

shingle being heaped up in the corner of the bay where the boat service now stands. I do not think the fear of this happening should induce the authorities in charge of the harbour to undertake the construction of the north pier at once, as the shingle may not heap up to an injurious extent inside the harbour; and, in any case, the evil will increase gradually, so that time will be given to build the north pier after it is found necessary to do so. The north pier would, however, much improve the harbour by giving shelter from northerly seas, to which the harbour will be otherwise quite open. I may mention that I reported on this harbour to the Hon. the Minister for Public Works on the 30th October, 1871, and again on the 14th July, 1874. I append copies of my reports.

*5th Question.*—Have not these works been somewhat prematurely undertaken, and will not the effect of what has been done prevent this harbour being so useful as would otherwise have been the case?

*Answer.*—I have no doubt it would have been better had the Oamaru Harbour been so designed as to have included water of sufficient depth for the largest class of ships. This was out of the question, on the score of cost, at the time the works were begun. If a beginning were now to be made, I have little doubt the works would be designed on a larger scale, and would be more serviceable to the Town of Oamaru. The work already done would be of very little use if the scale of the harbour were now increased. My reply to both sections of the question under reply is therefore in the affirmative.

*6th Question.*—Do you believe that any harbour could be successfully constructed between the Waitaki and Lake Ellesmere?

*Answer.*—I do not think so. The large Canterbury rivers bring down so much shingle that any harbour works would be rendered useless by it.

*7th Question.*—What is the effect of moving shingle on permanent harbour works?

*Answer.*—The shingle heaps up on the windward side of the harbour, until the corner between the pier and the beach is filled up, when the shingle begins to travel across the harbour mouth. If there is not sufficient tidal scour in and out of the harbour to keep open a channel, a shingle beach would be formed completely across it, and a detached beach would form to leeward. If there were sufficient scour to keep open the channel, a bar only would be formed across the harbour mouth, the depth of water on which would depend on the quantity of shingle travelling, the amount of scour, and the direction and force of the waves.

*8th Question.*—Are there any harbour works, within your knowledge or experience, the conditions of which are at all analogous to those of Timaru?

*Answer.*—There are many harbours which have been successfully built where a small travel of shingle takes place, but I know of no beach where a tithe of the quantity of shingle travels that does on the beach between the Waitaki and Lake Ellesmere; and I know of no harbour works having been undertaken under conditions so likely to lead to failure as occur there.

*9th Question.*—As regards the cost, are you of opinion that the figures of Sir J. Coode's estimate can be relied upon?

*Answer.*—The plans are not made in so detailed a manner that an estimate could be formed from them by any one but the designer, or at least without further information being furnished by him. From a very rough calculation I have made, I am afraid the actual cost would be found to exceed the estimate.

*10th Question.*—Are you of opinion that, if the proposed works are constructed, there is any likelihood of any injury to the harbour as it now is?

*Answer.*—No, I do not think so. In the event of a complete failure, the only effect would be that the shingle beach would be widened seaward until it embraced the harbour works.

*11th Question.*—Has the plan proposed by Sir J. Coode been carried out elsewhere on a scale sufficient to test its efficiency for large harbour works, such as proposed at Timaru?

*Answer.*—I have no knowledge of any large harbour at all similar in design to that proposed for Timaru.

*12th Question.*—Have you any objection to the proposed plan? If so, upon what do you base your objection.

*Answer.*—I am of opinion that the proposed plan is the only one on which there would be the least chance of success. I am, however, also of opinion that it would not be successful. I should have more hesitation in differing from the opinion of so eminent an engineer as Sir John Coode if he had any personal knowledge of the locality, and knew from his own observation how large a mass of shingle is brought down from the mountains by the Waitaki, Waihao, Otaio, and Pareora Rivers, all of which are to the south of Timaru.

From the Waitaki to Timaru the coast-line bears somewhat west of north, while the average direction of the seas beating on the beach is from the south-east. The beach is thus not at right angles to the direction of the seas, and the obliquity causes the shingle to be carried northward. To the north of Timaru the beach tends to the north-eastward, thus being nearly at right angles to the average seas, and the shingle there travels less rapidly than it does between the Waitaki and Timaru, but the quantity is much greater, as several very large shingle-bearing rivers there fall into the sea.

The quantity of shingle brought down by a river like the Waitaki is enormous. I know of no other country in which the geological and topographical features so favour the formation of shingle. The mountains in which the Waitaki and other Canterbury rivers have their sources are formed of clay-slates, so fissured that they may be said to consist of ready-made shingle: indeed, Dr. Hector named them provisionally, before their geological value was known, the "shingle-forming rocks." It is by no means uncommon to see in these ranges long slopes from 500 to 1,000 feet high, as regular as the slopes of a railway embankment, and formed entirely of clay-slates, broken up to about the size of road metal; the stone lies at an exact angle of repose, and if a shovelful were taken from the foot the movement would extend to the top of the slope. It may readily be conceived that a mountain torrent rushing past the foot of such a slope would carry immense quantities of shingle into the main stream. Even where the rocks are not actually broken up, they are so easily disintegrated that every small