

level of this datum the whole question of the depth of water on shoals and bars and the grounding of vessels, must necessarily depend. If this datum has been recorded by a bench mark, at the time the survey for the chart was made, or if it can be correctly determined, the height of the tide can be measured upward from it. The height of the tide at low water or at high water, as given in the tide tables, will then show what increase of depth is available for a vessel in addition to the depth shown on the chart. In the same way, the depth of water on the sill of a dry dock can also be found from the height of the tide, when once the level of the sill with reference to the datum has been determined by means of levels taken for the purpose.

The height of the tide may thus be of quite as much importance to shipping, as the time of high and low water itself. It is also of much consequence in our sea ports to have a reliable datum plane for the construction of harbour improvements; and also for city works; because the discharge of sewers for example, may be affected by the tide. In some cases also, the extent of the fore-shore and the position of low-water mark is important, as it may define the boundary of marine properties. In most of our cities, the question of a good datum plane for reference is in a very unsatisfactory position. Careful attention has therefore been given to this matter in connection with the tidal observations taken by this survey. For this purpose it is necessary to have accurate levels at the tide stations, and to reduce the tidal observations themselves to one uniform plane of reference. The direct measurement of water level during the rise and fall of the tide is obtained from the sight gauge, which is actuated by a float in the same way as the recording instrument itself. The actual level which this shows, has to be determined ultimately from a bench mark in the vicinity of the tide gauge. By referring the tide levels to this bench mark, the low water datum, mean sea level, etc., become definitely fixed. In this way also it even becomes possible to determine after a term of years, whether or not the coast itself is changing its elevation with reference to the mean level of the sea.

The results of the determinations of level and datum planes as obtained from the tidal observations themselves, and special instrumental levels taken for the purpose, will now be given.

St. John, N.B.—Owing to the great fire of 1877 the bench marks and other points of reference were destroyed; and when the tidal observations were begun in 1893, there was no means of ascertaining the datum plane used in the original Admiralty survey of the harbour, or in the later survey of the entrance to the harbour, made in 1887 by the Public Works Department; nor had any permanent marks been established to show the levels of high and low water at spring tides, as determined at the time that the Government wharf and the breakwater at Negro Point were constructed. There was also no City datum in use; as the steep slope of the streets was taken advantage of, to lay out city works by difference of level without reference to any one datum plane.

In these circumstances it was necessary to re-determine the low water datum; and its level was not easy to arrive at, where the tide has so great a range, the extreme range being nearly twenty-nine feet, and the level of low water at spring tides varying so much in consequence. This determination has now been made with great care; by means of the tidal observations themselves; and also from the level of the breakwater at Negro Point.

The levels which will be given, are all referred to a new bench mark which was cut on the granite foundation of the custom house. The lower part of the tide gauge consists of a timber column, fifty-six feet in height, heavily ballasted at its lower end so as to rest firmly on the bottom, and to be unaffected by any movement in the timber wharf against which it stands. The level of the gnomon or zero point of the sight gauge was determined with reference to the bench mark; and the level checked from time to time, to detect and allow for any settlement which might occur. The level of the tide at any moment is then observed by means of a steel tape attached to the tide float of the sight gauge; and from it a constant level is also derived which furnishes a reference plane for the continuous tidal record of the

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