Physical Features.

The general conditions to which special regard must be had in dealing with the question of harbour improvement works at Hokitika are well described in the notes published by the Harbour Board in April, 1877, wherein they state that the river, having its source in the snowy mountains to the southward, is subject to floods both from the melting of the snow and from the heavy rainfall of the district, and that it is continually changing its channel through the shingle-bed, and encroaching upon one or other of its banks according to circumstances. They also call attention to the fact that the position of the river entrance is subject to great fluctuations, the changes being dependent upon the varying conditions of flood-waters from the back country, and the direction and force of the seas along this particular part of the coast.

Briefly stated, the conditions within the tidal compartment of the Hokitika River are as follow: The range of a spring tide at the entrance, under normal conditions, is about 9 feet, gradually diminishing until tidal action altogether disappears at a point about $1\frac{1}{4}$ miles below Kanieri Ferry. In the Mahinapua River the tidal influence ceases at a distance of about $3\frac{1}{2}$ miles from its junction with the Hokitika, just within the outfall, at the point marked × in red on Drawing No. 1.

The total volume of tidal water flowing in and out through the entrance during ordinary springs is about 58,000,000 cubic feet, and the maximum discharge at half-ebb is at the rate of 240,000 cubic feet per minute.

During extreme floods, the level of the water in the Hokitika River just within the entrance has been raised as much as 3 feet 6 inches above ordinary spring-tide high water, whilst at the head of the tidal compartment the level at the same time was 10 feet 10 inches above the ordinary water-line; and at Kanieri the highest recorded flood was 15 feet 4 inches above the normal level. It will thus be seen that during great freshes the water surface assumes abnormal inclinations, resulting in the generation of rapid, indeed I may say violent, currents.

The area of watershed draining through the entrance at Hokitika is, according to Dr. Hector, 382 square miles, and the rainfall over that area 120 inches per annum. It is no very uncommon occurrence to find a rainfall of from 2 to 4 inches at Hokitika in a single day.

It necessarily follows that the river is not infrequently in a state of intense flood, the hydraulic gradient being on some occasions as much as 11 feet per mile opposite Gibson's Quay. It is difficult to compute with precision the discharge of the Hokitika River in freshes; but taking the data of inclination of river surface and sectional areas furnished by the observations made for me in the colony, I have arrived at the conclusion that the discharge of the Hokitika in extreme floods is about 9,500,000 cubic feet per minute, whilst in ordinary floods it is about 5,000,000 cubic feet per minute. The normal fresh-water discharge of the river is 360,000 cubic feet per minute, which is one-twenty-sixth of the quantity in extreme floods, or one-fourteenth of the ordinary flood discharge. I further find that the fresh water passing out through the entrance in times of ordinary floods is rather more than twenty times as great as the maximum discharge of tidal water during springs.

I have dwelt thus at length on the subject of the relative volumes of fresh and tidal waters, as they prove conclusively that the conditions in the Hokitika River are of an exceptional character. In most cases the tidal water constitutes the chief agency in the maintenance of an entrance channel; but, from the facts just stated, it is evident that in this instance the enormous and frequently-recurring floods will exercise by far the greatest influence in keeping open a navigable approach from the sea. Nevertheless, the great fluctuations in the volume of fresh water to which I have alluded form an important element to be kept in view in devising entrance works, for, notwithstanding the discharge during ordinary floods is 5,000,000 cubic feet per minute, the aggregate delivery of tidal and fresh waters combined is, under normal conditions, not more than 600,000 cubic feet per minute. Any entrance must, therefore, of necessity be subject to frequently-recurring fluctuations, sometimes in the ratio of 8 to 1, and on exceptional occasions to a much greater extent.

Having described the agency by means of which a navigable connection between the sea and the river must be maintained, I may remark that the counteracting influence, tending to block or obstruct the entrance, is the mass of shingle passing along the coast, the travel or drift of which is, in this case, from south to north. The accumulation of shingle in the opening and on the bar can only be kept down by fixing the entrance and concentrating the whole of the available forces, by passing the currents through a definite and duly-proportioned waterway.

Under the conditions which have existed up to the present time, the position of and depth of water in the entrance have both been subject to great changes, varying with the strength of the land-floods on the one hand, and the sea-disturbance on the other. Hence it is that the river outfall has varied from a line bearing west (by compass) from the flagstaff at the signal-station to a point about three-fourths of a mile to the southward thereof. When the entrance was at the most northerly point it was never good for any length of time; moreover, much inconvenience was then felt from the swell, which ran up the channel in front of the town. When at its most southerly point the entrance channel was also unsatisfactory: clearly the best position is midway between the two extremes just described.

It will be evident, from what I have stated, that the depths in the entrance have been subject to great variations; but no exact records of these seem to have been kept. The low-water depths in the channel in front of the town are shown on Drawing No. 1. The abnormal scour of 29 feet at the end of the lower wing-dam is due to the interference of that work with the true run of the currents. Upon the completion of the permanent training works, hereinafter described, this obstruction should be removed. Fortunately the water-frontage of the town takes the form of a concave curve, having a radius of about 60 chains. This will insure the continuance of the deepest water along and immediately in front of the wharves and quays at Hokitika.

Proposed Works.

It appears that designs for harbour works at Hokitika were invited in the early part of the year 1877, and, upon the recommendation of Mr. Blackett, C.E., the Government Marine Engineer, the