, in Queensland; and Colon, at the entrance to the Panama Canal. At the close of Mr. Holmes's examination in chief, Vizigapatam seemed to be a parallel case. Under cross-examination, however, it was ascertained that the harbour is not yet constructed, and the records produced showed that after various reports had been obtained, some (the majority) recommending an outer breakwater harbour, and others an inner harbour, the last one on record was an inner-harbour project, the inner basin to be approached by a channel cut through a sand-bar. This is as far as the information goes, and therefore it affords no lesson or guidance for Napier. As to Brisbane, we suggest that a glance at a large-scale map of the coast of Queensland is sufficient to dissipate the suggestion