

and the dynamometer observations were carried out under the direction of Major E. T. P. Shewen, who was for a number of years District Engineer for the Department of Public Works.

Through the opening of about 1,500 feet between the end of the breakwater and Partridge Island heavy southerly waves break and expend, following the ragged face inside the shore, and continue to roll towards the harbor, causing such extensive erosion of the coast line that protective measures had to be taken in building a revetment wall along the foot of Fort Dufferin.

The principal development in the harbor to date has been on the west side, on which there are at present ten berths, with 32 foot draft, and room for fifteen additional berths as soon as Negro Point Breakwater is extended to Partridge Island and railway facilities rearranged. On account of the limited frontage and the railway terminal situation, however, the harbor is being developed from both sides.

Annual Dredging

The entrance channel is 12,000 feet in length and 600 feet in width, and 32 feet clear depth at low water is maintained by annual dredging—the annual siltation varies, but generally amounts to about two feet.

When the Negro Point Breakwater is extended to Partridge Island (about 1,500 feet) the littoral drift from the south-west will be arrested and the flow more concentrated in the channel will increase the scour and assist in maintaining the channel depth.

The materials dredged in the harbor are principally clay, sand, gravel and silt. There is considerable quantity of submarine rock to be removed in order to straighten the channel, but on account of the extreme cost of same this work is being delayed.

During the year there are generally only two to eight tides below zero, forty 0.5 tides and sixty tides 1.5 feet above zero; the remainder of the tides range from 2.3 to 6.7 feet above zero. Boats generally prefer to berth at slack water. It is, therefore, evident that the channel is navigable for the largest steamers.

The wharves are built to provide 32 feet at low water. The harbor, fortunately, is free from the teredo, limnora and other sea worms. The type of construction up to the present has been timber cribwork and concrete, with cribwork substructure. On account of the scarcity and high cost of timber and the necessary extreme height of the wharves (about 65 feet), other types of structure are being investigated.

Extreme Tide and Consequent Currents

The outstanding features in St. John harbor are the extreme range of tide and the consequent currents.

The inward mean tidal flow is about 20,000 c.f.s. and the outward is about 40,000 c.f.s. (The maximum surface current velocity at the minimum section in the harbor is about four miles per hour.)

Unfortunately, no systematic meterings have to date been made of the river, and, consequently, the river flow is only an estimate. A series of float observations have been taken at various stages of the tide and at various depths below surface. These show very erratic current conditions. The fresh water from the river flows out, while underneath the tide rises and falls regularly.

The principal wharves are of cribwork with concrete superstructure, the cribs being placed on a prepared dredged bed, covered to an average depth of five feet with broken rock. Behind the cribs, selected dredged material is filled in, on which the necessary railway sid-

ings and sheds are built. The sheds are one story, of timber construction. At a number of the wharves grain conveyers are built from which boats can be loaded with grain at any stage of the tide. In addition to vertical fenders of 12 x 12 inches hard pine, floating fenders, about 36 inches diameter and 33 feet long, are placed about 80 foot centres. It may be noted that in berths 15 and 16, which are more exposed to wave action, the life of these floating fenders does not exceed two years.

Courtenay Bay Development

The Courtenay Bay development, on the east side of the harbor, comprises the building of a dry dock, 1,150 feet in length, 125 feet wide, with 40 feet of water on sill at high water, ordinary spring tides, and elevation of sill 14 feet below low water, spring tides; the building of a breakwater, 7,070 feet long, of which 4,570 feet have been completed; the dredging of a basin 32 feet below zero, and channel 22 feet below zero (zero being extreme mean low water). The details and layout of the wharves have not yet been decided. The breakwater is of the rubble mound type, top width 20 feet, seaward slope varying from two to one to three to one, according to location.

The breakwater does not have the exposure of Negro Point Breakwater, and it is, therefore, not expected that the slopes will suffer the raking down experienced at the latter place. The stones at the outer end, weighing upwards of ten tons, were lifted from their beds and moved about fifty feet during a storm in October last. The rock from the breakwater is obtained from the dry dock site, loaded by steam shovels and hauled by locomotive on standard track on trestle and dumped in the work. At the outer end of the breakwater, where the embankment is wide on account of the slopes and depth, two trestles will be used to ensure the larger stones being placed outside.

St. John, on account of geographic situation and consequent long railway haul, to date is principally a winter port. The traffic in 1895 amounted to three and a third million dollars imports, and three million dollars exports, whereas during the year 1917, the traffic amounted to sixteen and three-quarter millions imports, and two hundred million dollars exports.

BENEFITS OF THE PANAMA CANAL

THE United States government this fall will move far western wheat by way of the Pacific and the Panama Canal instead of across the continent by rail.

The plan is prophetic. While the Atlantic and the gulf feel the changes occasioned by the Panama Canal, it is the Pacific ports that actually realize the transformation. There is not a value upon the Pacific Slope that has not been enhanced by the canal, as there is not a cost of western products in New York that has not been favorably affected. And this influence is extending back from the Pacific into Montana, Idaho and the Rocky Mountain region generally.

British Columbia and Alaska also feel the benefit. The shipyards of the Pacific are quite as good for the purposes of this war as those of the Delaware. But for the canal the launchings at San Francisco, in the Columbia and Puget Sound would not have been, and Schwab would not have rejoiced Independence Day in the feats of ship construction on "the coast." Germany diligently prepared for war for a generation, but the United States forestalled her by a construction that will do much to thwart the Kaiser's plans immediately, and to prevent German aggrandizement hereafter. The canal as an engineering feat took the popular imagination for a day. Now it is accepted as an ordinary fact, like the Great Lakes. But the canal operates every day and more and more. It is a tremendous factor in the life of all the globe.—From *The Monetary Times*, Toronto.