

DEPARTMENT OF COMMERCE

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U. S. COAST AND GEODETIC SURVEY

R. S. PATTON, Director

TIDAL BENCH MARKS

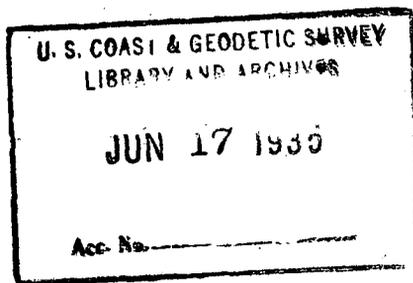
STATE OF
MASSACHUSETTS

By

L. A. COLE

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TIDAL BENCH MARKS, STATE OF MASSACHUSETTS

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INTRODUCTION

In connection with its hydrographic operations the United States Coast and Geodetic Survey has established from time to time many tidal bench marks along our coasts. Numerous requests from engineers and others for descriptions and elevations of these bench marks have led the bureau to begin publishing the data which are in manuscript form in the files, in order to be able to furnish the information more promptly and economically. In addition to the bench marks established by this survey, there are included also the bench marks of other organizations, such as municipal, State, and Federal engineers, which have been used by this bureau in the execution of the hydrographic work along the coast.

This information is being made available by sections of the coasts. The present volume is the seventh of the series. The six volumes which have previously been issued are listed on page 38 of this publication. It is the intent to issue similar volumes from time to time until all sections of the coasts have been covered.

STANDARD BENCH MARK

Various kinds of bench marks have been used to indicate the point of which the elevation was determined. Among these are nails in piles or other structures; small crosses and squares cut in curbstones and doorsteps; bolts in ledges, bowlders, and the foundations of buildings; and sometimes just a well-defined point on a fixed object

has been used. Since such marks may lack permanence and are often hard to identify, this bureau has adopted a standard brass disk identification mark. The standard brass disk is $3\frac{5}{8}$ inches in diameter and has a shank or stem on the back 3 inches long for insertion in a building or other substantial support.

At present there are two types of standard disk bench marks, as shown in Figures 1 and 2. The type shown in Figure 1 was formerly used in all leveling work of the bureau but is now used chiefly by hydrographic parties running short lines of levels, while the type (4) shown in Figure 2, which provides a place for inserting the elevation above mean sea level, is used for lines of the first-order level net of the United States. The other forms of the standard brass disk shown in Figure 2, though not intended primarily for bench marks, may be used as such when their elevations have been determined.

DATUM PLANES

In all engineering work where it is necessary to determine differences in elevation by spirit levels, and especially where it is desired to coordinate the work of various surveys, it is in the interest of efficiency and economy that a uniform datum be used. It has frequently happened that the various engineers operating in the same locality have used different arbitrary datums, which has led to much confusion. This condition can be obviated by the adoption of a single, reliable datum. Datums based on tidal definition are the best for both practical and scientific work, since they may be recovered even though all bench-mark connections be destroyed.

Of all the tidal datums, mean sea level is the most nearly fixed and, in general, the most satisfactory for land elevations. By a network of first-order levels it has been carried to many parts of the interior of the country, and new level lines are being added to this level net each year.

Mean sea level on the open coast may be considered for all practical engineering and surveying purposes to be in the same equipotential surface and may be defined as the level about which the tide oscillates. As determined by this bureau, it is derived from the hourly heights of the tide observed at the primary tide stations as referred to the zero of a fixed tide staff which has been connected with a primary bench mark by spirit levels. Because of the disturbing influences of wind and weather, an accurate determination of mean sea level must be based on observations extending over a considerable period of time. In general, a series of tidal observations three years in length will, when corrected by comparison with the results from a suitably located primary station, determine mean sea level within 0.02 foot; observations covering a period of a year will determine it to 0.05 foot, and a month of observations may be considered to determine it within 0.10 foot.

On inside bodies of water draining large areas which are subject to a considerable fresh-water run-off mean sea level is somewhat higher than on the open coast. In tidal rivers where the seasonal variations in run-off cause relatively large fluctuations in level it is sometimes preferable to speak of mean river level rather than mean sea level, though mean river level is determined by averaging the

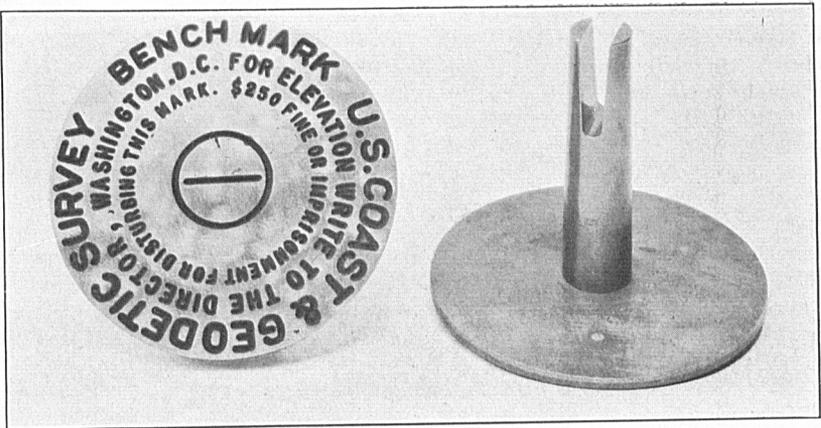


FIGURE 1.—STANDARD BENCH MARK

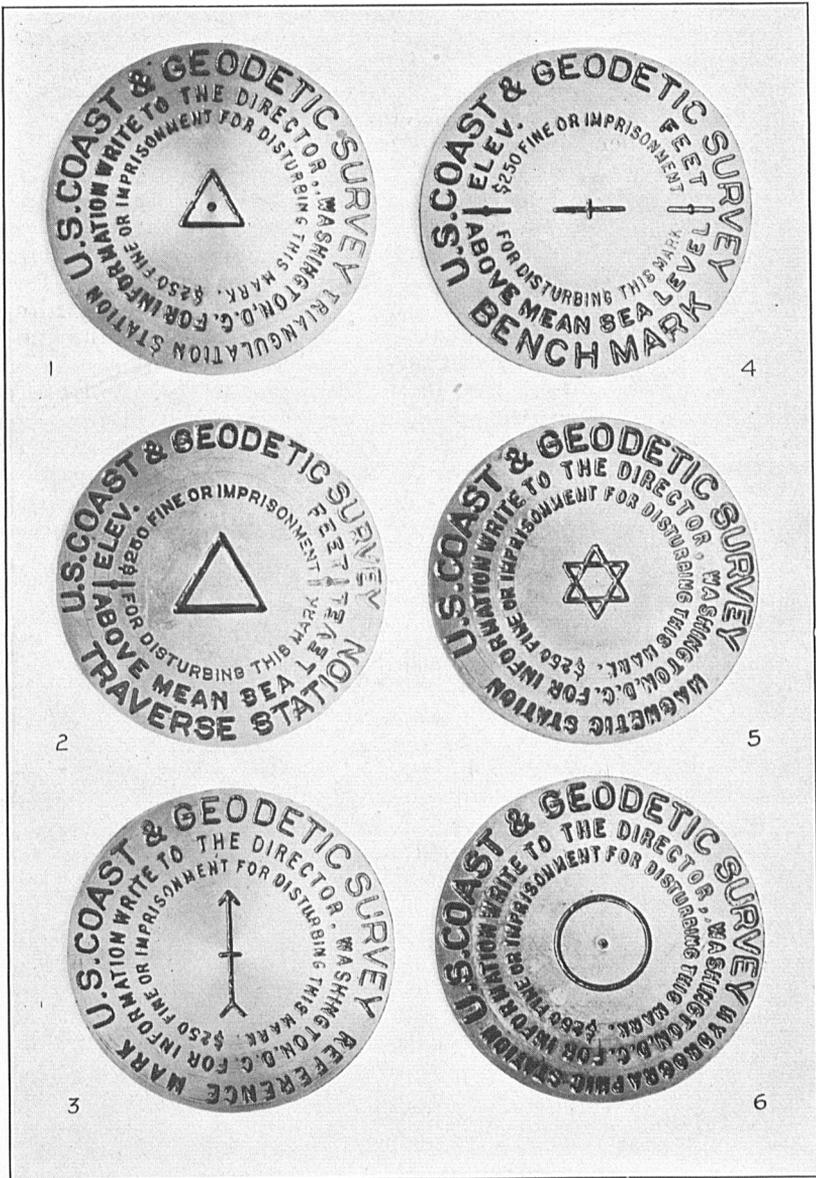


FIGURE 2.—STANDARD MARKS OF THE U. S. COAST AND GEODETIC SURVEY

1. Triangulation station mark
2. Traverse station mark
3. Reference mark

4. Bench mark
5. Magnetic station mark
6. Hydrographic station mark

hourly heights of the tide in precisely the same manner as mean sea level is determined.

While mean sea level is the most nearly uniform, or fixed, datum over a wide area and is the primary datum through which different surveys may be coordinated, other datums are also useful for hydrographic work and harbor engineering. Therefore, the elevations of the bench marks in this publication are referred to mean low water as well as to either mean sea level or half tide level, as the case may be. Those bench marks which have been connected with the first-order level net and are near a primary tide station are referred to mean sea level; all other bench marks are referred to half tide level. The relations of other tide planes to mean low water are given in the table following the descriptions and elevations of the bench marks for each station.

Half tide level is determined from the high and low water readings and lies midway between the planes of mean high water and mean low water. It should be carefully distinguished from mean sea level, which is determined from the hourly heights of the tide. For most places on the open coast half tide level does not differ much from mean sea level, and for practical purposes the two planes may be used as if identical. On inside waters, especially on the upper reaches of tidal rivers, there may be a considerable difference in the elevations of the two planes. The relation between these two planes at any place is fairly constant, and for places where the relation has been accurately determined from a year or more of observations the one may readily be derived from the other. At Boston, from more than seven years' observations at Commonwealth Pier No. 5, mean sea level averages 0.12 foot above mean tide level.

Mean high water is the mean height of all high waters and mean low water the mean height of all low waters for the period of the observations. The difference in height between mean high water and mean low water corresponds to the mean range of tide. The relation of mean high water and mean low water to half tide level at any point is equal to one-half the mean range of tide above and below that datum. The mean range of tide varies considerably from place to place, depending in a large measure on the location, depth of water, and configuration of the coast line. Therefore, mean high water and mean low water are not uniform datums over a large area, like mean sea level and half tide level, but vary in proportion to the difference in the mean range of tide over that area. Mean low water on the Atlantic coast of the United States is of importance as the hydrographic datum to which all soundings on charts and the predicted heights in tide tables are referred.

The highest and lowest tides represent the probable extreme heights for each locality and, in places where long series of observations are not available, have been estimated to the nearest half foot, based on the highest and lowest values observed in that region.

BASES OF ELEVATIONS

The elevations of the bench marks at the various tide stations are in most cases based on local tidal observations which have been reduced to mean values by comparison with simultaneous observations at other stations where longer series of tides have been ob-

served. As explained on page 2, regarding the determination of mean sea level, the accuracy of the elevations of the bench marks at the different tide stations will, in general, vary in accordance with the lengths of the tidal series upon which they depend. Those bench marks in the vicinity of Boston which have been connected with the first-order level net are referred to the standard datum of mean sea level. A well-determined plane of reference is thus afforded for all such bench marks. At stations where shorter series of tides have been observed the bench marks are referred to half tide level. A statement in regard to the lengths of the tidal series at each station precedes the descriptions of the bench marks at that station.

The elevations of the planes of mean high water and mean low water given in the tables following the descriptions of bench marks at each station were obtained from mean sea level or half tide level through the local mean range of tide, while the elevations of the planes of highest and lowest tides are based on the highest and lowest tides observed in that region, especially at the nearest primary tide station, where long series of tides have been observed. At Boston the dates and heights of the actual highest and lowest tides observed during the period of the observations are given, but for the other stations the heights have been estimated to the nearest half foot above and below the plane of mean low water. The purpose of furnishing these highest and lowest elevations is to give the engineer an approximation of the extreme stages of the water that may occur in the different localities.

CHANGES IN ELEVATION

Although a bench mark may appear to be quite permanent in character and correspond with its description, the elevation may have changed materially since its determination because of settling of the immediate locality from construction work or from other causes. Engineers are therefore cautioned to make use of at least two bench marks where possible. They will confer a favor on the profession and on this bureau by reporting to the Director, United States Coast and Geodetic Survey, Washington, D. C., or to the inspector, United States Coast and Geodetic Survey, Room 21, 92 State Street, Boston, Mass., any changes in elevation or destruction of bench marks noted, in order that information in regard to these marks may be kept up to date and this publication revised when necessary.

DESCRIPTIONS AND ELEVATIONS OF TIDAL BENCH MARKS

[The year of establishment is given in parentheses following the number of the bench mark]

SALISBURY BEACH, MERRIMACK RIVER ENTRANCE

The elevations of the following bench marks are based on 56 high waters and 56 low waters observed during the period December 1 to 29, 1912, reduced to mean values by comparison with simultaneous observations at Portland, Me., and on 32 high waters and 33 low waters observed during the period August 15 to 31, 1928, reduced to mean values by comparison with simultaneous observations at Boston, Mass., and Portsmouth, N. H.

Bench mark 1 (1878), *Salisbury Beach*, is the center of a cross cut in a lead plug in a drill hole in the southern face of the third granite rock from the bottom and on the southwest corner of Black Rock Spindle, also known as "The Butlers Toothpick." Elevation: 9.04 feet above mean low water; 5.04 feet above half tide level.

Bench mark 2 (1912), *Salisbury Beach*. is a Coast and Geodetic Survey standard disk set in the highest point of a group of black rocks covered at high water, a short distance along the shore east of the wharf. Elevation: 5.97 feet above mean low water; 1.97 feet above half tide level.

Bench mark 3 (1912), *Salisbury Beach*. is a Coast and Geodetic Survey standard disk cemented into the rock near the highest point of the more easterly of two groups of black rocks close in to the shore line from the "Toothpick." The rocks show distinctly at about half tide. Elevation: 10.83 feet above mean low water; 6.33 feet above half tide level.

Bench mark 4 (1912), *Salisbury Beach*, is a hole drilled in the highest point of the outer of three groups of black rocks just inshore from the "Toothpick." Elevation: 10.76 feet above mean low water; 6.76 feet above half tide level.

Bench mark 5 (1928), *Salisbury Beach*, is a Coast and Geodetic Survey standard disk, stamped "N5/1928," cemented in a drill hole in the solid cement foundation of a garage. The mark is on the vertical face of the foundation and is located on the south side near the southwest corner of the garage. The garage is built of hollow concrete blocks, and the present owner is Mr. Carr. It is on the west side of the present road leading to the beach. The distance from the high-water line to the bench mark is 525 feet. Elevation: 13.50 feet above mean low water; 9.50 feet above half tide level.

Bench mark 6 (1928), *Salisbury Beach*, is a Coast and Geodetic Survey standard disk, stamped "N6/1928," cemented in a drill hole on the top of a cement cylinder. The cylinder is one of the four cement foundations which hold the back range for entering the harbor. These foundations are made up of tile pipe, about 2 inches in diameter, filled with concrete. The mark is set in the southeast foundation. The ranges for entering the harbor have been moved several times on account of the shifting of the channel. The bench mark is 739 feet from the present high-water line. Elevation: 15.23 feet above mean low water; 11.23 feet above half tide level.

Bench mark 7 (1928), *Salisbury Beach*, is a Coast and Geodetic Survey standard disk, stamped "N7/1928," cemented in the vertical southeast face of the rock foundation of "Butler's Toothpick." The stone foundation of the "Toothpick" is square and extends about 11 feet above high water. The upper part of the beacon is built of clapboarding, pyramidal in shape and painted red. The bench mark is on the southeast face and about 2 feet above the high-water line. Elevation: 10.91 feet above mean low water; 6.91 feet above half tide level.

The elevations of tide planes at Salisbury Beach referred to mean low water are as follows:

	Feet
Highest tide.....	11.50
Mean high water.....	8.00
Half tide level.....	4.00
Mean low water.....	0.00
Lowest tide.....	-3.50

PLUM ISLAND (BLUFF WHARF), PLUM ISLAND SOUND

The elevations of the following bench marks are based on 15 high waters and 12 low waters observed during the period September 11 to October 12, 1911, reduced to mean values by comparison with simultaneous observations at Little Neck, Ipswich River, where the datum was derived from 57 consecutive low waters observed at Dodge's Wharf about 3 miles up the river and referred to Little Neck by comparison of simultaneous observations consisting of 4 high and 4 low waters. The plane of reference thus derived for Plum Island is also supported by a comparison of simultaneous observations at Fort Hamilton, N. Y., where the datum is based on 30 years' observations.

Bench mark 1 (1911), *Plum Island*, is a Coast and Geodetic Survey standard reference mark cemented in a drill hole in a rock which is either a large covered boulder or an outcropping ledge. The arrow on the disk points to the tide staff at Bluff Wharf. The mark is 42.8 feet northeast of a flagpole at the inshore end of the wharf and 44.7 feet from the northwest corner of a house. Elevation: 21.74 feet above mean low water; 17.39 feet above half tide level.

Bench mark 2 (1911), *Plum Island*, is a Coast and Geodetic Survey standard reference mark located 189 feet east southeast from bench mark 1. Elevation: 21.56 feet above mean low water; 17.21 feet above half tide level.

Bench mark 3 (1911), *Plum Island*, is a $\frac{7}{8}$ -inch hole drilled about $\frac{1}{2}$ inch deep in a boulder which is located 150 feet southwest from bench mark 2. Elevation: 22.30 feet above mean low water; 17.95 feet above half tide level.

The elevations of tide planes at Plum Island referred to mean low water are as follows:

	Feet
Highest tide.....	12.00
Mean high water.....	8.70
Half tide level.....	4.35
Mean low water.....	0.00
Lowest tide.....	-3.50

LITTLE NECK, IPSWICH RIVER ENTRANCE

Tides were observed in this locality by the Coast and Geodetic Survey from September 28 to November 30, 1852, and from October 3 to October 6, 1911. The plane of mean low water, however, was determined by the United States Army Engineers and is the average of 57 consecutive low waters from June 16 to July 15, 1875, observed at Dodge's Wharf, Ipswich, and referred to bench mark No. 1 at Little Neck by comparison of four consecutive high and low waters observed simultaneously at each place. (See Report of the Chief of Engineers for 1876, p. 200.)

Bench mark 1 (U. S. Army Engineers, 1875), Little Neck, is the top of a brass bolt set in a large boulder near the northeast corner of Little Neck Wharf. It is at the upper one of the two wharves which were at Little Neck in 1911. The boulder is 16 feet from the line of the north edge of wharf. The brass bolt has a cross on it. There are also three iron bolts on the same boulder. Elevation: 9.71 feet above mean low water; 5.36 feet above half tide level.

The elevations of tide planes at Little Neck referred to mean low water are as follows:

	Feet
Highest tide.....	12.00
Mean high water.....	8.70
Half tide level.....	4.35
Mean low water.....	0.00
Lowest tide.....	-3.50

ANNISQUAM, ANNISQUAM RIVER

The elevations of the following bench marks are based on 13 high waters and 14 low waters observed during the period September 28 to October 5, 1928, reduced to mean values by comparison with simultaneous observations at Ten Pound Island, Gloucester Harbor.

Bench mark 1 (1928), Annisquam, is a Coast and Geodetic Survey standard disk set in cement in a drill hole in a reddish rock ledge about 82 feet north-northwest of the stone beacon on which the tide gage was established; this ledge is characteristic, as it is the only one of this color in the immediate vicinity; this ledge and a series of large rocks bare at low water out to the beacon and lie about 164 feet to the southeast of the Annisquam Yacht Club. At high water the top of the ledge is just about awash. The stone beacon is off the southern tip of peninsula on which the town of Annisquam is located. The beacon is built up crib fashion of large granite posts, the interior being filled with large irregular blocks of rock. Elevation: 9.07 feet above mean low water; 4.82 feet above half tide level.

Bench mark 2 (1928), Annisquam, is a Coast and Geodetic Survey standard disk set in cement in a drill hole in a large gray rock ledge immediately inshore from the yacht club house. It is about 16 feet to the southeastward of the walk leading to the clubhouse and about 230 feet north by east of the stone beacon; a point on the walk immediately abreast of the disk is about 62 feet in from the center of Riverside Drive. Elevation: 21.03 feet above mean low water; 16.78 feet above half tide level.

Bench mark 3 (1928), Annisquam, is a Coast and Geodetic Survey standard disk set in cement in a drill hole in a rock ledge near the northwest corner of the sea wall of the yacht club tennis courts; it is about 131 feet to the northward of the walk leading to the clubhouse and about 328 feet north by west of the stone beacon. Elevation: 11.82 feet above mean low water; 7.57 feet above half tide level.

The elevations of tide planes at Annisquam referred to mean low water are as follows:

	Feet
Highest tide.....	12.00
Mean high water.....	8.50
Half tide level.....	4.25
Mean low water.....	0.00
Lowest tide.....	-3.50

WOLF HILL, ANNISQUAM RIVER

The elevations of the following bench marks are based on six high waters and six low waters observed during the period September 28 to October 29, 1928, reduced to mean values by comparison with simultaneous observations at Ten Pound Island, Gloucester Harbor.

Bench mark 1 (1928), *Wolf Hill*, is a Coast and Geodetic Survey standard disk cemented in a drill hole on a rather prominent rocky ledge at the base of Wolf Hill. The ledge at this point is of light-gray granite, which rises in an almost straight wall from the river and flattens out in a horizontal shelf about 7.0 feet above high water. The bench mark is set in this horizontal shelf and is surrounded at a distance of about 3 feet by four iron rods set in drill holes in the ledge. Elevation: 16.11 feet above mean low water; 11.66 feet above half tide level.

Bench mark 2 (1928), *Wolf Hill*, is a Coast and Geodetic Survey standard disk cemented in a drill hole in the same granite ledge as bench mark 1. It is set horizontally near the southernmost outcropping of the ledge. To the southward of this point the beach consists of large detached boulders. Elevation: 12.63 feet above mean low water; 8.18 feet above half tide level.

Bench mark 3 (1928), *Wolf Hill*, is a Coast and Geodetic Survey standard disk cemented in a drill hole in the top of the largest boulder on the river side of the point at the southern tip of Wolf Hill. This boulder is about 6 feet in diameter. Elevation: 17.36 feet above mean low water; 12.91 feet above half tide level.

The elevations of tide planes at Wolf Hill referred to mean low water are as follows:

	Feet
Highest tide.....	12.50
Mean high water.....	8.90
Half tide level.....	4.45
Mean low water.....	0.00
Lowest tide.....	-3.50

ROCKPORT HARBOR

The elevations of the following bench marks are based on six high waters and five low waters observed September 21, 22, 23, and October 1 and 2, 1928, reduced to mean values by comparison with simultaneous observations at Ten Pound Island, Gloucester Harbor.

Bench mark 9 (1928), *Rockport Harbor*, is a Coast and Geodetic Survey standard disk set in the street curbing on the southeasterly corner of Mount Pleasant Avenue and the alleyway or street leading down to the Tee Wharf. Elevation: 17.86 feet above mean low water; 13.56 feet above half tide level.

Bench mark 10 (1928), *Rockport Harbor*, is a Coast and Geodetic Survey standard disk set in the inner sidewalk curbing at the intersection of the sidewalk on the southerly side of Broadway and a walk leading off into the small park at the corner of Broadway and Mount Pleasant Avenue; it is 43 paces from bench mark 9 and 15 paces from the street beacon located at the intersection of the above streets. Elevation: 18.24 feet above mean low water; 13.94 feet above half tide level.

Bench mark 11 (1928), *Rockport Harbor*, is a Coast and Geodetic Survey standard disk set in the inner or sidewalk curbing on the northerly side of Broadway at the junction of the southerly side of the sidewalk leading from the main entrance to the school building. It is about on line with bench marks 9 and 10 and distant 61 paces from bench mark 10. It is 71 paces from a fire plug located at the westerly corner of the intersection of Broadway and Mount Pleasant Avenue. Elevation: 21.60 feet above mean low water; 17.30 feet above half tide level.

Bench mark 12 (1928), *Rockport Harbor*, is a large drill hole in the top of a ledge at about the extension of the curb line on the northerly side of Atlantic Avenue toward the headlands and about 25 feet beyond the last house on the northwest side of Atlantic Avenue. Elevation: 36.96 feet above mean low water; 32.66 feet above half tide level.

Bench mark 13 (1928), *Rockport Harbor*, is a drill hole in the granite outcrop at the top of the hill just to the northeast of the intersection of Atlantic and Highland Avenues; the drill hole is almost at the highest point of rock and is 20 paces to the north of Highland Avenue. Elevation: 59.53 feet above mean low water; 55.23 feet above half tide level.

The elevations of tide planes at Rockport Harbor referred to mean low water are as follows:

	Feet
Highest tide-----	12.50
Mean high water-----	8.60
Half tide level-----	4.50
Mean low water-----	0.00
Lowest tide-----	-3.50

TEN POUND ISLAND, GLOUCESTER HARBOR

The elevations of the following bench marks are based on 190 high waters and 189 low waters observed during the period July 20 to October 26, 1928, reduced to mean values by comparison with simultaneous observations at Boston, Mass., and Portsmouth, N. H.

Bench mark 1 (1894), *Ten Pound Island*, is the top of the horizontal brick shaft at the base of the lighthouse. It was recovered in 1928, but no very definite point could be taken, as the brickwork at the base of the lighthouse is somewhat uneven. This brick shelf is about one brick wide and about 1 foot from the ground and entirely surrounds the lighthouse. An unmarked point was taken on the northern side of the shelf facing the city hall. Elevation: 27.35 feet above mean low water; 22.97 feet above half tide level.

Bench mark 2 (1894), *Ten Pound Island*, is the base of a triangle cut on the face of a rock about 36 feet easterly from the northeast corner of the light keeper's house. It was recovered in 1928 on side face of boulder away from the light keeper's house and facing the city hall. It is about 1½ feet to the eastward of a large triangular rift in the side of the rock and is so near the ground that it may be hidden by grass. Elevation: 27.65 feet above mean low water; 23.30 feet above half tide level.

Bench mark 3 (1894), *Ten Pound Island*, is a horizontal line within a circle cut on face of rock about 105 feet northeasterly from northeast corner of light keeper's house and about 70 feet from bench mark 2. It is on a large ledge on the northerly side of the island near the top of hill. The mark faces toward the lighthouse and is about 78 feet north by east of bench mark 8. Elevation: 27.58 feet above mean low water; 23.23 feet above half tide level.

Bench mark 4a (1928), *Ten Pound Island*, is a small cross cut into the top of the largest and highest boulder in the eastern half of the island. This boulder is about 4 feet, roughly cubical, and lies about 65 feet to the southeastward of the path leading to the lighthouse. It is about 96 feet east-southeast of bench mark 8. Elevation: 31.56 feet above mean low water; 27.21 feet above half tide level.

Bench mark 5 (1916), *Ten Pound Island*, is a brass plug set vertically in ledge with cement and projects about ¾ inch. It is 71 feet west (true) of western corner of fish hatchery building (laboratory) and near the path running to the light keeper's house. It was recovered in 1928 and found to be about 6.5 feet northward of path leading from the fisheries to the lighthouse. It is 70 feet northeast of bench mark 10 and 21 meters (measured along the slope of ground) south-southwest of stack of fisheries heating plant. Elevation: 29.21 feet above mean low water; 24.86 feet above half tide level.

Bench mark 6 (1916), *Ten Pound Island*, is a Coast and Geodetic Survey standard disk set obliquely into the slanting face of ledge on the north-northeast side of the island and facing directly toward Gloucester City Hall. The bench mark is about 7 feet horizontally from high-water line and 11 feet above it. It is 65 feet southwest from stack of heating plant and 95 feet from west corner of laboratory. It was recovered in 1928 and found to be 29 feet north-northwest of bench mark 5. Elevation: 24.90 feet above mean low water; 20.55 feet above half tide level.

Bench mark 7 (1916), *Ten Pound Island*, is a brass plug set vertically in ledge in cement in yellowish-brown granite ledge near the retaining walls to the northwest of the heating plant of the fish laboratory. It is 39 feet to northwest of stack. It was recovered in 1928 and was found to be 24 feet north of the westerly corner of coal shed to heating plant. Elevation: 15.40 feet above mean low water; 11.05 feet above half tide level.

Bench mark 8 (1928), Ten Pound Island, is a Coast and Geodetic Survey standard disk set in cement in a drill hole in the surface of a large rock ledge but little higher than the surrounding surface. It is 54 feet east of the north-east corner of the light keeper's house and 59 feet east-northeast of the south-east corner of house. Elevation: 29.77 feet above mean low water; 25.42 feet above half tide level.

Bench mark 9 (1928), Ten Pound Island, is a Coast and Geodetic Survey standard disk cemented in a drill hole in the highest part of rock ledge on the southeastern side of the island in a general east-southeast direction from the lighthouse. It is 173 feet south-southwest from the fisheries flagstaff and 59 feet southeast of bench mark 4a. Bench mark 11 is also on the same rock ledge. Elevation: 33.48 feet above mean low water; 29.13 feet above half tide level.

Bench mark 10 (1928), Ten Pound Island, is a drill hole surrounded by a triangle cut into the surface of the rock ledge that lies in the path to the light. It is about 120 feet northeasterly from the light keeper's house and 61 feet northeast of bench mark 8. Elevation: 29.35 feet above mean low water; 25.00 feet above half tide level.

Bench mark 11 (1928), Ten Pound Island, is a small arrow with a drill hole at the center and the letter "S" at one end cut into the surface of the ledge. It is 182 feet south-southwest of the fisheries flagstaff and 8.2 feet westerly of bench mark 9 on the same rock ledge. Elevation: 34.02 feet above mean low water; 29.67 feet above half tide level.

Bench mark 12 (1928), Ten Pound Island, consists of three small drill holes roughly triangular in outline in the surface of a small patch of outcropping ledge at the surface of the ground in the light keeper's yard. From this point the light is just on line with the back corner of the light keeper's house. The bench mark is 36.7 feet from the most easterly corner and 24.1 feet from the southeast corner of the house and 62 feet southwest of bench mark 8. Elevation: 25.40 feet above mean low water; 21.05 feet above half tide level.

The elevations of tide planes at Ten Pound Island referred to mean low water are as follows:

	Feet
Highest tide.....	12.50
Mean high water.....	8.70
Half tide level.....	4.35
Mean low water.....	0.00
Lowest tide.....	-3.50

BEVERLY

The elevations of the following bench marks are based on seven high waters and four low waters observed during the period from June 10 to July 18, 1916, reduced to mean values by comparison with simultaneous observations at Portland, Me., where the datum was based on four years of observations.

Bench mark 1 (1916), Beverly, is a Coast and Geodetic Survey standard disk set in the top of a granite block forming the upper surface of the retaining wall between the Sprague, Breed & Brown Dock and Foster Wharf. Elevation: 14.71 feet above mean low water; 10.21 feet above half tide level.

Bench mark 2 (1916), Beverly, is a ½-inch brass bolt set horizontally into the granite corner stone at the southwest corner of the building on the east side of Foster Wharf. Elevation: 14.96 feet above mean low water; 10.46 feet above half tide level.

Bench mark 3 (1916), Beverly, is a ½-inch brass bolt set vertically in the concrete pier at the northeast corner of the Sprague, Breed & Brown Dock. The pier supports a pillar of the coal company elevated track. Elevation: 17.81 feet above mean low water; 13.31 feet above half tide level.

The elevations of tide planes at Beverly referred to mean low water are as follows:

	Feet
Highest tide.....	13.00
Mean high water.....	9.00
Half tide level.....	4.50
Mean low water.....	0.00
Lowest tide.....	-4.00

SALEM

The elevations of the following bench marks are based on 107 high waters and 109 low waters observed during the periods September 4 to December 7, 1894, and August 13 to 28, 1895.

Bench mark 1 (1894), Salem, is the upper surface of cement foundation of Fort Pickering Lighthouse, near entrance to bridge. Elevation: 15.32 feet above mean low water; 10.82 feet above half tide level.

Bench mark 3 (1894), Salem, is the top of the 10th course of bricks of Derby Wharf Lighthouse, close to the right-hand side of the door as one enters the tower. Elevation: 12.77 feet above mean low water; 8.27 feet above half tide level.

Bench mark 19 (1916), Salem, is a Coast and Geodetic Survey standard disk set in the southwest corner of custom house on Derby Street near Derby Wharf. Elevation: 18.08 feet above mean low water; 13.58 feet above half tide level.

Bench mark 20 (1916), Salem, is a brass plug set horizontally in granite corner stone of Polish drug store about 2 feet from the pavement. The drug store is on the south side of Derby Street just east of Derby Wharf. Elevation: 16.26 feet above mean low water; 11.76 feet above half tide level.

Bench mark 21 (1916), Salem, is a brass rod set vertically in top of granite rock near the light keeper's house for Fort Pickering Light on Winter Island. Elevation: 19.00 feet above mean low water; 14.50 feet above half tide level.

The elevations of tide planes at Salem referred to mean low water are as follows:

Highest tide.....	13.00
Mean high water.....	9.00
Half tide level.....	4.50
Mean low water.....	0.00
Lowest tide.....	-4.00

MARBLEHEAD

The elevations of the following bench marks are based on three high waters and four low waters observed at Gilbert's Wharf during the period August 20 to 29, 1895.

Bench mark 2 (1909), Marblehead, is a cross cut in the concrete on top of the wall at the southeast corner of Tucker's Wharf, outside the iron rail. Elevation: 13.90 feet above mean low water; 9.36 feet above half tide level.

Bench mark 3 (1909), Marblehead, is the center of a cross cut in the east wall of the New Fountain Inn near the southeast corner. It is in the second course of masonry about 1½ feet above the surface of the ground. Elevation: 21.20 feet above mean low water; 16.66 feet above half tide level.

Bench mark 4 (1909), Marblehead, is a horizontal line cut in the face of ledge that juts out from south foundation wall of the New Fountain Inn. The letters "B. M." are cut into the rock above the line. The mark is 20 paces down from the southeast corner of the hotel and is about 4.2 feet above the surface of the ground. Elevation: 20.98 feet above mean low water; 16.44 feet above half tide level.

Bench mark 5 (1916), Marblehead, is a Coast and Geodetic Survey standard disk set horizontally in the granite block at the northeast corner of the New Fountain Inn. Elevation: 21.21 feet above mean low water; 16.67 feet above half tide level.

The elevations of tide planes at Marblehead referred to mean low water are as follows:

Highest tide.....	13.00
Mean high water.....	9.08
Half tide level.....	4.54
Mean low water.....	0.00
Lowest tide.....	-4.00

BOSTON HARBOR

The bench marks in Boston Harbor and vicinity are listed by groups according to the localities in which they are found. The elevations of these bench marks are referred to the principal tidal datums for Boston Harbor as described below. Many of them have been connected directly by first-order levels with the basic bench marks used in defining the datums, and others have been

connected with the datums through simultaneous water levels. The method used in referring the bench marks to the datums is indicated at the beginning of each group of marks.

Sea-level datum.—The sea-level datum adopted for Boston in connection with first-order leveling in 1923 was derived from the hourly heights of the tide at Commonwealth Pier No. 5, covering a period of two years beginning August 1, 1921, the results being corrected by comparison with those obtained from simultaneous observations at Portland, Me., the corresponding datum at the latter place being based upon 11 years of observations. This sea-level datum is defined as being 13.304 feet below bench mark 7 located in the vicinity of the tide station at Commonwealth Pier No. 5. Through the first-order leveling of 1923 this datum was referred to many other bench marks in Boston and vicinity.

Boston low-water datum.—This datum was established by the Coast Survey many years ago from observations at the Boston Navy Yard, and has since been used by the United States Army Engineers and others. It is 0.04 foot above the present best-determined mean low water at the navy yard and 0.03 foot below the best-determined mean low water at Commonwealth Pier No. 5 from all observations available at the close of the year 1926. This datum is defined as being 14.69 feet below bench mark 1 on the old dry dock at the navy yard in Charlestown.

Boston city base.—Although not used in this publication for a reference plane, the Boston city base is a datum which has been used by the city of Boston for many years. According to the report of the city engineer of Boston for the year 1904, it is 15.11 feet below the "new" bench mark on the coping of the old dry dock, which is bench mark 2 of the Coast and Geodetic Survey at Charlestown. The elevation relative to bench mark 1 on the coping at the entrance to the dry dock is also given in the same report, but bench mark 2 is the basic bench mark for the Boston city levels.

Navy-yard datum.—This datum used by the Navy Department for work in the vicinity of the navy yard at Charlestown has been defined as a plane 114.54 feet below "Navy Yard Bench Mark 1," which is bench mark 2 of the Coast and Geodetic Survey.

Summary of datums.—The relations of these datums to the sea-level datum as determined by the leveling of 1923 are as follows:

	Feet
Sea-level datum (13.304 feet below B. M. 7)-----	0.00
Boston low-water datum (14.69 feet below B. M. 1)-----	-4.87
Boston city base (15.11 feet below B. M. 2)-----	-5.65
Navy-yard datum (114.54 feet below B. M. 2)-----	-105.08

BOSTON LIGHT, LITTLE BREWSTER ISLAND

The following bench marks are referred to the Boston standard datums, through the primary tide station at Commonwealth Pier No. 5, by simultaneous water levels covering the period June 9 to July 21, 1926; the references to mean low water of the United States Army Engineers are based on the datum adopted by the United States Army Engineers for work among the islands in this vicinity.

Bench mark 1 (1860), Boston Light, is the center of a circle cut on top of a ledge of stone and marked thus: "C ⊙ S." It is about 340 feet westerly from the lighthouse and 15 feet southeast of the southeast corner of the boathouse (new in 1899). Elevation: 25.64 feet above Boston low-water datum; 20.77 feet above sea-level datum; 25.77 feet above mean low water of the United States Army Engineers.

Bench mark 4 (1899), Boston Light, is the top of an eyebolt, without a ring, which is set in the rock 15 feet north of the northeast corner of the boathouse. Elevation: 20.09 feet above Boston low-water datum; 15.22 feet above sea-level datum; 20.22 feet above mean low water of the United States Army Engineers.

Bench mark 5 (1899), Boston Light, is the top of an eyebolt, containing a large ring, which is set in a rock near and northerly from bench mark 4. Elevation: 18.53 feet above Boston low-water datum; 13.69 feet above sea-level datum; 18.69 feet above mean low water of the United States Army Engineers.

Bench mark 8 (1916), Boston Light, is a Coast and Geodetic Survey standard disk set vertically in the ledge in front of and near the light keeper's house. Elevation: 25.98 feet above Boston low-water datum; 21.05 feet above sea-level datum; 26.05 feet above mean low water of the United States Army Engineers.

Bench mark 9 (1926), Boston Light, is a Coast and Geodetic Survey standard disk, stamped "9/1926," cemented into the rock 20 feet from the light keeper's house toward the lighthouse. Elevation: 23.51 feet above Boston low-water datum; 18.64 feet above sea-level datum; 23.64 feet above mean low water of the United States Army Engineers.

Bench mark 10 (1926), Boston Light, is a Coast and Geodetic Survey standard disk, stamped "10/1926," cemented into the rock on the point making out north-west from the light keeper's house. Elevation: 16.31 feet above Boston low-water datum; 11.44 feet above sea-level datum; 16.44 feet above mean low water of the United States Army Engineers.

The elevations of tide planes at Boston Light referred to Boston low-water datum are as follows:

	Feet
Highest tide.....	13.00
Mean high water.....	9.34
Sea-level datum.....	4.87
Half tide level.....	4.84
Mean low water (U. S. Army Engineers).....	-0.13
Boston low-water datum.....	0.00
Lowest tide.....	-3.09

GEORGES ISLAND

The following bench marks are referred to the mean low water adopted by the United States Army Engineers for work among the islands in this vicinity.

Bench mark 3 (U. S. Army Engineers), Georges Island, consists of a lead plug in a large stone on the south side of the sea wall, 36.7 feet from the angle in the wall and 1.25 feet from the outer face of the same. Elevation: 13.80 feet above mean low water of the United States Army Engineers.

Bench mark 5a (1916), Georges Island, is the top of an iron bolt 66.9 feet north from the southwest corner of the sea wall and 4.15 feet from the face of same. Elevation: 13.24 feet above mean low water of the United States Army Engineers.

Bench mark 6 (1906), Georges Island, is the top of a large flat stone alongside an iron bolt on west sea wall. It is 33.1 feet north from southwest corner of the wall and 1 foot from the face of same. Elevation: 13.15 feet above mean low water of the United States Army Engineers.

Bench mark 6a (1916), Georges Island, is the top of bolt described under bench mark 6. Elevation: 13.21 feet above mean low water of the United States Army Engineers.

Bench mark 7 (1916), Georges Island, is a Coast and Geodetic Survey standard disk set horizontally in the southeast corner of the red brick building at inner end of wharf at Fort Warren. Elevation: 15.56 feet above mean low water of the United States Army Engineers.

CHELSEA CREEK ENTRANCE

The following bench marks are referred to the Boston standard datums through the primary tide station at Commonwealth Pier No. 5, by a comparison of simultaneous tides consisting of 13 high waters and 14 low waters observed during the period July 24 to July 31, 1926.

Bench mark 1 (1926), Chelsea Creek, is a Coast and Geodetic Survey standard disk, stamped "1/1926," set on top of the west abutment of highway bridge, 2 feet south of south edge of bridge. Elevation: 17.63 feet above Boston low-water datum; 12.76 feet above sea-level datum.

Bench mark 2 (1926), Chelsea Creek, is a Coast and Geodetic Survey standard disk, stamped "2/1926," set on top of the west abutment of highway bridge, 2 feet north of north edge of bridge. Elevation: 17.76 feet above Boston low-water datum; 12.89 feet above sea-level datum.

Bench mark 3 (1926), Chelsea Creek, is a Coast and Geodetic Survey standard disk, stamped "3/1926," set on top of east abutment of highway bridge, 18 inches south of south edge of bridge. Elevation: 17.71 feet above Boston low-water datum; 12.84 feet above sea-level datum.

The elevations of tide planes at Chelsea Creek Entrance referred to Boston low-water datum are as follows:

	Feet
High st tide.....	15.00
Mean high water.....	9.49
Sea-level datum.....	4.87
Boston low-water datum.....	0.00
Lowest tide.....	-3.50

BOSTON NAVY YARD, CHARLESTOWN

The following bench marks are referred directly to the Boston standard datums by spirit-leveling connections:

Bench mark 1 (1847), *Boston Navy Yard*, is the top of the granite wall at the entrance to the United States Navy Dry Dock No. 1 at Charlestown. The point taken is directly over the inlaid bronze scale at the southerly corner and outside the floating gate of the dock. Originally there was apparently no special identification mark, but in 1916 a reference was made to a rectangle cut in the stone. Elevation: 14.69 feet above Boston low-water datum; 9.82 feet above sea-level datum.

Bench mark 2 (1867), *Boston Navy Yard*, often called the "new bench mark," is the top of the facing of the United States Navy Dry Dock No. 1 at Charlestown, on the west side near the head directly over the foot of the long steps. The place is indicated by an arrow cut in the side of the stone. This bench mark has also been designated as "Navy Yard Bench Mark 1," but it should be distinguished from the original bench mark 1 described above. This is the basic bench mark for the Boston city levels. Elevation: 14.33 feet above Boston low-water datum; 9.46 feet above sea-level datum.

Bench mark 3 (1916), *Boston Navy Yard*, is a Coast and Geodetic Survey standard disk set horizontally in the granite block at the head of United States Navy Dry Dock No. 2 at Charlestown. Elevation: 13.83 feet above Boston low-water datum; 8.96 feet above sea-level datum.

Navy-yard bench mark 8 (levels 1923), *Boston Navy Yard*, is a chiseled square at the head of Dry Dock No. 2 in the Charlestown Navy Yard in the top of the masonry about 1 foot north of bench mark No. 3. Elevation: 14.35 feet above Boston low-water datum; 9.48 feet above sea-level datum.

Navy-yard bench mark 10 (levels 1923), *Boston Navy Yard*, is a chiseled square in the pier supporting a column on the southeast side of an octagonal building north of the tennis courts in the navy yard. Elevation: 18.18 feet above Boston low-water datum; 13.31 feet above sea-level datum.

Navy-yard bench mark 18 (levels 1923), *Boston Navy Yard*, is a chiseled square in the top of the lower course of masonry at the southwest corner of building 75 in the Charlestown Navy Yard at the corner of Second Avenue and Thirteenth Street. Elevation: 15.81 feet above Boston low-water datum; 10.94 feet above sea-level datum.

Navy-yard bench mark 19 (levels 1923), *Boston Navy Yard*, is a chiseled square in the top of the lower course of stone at the northeast corner of building 77 at the corner of Fifth Avenue and Sixteenth Street. Elevation: 17.85 feet above Boston low-water datum; 12.98 feet above sea-level datum.

Bench mark "Waverly House" (levels 1923), *Charlestown*, is a Boston city bench mark and is a point on the right outer corner, facing the building, of the second stone step at the entrance to Waverly House on City Square. Elevation: 23.01 feet above Boston low-water datum; 18.14 feet above sea-level datum.

Bench mark F-2 (1923), *Charlestown*, is a Coast and Geodetic Survey standard disk set vertically in the center of the west side of the fourth pier from the eastern, or Charlestown, end of the "Prison Point Bridge," which is a viaduct carrying Prison Point Street over the railroad tracks and connecting East Cambridge and Charlestown. Elevation: 16.44 feet above Boston low-water datum; 11.58 feet above sea-level datum.

The elevations of other tide planes at Boston Navy Yard are based on some 39 years of tidal observations for the periods 1847 to 1876, 1902 to 1906, and 1908 to 1911. These planes, together with sea-level datum referred to Boston low-water datum, are as follows:

	Feet
Highest tide (Apr. 16, 1851) ¹	15.0
Mean high water.....	9.67
Sea-level datum.....	4.87
Half tide level.....	4.81
Boston low-water datum.....	0.00
Mean low water.....	-0.04
Lowest tide (Feb. 27, 1869).....	-3.5

¹ Occurred during a severe storm which destroyed the Minots Ledge Lighthouse.

BOSTON (CENTRAL PORTION)

The following bench marks are referred directly to the Boston standard datums by spirit-leveling connections:

Bench mark "Post Office," *Boston (central portion)*, is a Weather Bureau bench mark on the post-office building at the corner of Milk Street and Post Office Square, in the corner stone at the southeast corner, 1 foot above the sidewalk. Bench mark is a chiseled square. Elevation: 19.46 feet above Boston low-water datum; 14.59 feet above sea-level datum.

Bench mark "83 South Street," *Boston (central portion)*, is a Boston city bench mark on the lower iron step at 83 South Street. The left outer corner of the step faces the building. Elevation: 17.66 feet above Boston low-water datum; 12.78 feet above sea-level datum.

Bench mark J-2 (1923), *Boston (central portion)*, is a Coast and Geodetic Survey standard disk 306 feet south of the south end of the train shed at the Southern Union Station, 213 feet south of signal bridge No. 1; 63 feet north of signal bridge No. 5; $4\frac{1}{2}$ feet east of an easterly approach track; in the top of the stone coping at the south end of the iron railing. Elevation: 24.18 feet above Boston low-water datum; 19.31 feet above sea-level datum.

Bench mark "Boston & Albany mileage 0.49," *Boston (central portion)*, is a chiseled square on the northwest corner of the end capstone of the retaining wall at mileage 0.40 on the Boston & Albany Railroad and also on the New York, New Haven & Hartford Railroad, south of the tracks of the latter railroad. Elevation: 16.99 feet above Boston low-water datum; 12.12 feet above sea-level datum.

Bench mark "Boston & Albany mileage 0.61," *Boston (central portion)*, is a chiseled square on the northeast corner of the central pier of the Boston & Albany Railroad bridge No. 3 at mileage 0.61. Elevation: 6.41 feet above Boston low-water datum; 1.54 feet above sea-level datum.

Bench mark E-2 (1923), *Boston (central portion)*, is a Coast and Geodetic Survey standard disk set horizontally in the footing at the south end of the east center pier of the Boston & Albany Railroad bridge at mileage 1.19, which is the second overhead bridge south of the Trinity Place depot of the Boston & Albany Railroad. Elevation: 6.24 feet above Boston low-water datum; 1.37 feet above sea-level datum.

Bench mark "Boston & Albany mileage 1.35," *Boston (central portion)*, is a chiseled square on the northwest corner of the lower stone step at the baggage-room door of the Huntington Avenue depot at mileage 1.35 on the Boston & Albany Railroad. Elevation: 9.39 feet above Boston low-water datum; 4.52 feet above sea-level datum.

Bench mark "Boston & Albany," *Boston (central portion)*, is a chiseled square on the northwest corner of the southwest pier of the Boston & Albany Railroad signal bridge just east of bridge No. 16 at mileage 2.41. Elevation: 16.29 feet above Boston low-water datum; 11.42 feet above sea level datum.

Bench mark G-2 (1923), *Boston (central portion)*, is a Coast and Geodetic Survey standard disk at the east end of the center support of Cottage Farm Bridge No. 18 carrying Commonwealth Avenue over the Boston & Albany Railroad tracks at mileage 3.13, in the east face of the support, $2\frac{1}{2}$ feet above the ground. Elevation: 15.87 feet above Boston low-water datum; 11.00 feet above sea-level datum.

Bench mark "Van Orden Cottage Farm," *Boston (central portion)*, is a chiseled square at the east end of the foundation of the north abutment of Cottage Farm Bridge No. 18 carrying Commonwealth Avenue over the Boston & Albany Railroad tracks at mileage 3.13. Elevation: 14.94 feet above Boston low-water datum; 10.08 feet above sea-level datum.

Bench mark "Boston & Albany Cottage Farm," *Boston (central portion)*, is a chiseled square on the west wing, south abutment, of Cottage Farm Bridge No. 18 carrying Commonwealth Avenue over the Boston & Albany Railroad tracks at mileage 3.13, in the northwest corner of the lower coping stone. Elevation: 17.37 feet above Boston low-water datum; 12.50 feet above sea-level datum.

Bench mark "Cottage Farm, Boston City," *Boston (central portion)*, is a point on the bridge abutment in line with the north curb of Commonwealth Avenue and southwest of the Boston & Albany Railroad tracks, near the northwest end of the top of the abutment of Cottage Farm Bridge No. 18 carrying Commonwealth Avenue over the railroad at mileage 3.13. Elevation: 32.67 feet above Boston low-water datum; 27.80 feet above sea-level datum.

SOUTH BOSTON

The following bench marks are referred directly to the Boston standard datum by spirit-leveling connections:

Bench mark 6 (1921), *South Boston*, is a Coast and Geodetic Survey standard disk, stamped "6/1921," cemented in window sill of fifth window on northerly side of shore end of Commonwealth Pier No. 5, opposite tide staff. Elevation: 20.02 feet above Boston low-water datum; 15.15 feet above sea-level datum.

Bench mark 7 (1922), *South Boston*, is a Coast and Geodetic Survey standard disk cemented in upper surface of water table on side of heating plant opposite Commonwealth Pier No. 5, stamped "7/1922." The point of reference used is on the highest part of disk, which is just outside the small circle toward the side of the building. This bench has been adopted as the primary bench mark for the tidal series at Commonwealth Pier No. 5. Elevation: 18.17 feet above Boston low-water datum; 13.30 feet above sea-level datum.

Bench mark 8 (1922), *South Boston*, is a Coast and Geodetic Survey standard disk, stamped "8/1922," cemented in stone retaining wall opposite stairway leading down from Summer Street to C Street, and is on ledge just above first landing, about 7 feet below the top of wall. Elevation: 29.68 feet above Boston low-water datum; 24.81 feet above sea-level datum.

Bench mark "481 Summer Street," *South Boston* (established by Boston city engineers), is the outer right-hand corner of granite doorstep, when facing building, of No. 481 Summer Street. Elevation: 26.39 feet above Boston low-water datum; 21.52 feet above sea-level datum.

Bench mark "Dry Dock," *South Boston* (established by the Commonwealth of Massachusetts and maintained by the Navy Department), is the top of brass cap on iron rod, 2 inches in diameter, which has its foot in bedrock and extends upward through the concrete backing of the southern wall of the Navy Dry Dock No. 3 in South Boston, nearly to the surface, and is inclosed in a 4-inch iron pipe. A cast-iron cover bears the inscription "Bench Mark—Do not Disturb." Elevation: 15.14 feet above Boston low-water datum; 10.27 feet above sea-level datum.

Bench mark 9 (1922), *South Boston*, is a Coast and Geodetic Survey standard disk, stamped "9/1922," set in water table on the F Street side of No. 416 West Broadway, under the third window, 51½ feet from front of building. In 1922 building was occupied by P. F. Carey Furniture Co. Elevation: 52.35 feet above Boston low-water datum; 47.48 feet above sea-level datum.

Bench mark 10 (1922), *South Boston*, is a Coast and Geodetic Survey standard disk, stamped "10/1922," set in water table about 2 inches above sidewalk on F Street side of No. 423 West Broadway, 45.6 feet from front of building. In 1922 building was occupied by F. W. Woolworth Co. store. Elevation: 49.55 feet above Boston low-water datum; 44.68 feet above sea-level datum.

Bench mark "481 West Broadway," *South Boston* (established by Boston city engineers), is a Boston city bench mark, on the right buttress of the stone stairway at No. 481 West Broadway—the right outer corner of the buttress, facing the building. Elevation: 64.02 feet above Boston low-water datum; 59.15 feet above sea-level datum.

Bench mark "82 G Street," *South Boston* (established by Boston city engineers), is a Boston city bench mark on the right buttress, facing the building, at the side of the stairway at No. 82 G Street—the lower outer corner of the buttress. Elevation: 109.05 feet above Boston low-water datum; 104.18 feet above sea-level datum.

Bench mark 11 (1922), *South Boston*, is a Coast and Geodetic Survey standard disk stamped "11/1922," set in north end of fifth marble step inside iron gate and back of north gatepost at entrance to Washington Monument in Thomas Park, Dorchester Heights, South Boston. Elevation: 148.75 feet above Boston low-water datum; 143.88 feet above sea-level datum.

Bench mark 12 (1922), *South Boston*, is a Coast and Geodetic Survey standard disk, stamped "12/1922," set in top of step at right of doorway on entering building at north entrance to South Boston High School. Elevation: 116.45 feet above Boston low-water datum; 111.58 feet above sea-level datum.

The elevations of mean high water, mean low water, and half-tide level at Commonwealth Pier referred to Boston low-water datum are based on automatic tide-gauge records for the period August, 1921, to December, 1926, in-

clusive. The highest and lowest tides are the extreme tides for Boston Harbor and were observed at the navy yard. They were referred to Commonwealth Pier by spirit levels.

These tide planes, together with sea-level datum referred to Boston low-water datum, are as follows:

	Feet
Highest tide (Apr. 16, 1851)-----	15. 0
Mean high water-----	9. 45
Sea-level datum-----	4. 87
Half tide level-----	4. 74
Mean low water-----	0. 03
Boston low-water datum-----	0. 00
Lowest tide (Feb. 27, 1869)-----	-3. 5

CAMBRIDGE

The following bench marks are referred directly to the Boston standard datums by spirit-leveling connections:

Bench mark E-2 (1923), Cambridge, is a Coast and Geodetic Survey standard disk, about 600 feet north of the Boston & Maine Railroad depot, in the top of the footing at the east end of the north abutment of the bridge carrying the southern division over the Fitchburg division, 4 feet east of the east rail and 2 feet above the Fitchburg division track level. Elevation: 14.03 feet above Boston low-water datum; 9.16 feet above sea-level datum.

Bench mark "M. I. T." (Massachusetts Institute of Technology), Cambridge, is a brass plug in the concrete cap on a pile driven into the ground and covered by an iron plate in the floor in front of room 3-019 in the basement of the Massachusetts Institute of Technology. Elevation: 10.07 feet above Boston low-water datum; 5.20 feet above sea-level datum.

Bench mark "M. I. T. Special Bench Mark" (Massachusetts Institute of Technology), Cambridge, is located about 150 feet east and 15 feet south of the southwest corner of Massachusetts Institute of Technology. It consists of an 8-inch iron pipe filled with concrete extending down 10 feet into bedrock, which at this point is 112 feet below the surface. The upper 5 feet are protected from frost and moisture by a concrete sewer pipe fitted with a Ford meter-box cover. A special casting set in concrete in the top of the pipe serves as the bench mark. Elevation: 14.42 feet above Boston low-water datum; 9.55 feet above sea-level datum.

Bench mark "Cambridge City," Cambridge, is a brass plug in the top at the west end of the north abutment of Harvard Bridge carrying Massachusetts Avenue over the Charles River, at the street level and on the Charles River Road, 2 feet from the railings on the bridge. Elevation: 19.82 feet above Boston low-water datum; 14.95 feet above sea-level datum.

BROOKLINE

The following bench marks are referred to Boston standard datum by spirit-leveling connections:

Bench mark Q-2 (1923), Brookline, is a Coast and Geodetic Survey standard disk located about 300 feet west of the west end of the Boston & Albany Railroad depot at Brookline, 5 feet south of the south rail, in the center of the south abutment of the Boston & Albany Railroad bridge No. 156, 3 feet above the ground. Elevation: 22.61 feet above Boston low-water datum; 17.74 feet above sea-level datum.

Bench mark "Van Orden St. Marys Street," Brookline, is a chiseled square at the east end of the north abutment of St. Marys Street Bridge over the Boston & Albany Railroad tracks, in the top of the second stone. Elevation: 16.58 feet above Boston low-water datum; 11.71 feet above sea-level datum.

NEPONSET RIVER RAILROAD BRIDGE

The following bench marks are referred to the Boston standard datums through the primary tide station at Commonwealth Pier No. 5, by a comparison of simultaneous tides consisting of 13 high waters and 11 low waters observed during the period July 14 to July 22, 1926.

Bench mark 1 (1926), Neponset River Railroad Bridge, is a Coast and Geodetic Survey standard disk, stamped "1/1926," cemented in drill hole flush with the horizontal top surface of the stone bridge pier at the southerly side of

the railroad bridge lift span. The mark is about 1 foot from the bridge span on its easterly side. Elevation: 14.01 feet above Boston low-water datum; 9.14 feet above sea-level datum.

Bench mark 2 (1926), *Neponset River Railroad Bridge*, is a Coast and Geodetic Survey standard disk, stamped "2/1926," cemented in drill hole flush with the horizontal top surface in the next stone pier to the south of bench mark 1. Elevation: 13.93 feet above Boston low-water datum; 9.06 feet above sea-level datum.

Bench mark 3 (1926), *Neponset River Railroad Bridge*, is a Coast and Geodetic Survey standard disk, stamped "3/1926," cemented in drill hole flush with the horizontal top surface of stone bridge pier on the southerly side of the railroad bridge, just to the north of that in which bench mark 1 is located. Elevation: 13.36 feet above Boston low-water datum; 8.49 feet above sea-level datum.

The elevations of tide planes at Neponset River Railroad Bridge referred to Boston low-water datum are as follows:

	Feet
Highest tide.....	15.00
Mean high water.....	9.49
Sea-level datum.....	4.87
Boston low-water datum.....	0.00
Lowest tide.....	-3.50

NUT ISLAND

The following bench marks are referred to the Boston standard datums through the primary tide station at Commonwealth Pier No. 5, by a comparison of simultaneous tides consisting of 89 high waters and 88 low waters observed during the period June 9 to July 27, 1926.

Bench mark 1 (city of Boston), *Nut Island*, is a stone monument on the westerly side of Nut Island and reported to be easily found. Elevation: 29.42 feet above Boston low-water datum; 24.55 feet above sea-level datum.

Bench mark 2 (1916), *Nut Island*, is a Coast and Geodetic Survey standard disk set in northeast corner of granite foundation of sewer pumping station. Elevation: 31.98 feet above Boston low-water datum; 27.11 feet above sea-level datum.

Bench mark 3 (1916), *Nut Island*, is a ½-inch brass bolt set vertically in granite block of retaining wall just north of shore end of coal pier. Elevation: 23.75 feet above Boston low-water datum; 18.88 feet above sea-level datum.

Bench mark 4 (1926), *Nut Island*, is a Coast and Geodetic Survey standard disk, stamped "4/1926," cemented in a drill hole in the concrete coping of a sewer manhole about 40 yards northwest from the shore end of the pier. Elevation: 26.90 feet above Boston low-water datum; 22.03 feet above sea-level datum.

Bench mark 5 (1926), *Nut Island*, is a Coast and Geodetic Survey standard disk, stamped "5/1926," cemented on top of a granite block on the upper sea wall about 50 yards south from the boathouse. Elevation: 19.24 feet above Boston low-water datum; 14.37 feet above sea-level datum.

The elevations of tide planes at Nut Island referred to Boston low-water datum are as follows:

	Feet
Highest tide.....	15.00
Mean high water.....	9.27
Sea-level datum.....	4.87
Boston low-water datum.....	0.00
Lowest tide.....	-3.50

WEYMOUTH FORE RIVER BRIDGE

The following bench marks are referred to the Boston standard datums through the primary tide station at Commonwealth Pier No. 5, by a comparison of simultaneous tides consisting of 14 high waters and 14 low waters observed during the period June 17 to July 14, 1926.

Bench mark 1 (1926), *Weymouth Fore River Bridge*, is a Coast and Geodetic Survey standard disk, stamped "1/1926," set flush with the concrete surface of the stair platform on its southeast corner south of brick building of Edison coaling plant. Elevation: 15.55 feet above Boston low-water datum; 10.68 feet above sea-level datum.

Bench mark 2 (1926), Weymouth Fore River Bridge, is a Coast and Geodetic Survey standard disk, stamped "2/1926," set flush with the surface of the concrete wharf near the southwest corner, just south of the concrete mooring-bitt block. Elevation: 14.64 feet above Boston low-water datum; 9.77 feet above sea-level datum.

Bench mark 3 (1926), Weymouth Fore River Bridge, is a Coast and Geodetic Survey standard disk, stamped "3/1926," set flush with the surface of the concrete fence that makes out from the extreme easterly side of the wharf running normal to the road. Elevation: 19.27 feet above Boston low-water datum; 14.40 feet above sea-level datum.

The elevations of tide planes at Weymouth Fore River Bridge referred to Boston low-water datum are as follows:

Highest tide-----	15.00
Mean high water-----	9.49
Sea-level datum-----	4.87
Boston low-water datum-----	0.00
Lowest tide-----	-3.50

CROW POINT, HINGHAM HARBOR ENTRANCE

The following bench marks are referred to the Boston standard datums through the primary tide station at Commonwealth Pier No. 5, by a comparison of simultaneous tides consisting of 37 high waters and 36 low waters observed during the period June 19 to July 8, 1926.

Bench mark 1 (1926), Crow Point, is a Coast and Geodetic Survey standard disk, stamped "1/1926," cemented in a drill hole on top of stone sea wall northwest from dock and about halfway between dock entrance and shore. Elevation: 14.31 feet above Boston low-water datum; 9.44 feet above sea-level datum.

Bench mark 2 (1926), Crow Point, is a Coast and Geodetic Survey standard disk, stamped "2/1926," cemented in a drill hole on top of stone sea wall on main shore line about 20 feet south of dock entrance, at a turn in the wall. Elevation: 13.87 feet above Boston low-water datum; 9.00 feet above sea-level datum.

Bench mark 3 (1926), Crow Point, is a Coast and Geodetic Survey standard disk, stamped "3/1926," cemented in a drill hole on top of stone sea wall on main shore line about 100 yards northwest of dock entrance, at a sudden bend in the shore line. Elevation: 14.20 feet above Boston low-water datum; 9.33 feet above sea-level datum.

The elevations of tide planes at Crow Point referred to Boston low-water datum are as follows:

Highest tide-----	15.00
Mean high water-----	9.49
Sea-level datum-----	4.87
Boston low-water datum-----	0.00
Lowest tide-----	-3.50

COHASSET HARBOR ENTRANCE, SHEPPARD LEDGE

The elevations of the following bench marks are based on 8 high waters and 11 low waters observed at Sheppard Ledge during the period July 20 to August 29, 1894.

Bench mark 2 (1894), Cohasset Harbor Entrance, is a cross marked "B+M," cut on horizontal surface of top of highest point of rock of the easternmost rock island of Sheppard Ledge. Elevation: 17.98 feet above mean low water; 13.48 feet above half tide level.

Bench mark 3 (1916), Cohasset Harbor Entrance, is a Coast and Geodetic Survey standard disk set on top of the highest boulder on the beach, about 328 feet north from the clubhouse, The Glades, on the mainland near Sheppard Ledge. It is about 112 feet north of the concrete sea wall. Elevation: 20.99 feet above mean low water; 16.49 feet above half-tide level.

Bench mark 4 (1916), Cohasset Harbor Entrance, is a Coast and Geodetic Survey standard disk set in the outer slope of a ledge projecting out of the lawn bank about 328 feet northwest from The Glades clubhouse. This bench mark is nearly in line with bench marks 2 and 3 and about 164 feet south-easterly from the latter. Elevation: 20.95 feet above mean low water; 16.45 feet above half tide level.

Bench mark 5 (1916), Cohasset Harbor Entrance, is a ½-inch brass rod set vertically in top of rock of Sheppard Ledge next west of the one on which bench mark 2 is located. Elevation: 17.37 feet above mean low water; 12.87 feet above half tide level.

Bench mark 6 (1916), Cohasset Harbor Entrance, is a Coast and Geodetic Survey standard disk cemented in the horizontal face of rock about 10 feet west of bench mark 2. Elevation: 17.73 feet above mean low water; 13.23 feet above half tide level.

The elevations of tide planes at Cohasset Harbor Entrance referred to mean low water are as follows:

	Feet
Highest tide.....	11. 00
Mean high water.....	9. 00
Half tide level.....	4. 50
Mean low water.....	0. 00
Lowest tide.....	-3. 50

SCITUATE

The elevations of the following bench marks are based on 24 high waters and 26 low waters observed during the period July 7 to August 13, 1915, and supported by a later series consisting of 21 high waters and 25 low waters observed during the period June 28 to July 11, 1924, reduced to mean values by comparison with simultaneous observations at Boston, Commonwealth Pier No. 5, where the datum is based on two years of observations.

Bench mark 1 (1915), Scituate, is a copper plug set in the concrete wall of the new city dock near Welch's Coal Wharf. Elevation: 14.98 feet above mean low water; 10.48 feet above half tide level.

Bench mark 2 (1915), Scituate, is a copper plug in a large rock in a stone wall on the east side of Front Street, about 164 feet north of a culvert under the road. Elevation: 13.27 feet above mean low water; 8.77 feet above half tide level.

Bench mark 3 (1916), Scituate, is a Coast and Geodetic Survey standard disk set 1 foot east of the inside corner of the concrete sea wall on the north side of the new town wharf. Elevation: 17.08 feet above mean low water; 12.58 feet above half tide level.

Bench mark 4 (1924), Scituate, is a Coast and Geodetic Survey standard disk set in a 1-inch drill hole with cement, in the top of a large flat rock about 262 feet north of the end of the concrete sea wall on the north side of the new city dock. Elevation: 16.47 feet above mean low water; 11.97 feet above half tide level.

Bench mark 5 (1924), Scituate, is a Coast and Geodetic Survey standard disk set in a 1-inch drill hole with cement, in the top of the masonry sea wall on the south side of the city dock, near the south end of the wall. It is about 56 feet south of bench mark 1 and directly opposite the residence of Capt. E. E. Edson. Elevation: 14.77 feet above mean low water; 10.27 feet above half tide level.

The elevations of tide planes at Scituate referred to mean low water are as follows:

	Feet
Highest tide.....	11. 00
Mean high water.....	9. 00
Half tide level.....	4. 50
Mean low water.....	0. 00
Lowest tide.....	-3. 50

GREEN HARBOR, CAPE COD BAY

The elevations of the following bench marks are based on one high water and one low water observed September 19 and 20, 1916, reduced to mean values by comparison with simultaneous observations at Plymouth, which, in turn, had been reduced to mean values by comparison with simultaneous observations at Portland, Me., where the datum was based on two years of observations.

Bench mark 1 (1916), Green Harbor, is a Coast and Geodetic Survey standard disk set in the east end of the lowest step leading up in corner of small sea wall, at cottage nearest the end of bulkhead. Elevation: 11.85 feet above mean low water; 7.35 feet above half tide level.

Bench mark 2 (1916), Green Harbor, is a triangle on top of a large rock in the western jetty about 328 feet from the shore end. The mark was found by

accident and looks like a Coast and Geodetic Survey mark. Elevation: 10.23 feet above mean low water; 5.73 feet above half tide level.

Bench mark 3 (1916), Green Harbor, is a Coast and Geodetic Survey standard disk cemented in a crevice between two rocks which form part of the western foundation of first bridge south of Green Harbor bulkhead. The rocks are on the north side of the bridge, and the mark is immediately below the girder and about 4 feet below the roadway of the bridge. Elevation: 10.41 feet above mean low water; 5.91 feet above half tide level.

The elevations of tide planes at Green Harbor referred to mean low water are as follows:

	Feet
Highest tide.....	12.00
Mean high water.....	9.00
Half tide level.....	4.50
Mean low water.....	0.00
Lowest tide.....	-3.50

PLYMOUTH, PLYMOUTH HARBOR

The elevations of the following bench marks are based on seven high waters and six low waters for the period July 20 to July 29, 1916, reduced to mean values by comparison with simultaneous observations at Portland, Me., where the datum was based on two years of observations.

Bench mark 4 (1916), Plymouth, is the highest point of "Plymouth Rock," located on Water Street near the foot of North Street. Elevation: 20.10 feet above mean low water; 15.32 feet above half tide level.

Bench mark 5 (1916), Plymouth, is a hole in the center of a triangle cut in the cement walk about the pavilion and southeasterly from "Plymouth Rock." Elevation: 15.94 feet above mean low water; 11.16 feet above half tide level.

Bench mark 6 (1916), Plymouth, is a Coast and Geodetic Survey standard disk set vertically in the east face and at the north end of the sea wall extending along the east side of Water Street from Craig's Wharf to the foot of Howland Street. It is about 3 feet from the top of the sea wall. Elevation: 15.31 feet above mean low water; 10.53 feet above half tide level.

Bench mark 7 (1916), Plymouth, is a triangle cut on the top surface of the southeast portico of the Plymouth County courthouse, 1½ inches outside the base of the southern pillar that is nearest the wall of the courthouse. Elevation: 74.98 feet above mean low water; 70.20 feet above half tide level.

Bench mark 8 (1916), Plymouth, is a cross cut about 2 inches from the wall, in the left end of the step at the entrance to the belfry of the First Church of Plymouth, in the Town Square. Elevation: 72.20 feet above mean low water; 67.42 feet above half tide level.

Bench mark 9 (1916), Plymouth, is a Coast and Geodetic Survey standard disk set in the east face near the northeast corner of the foundation of the mail-receiving room of the new post office, about 4 feet above the level of the yard and driveways. Elevation: 55.25 feet above mean low water; 50.47 feet above half tide level.

The elevations of tide planes at Plymouth referred to mean low water are as follows:

	Feet
Highest tide.....	12.00
Mean high water.....	9.56
Half tide level.....	4.78
Mean low water.....	0.00
Lowest tide.....	-4.00

SAGAMORE BEACH, CAPE COD BAY

The elevations of the following bench marks are based on 56 high waters and 56 low waters observed during the period July 17 to August 15, 1860.

Bench mark 2 (1860), Sagamore Beach, is the highest point of a large boulder in the thick underbrush and covered with wild grapevines, about 100 feet south of Sagamore Lodge. The rock, which is about 200 feet from the high-water line, has a rather sharp edge along its top and is marked prominently with the large letters "CS" cut on its northern face. Elevation: 28.66 feet above mean low water; 23.94 feet above half tide level.

Bench mark 3 (1916), Sagamore Beach, is the highest point of "Big Seabitch" rock, about 328 feet out from high-water line directly offshore from the first deep cut in the high sand bluff south of Peaked Cliff. It is marked

by a drill hole at the point and a cross cut in the rock 3 feet inshore from the hole. Elevation: 5.97 feet above mean low water; 1.25 feet above half tide level.

Bench mark 4 (1916), *Sagamore Beach*, is a Coast and Geodetic Survey standard disk set in a large boulder on the south side of the path leading from Sagamore Lodge up the hill to the main road. The rock is about 118 feet from the road and 36 feet from the northeast corner of the piazza of a bungalow. About 2 feet square of the boulder shows above ground. Elevation: 56.20 feet above mean low water; 51.48 feet above half tide level.

The elevations of tide planes at Sagamore Beach referred to mean low water are as follows:

	Feet
Highest tide.....	13.50
Mean high water.....	9.44
Half tide level.....	4.72
Mean low water.....	0.00
Lowest tide.....	-4.00

BARNSTABLE HARBOR, CAPE COD

The elevation of the following bench mark is based on 41 high waters and 46 low waters observed during the period July 20 to August 16, 1861.

Bench mark 1 (1861), *Barnstable Harbor*, is the highest point of Bench Rock located on the flats near Mussel Point on the south side of Sandy Neck. Elevation: 2.79 feet above mean low water; 1.93 feet *below* half tide level.

The elevations of tide planes at Barnstable Harbor referred to mean low water are as follows:

	Feet
Highest tide.....	13.50
Mean high water.....	9.44
Half tide level.....	4.72
Mean low water.....	0.00
Lowest tide.....	-4.00

WELLFLEET HARBOR, CAPE COD

The elevations of the following bench marks are based on 15 high waters and 15 low waters observed during the period August 1 to August 8, 1926, reduced to mean values by comparison with simultaneous observations at Commonwealth Pier No. 5, Boston, where the datum is based on two years of observations.

Bench mark 1 (1926), *Wellfleet Harbor*, is a Coast and Geodetic Survey standard disk, stamped "1/1926," cemented in a drill hole, flush with the concrete floor projecting out from the eastern door of the stucco garage 75 yards east of the hotel wharf. Elevation: 15.43 feet above mean low water; 10.08 feet above half tide level.

Bench mark 2 (1926), *Wellfleet Harbor*, is a Coast and Geodetic Survey standard disk, stamped "2/1926," cemented in a drill hole flush with the vertical surface of the concrete sea wall at the western end about 10 yards west of the cottage. Elevation: 12.24 feet above mean low water; 6.89 feet above half tide level.

The elevations of tide planes at Wellfleet Harbor referred to mean low water are as follows:

	Feet
Highest tide.....	15.00
Mean high water.....	10.70
Half tide level.....	5.35
Mean low water.....	0.00
Lowest tide.....	-4.00

NORTH TRURO, CAPE COD

The elevations of the following bench marks are based on four high waters and four low waters observed at North Truro during the period July 12 to 17, 1889, and 123 high waters and 121 low waters observed at High Head Life Saving Station during the period June 12 to August 22, 1889, the tide staffs at the two places having been connected by a line of spirit levels.

Bench mark XVI (1889), *North Truro*, established in connection with the physical hydrographic survey of Cape Cod Peninsula, 1886 to 1889, is the high-

est point on the top of the one hundred and sixteenth milepost, Cape Cod Division of the Old Colony Railroad. The milepost stands close to the track on the north side and is about halfway between the depots at North Truro and Provincetown; it is a rough granite post about 1 foot square, projecting 5 feet above the ground; two adjoining faces near the top are dressed, on each of which are the figures "116," put on with black paint. Elevation: 15.83 feet above mean low water; 11.24 feet above half tide level.

Bench mark XVII (1889), North Truro, established in connection with the physical hydrographic survey of Cape Cod Peninsula, 1886 to 1889, is the highest point on the top of the one hundred and seventeenth milepost, Cape Cod Division of the Old Colony Railroad. The milepost stands close to the track on the north side and is about 2½ miles from the depot at Provincetown; it is also just east of where the wagon road crosses the track, near the east end of the dike, at Beach Point; it is a rough granite post about 1 foot square, projecting nearly 6 feet above ground; two adjoining faces near the top are dressed, on each of which are the figures "117," put on with black paint. Elevation: 18.78 feet above mean low water; 14.12 feet above half tide level.

Bench mark XVIII (1889), North Truro, established in connection with the physical hydrographic survey of Cape Cod Peninsula, 1886 to 1889, is on the town line between the towns of Truro and Provincetown. It is the highest point on the top of the rough granite post known as Truro Corner 5 and stands on the northeast side of the dike at Beach Point; it projects about 18 inches above ground and has the letter "T" cut in the Truro side and "P" in the Provincetown side of the post. Standing just across the roadway (on the southwest side of dike) is a stone post similar in size and shape, which is also on the town line. Elevation: 13.52 feet above mean low water; 8.93 feet above half tide level.

The elevations of tide planes at North Truro referred to mean low water are as follows:

Highest tide	-----	13.50
Mean high water	-----	9.18
Half tide level	-----	4.59
Mean low water	-----	0.00
Lowest tide	-----	-3.50

PROVINCETOWN, CAPE COD

The following bench marks are referred to High Head half tide level by spirit-level connections in 1889. This datum was determined from two months of total records observed during the period from June 15 to August 15, 1889, at High Head Life Saving Station.

The reference to mean low water is based upon the relation established through the mean range of tide as derived from several series of tidal observations at Provincetown taken during the following periods: July 1, 1883, to March 1, 1884; September 5 to September 21, 1889; and July 9 to 31, 1902.

Bench mark 76 (1889), Provincetown, established in connection with the physical hydrographic survey of Cape Cod Peninsula, 1886 to 1889, is the top of the granite block which supports the iron fence post at the southeast corner of Centenary M. E. Church yard, at the intersection of Commercial and Winthrop Streets. Standing on the east side of the bench (in Winthrop Street) is a rough granite post which is about 1 foot higher. Elevation: 28.43 feet above mean low water; 23.83 feet above High Head half tide level.

Bench mark 5 (1890), Provincetown, also known as T. B. M. 3 of precise levels, is a cross cut on stone foundation of iron fence in front of Center Street M. E. Church, corner of Center and Commercial Streets, about 1 foot west from southeast corner of fence. Elevation: 23.04 feet above mean low water; 19.44 feet above High Head half tide level.

The elevations of tide planes at Provincetown referred to mean low water are as follows:

Highest tide	-----	13.50
Mean high water	-----	9.20
High Head half tide level	-----	4.60
Mean low water	-----	0.00
Lowest tide	-----	-4.00

HIGH HEAD, CAPE COD

The elevations of the following bench marks are based on two months of tidal records observed during the period June 15 to August 15, 1889, at the High Head Life Saving Station.

Bench mark XV (1889), *High Head*, established in connection with the physical hydrographic survey of Cape Cod Peninsula, 1886 to 1889, is the top of a copper bolt leaded in a large bowlder; the bowlder is buried about 1 foot below the surface of the ground and is between the wagon track and fence, just east of William Holden's wagon house, 114 feet from the northeast corner. It is 262 feet from the northeast corner of the dwelling house and 190 feet from northwest corner of the barn. It is nearly a mile from High Head Life Saving Station. Elevation: 10.07 feet above mean low water; 6.22 feet above half tide level.

Bench mark T. B. M. 69 (1889), *High Head*, established in connection with the physical hydrographic survey of Cape Cod Peninsula, 1886 to 1889, is the center of the top of a granite post that is located on top of the second bluff to the eastward of William Holden's house. The post has a dressed top about 6 by 6 inches and projects 1 foot above the ground. It has the letters "U. S. No. 3" cut in one of its sides. Elevation: 70.09 feet above mean low water; 66.24 feet above half tide level.

Bench mark 64 (1889), *Cape Cod Light, near High Head*, established in connection with the physical hydrographic survey of Cape Cod Peninsula, 1886 to 1889, is the center of the top of the granite post marking the northwest corner of the lighthouse grounds and is also just at the corner of the platform in front of the Highland signal station. Elevation: 132.62 feet above mean low water; 128.77 feet above half tide level.

Bench mark XIII (1889), *Cape Cod Light, near High Head*, established in connection with the physical hydrographic survey of Cape Cod Peninsula, 1886 to 1889, is the middle of a horizontal mark cut on the outside vertical face of one of the granite window sills of the lighthouse tower. The line cut is not very prominent. Elevation: 142.34 feet above mean low water; 138.49 feet above half tide level.

The elevations of tide planes at High Head referred to mean low water are as follows:

	Feet
Highest tide	12.00
Mean high water	7.70
Half tide level	3.85
Mean low water	0.00
Lowest tide	-3.50

PAMET RIVER LIFE-SAVING STATION, CAPE COD.

The elevation of the following bench mark is based on 55 high waters and 54 low waters observed during the period of September 11 to October 23, 1888.

Bench mark XII (1888), *Pamet River Life Saving Station*, established in connection with the physical hydrographic survey of Cape Cod Peninsula, 1886 to 1889, is the top of a copper bolt $\frac{1}{2}$ inch in diameter set in the top of a granite bowlder which projects about 1 foot above the ground and is about 9 feet in circumference. It is situated in the field owned by John Joseph near the north bank of the Pamet River and about $\frac{1}{3}$ mile due west of the Pamet Life Saving Station. The bolt is fastened into the bowlder with lead and projects $\frac{1}{2}$ inch above the surface of the stone. Elevation: 13.22 feet above mean low water; 9.65 feet above half tide level.

The elevations of tide planes at Pamet River Life Saving Station referred to mean low water are as follows:

	Feet
Highest tide	11.00
Mean high water	7.14
Half tide level	3.57
Mean low water	0.00
Lowest tide	-3.50

NAUSET BEACH BEACONS, CAPE COD

The elevations of the following bench marks are based on 33 high waters and 37 low waters observed during the period August 1 to August 21, 1888.

Bench mark 38 (1888), Nauset Beach Beacons, established in connection with the physical hydrographic survey of Cape Cod Peninsula, 1886 to 1889, is on a granite stone set to mark the boundary between the towns of Eastham and Wellfleet. It is about $1\frac{1}{2}$ miles to the northward of the Nauset Beach Beacons, standing within 50 feet of the top of the bluff facing the ocean. It is about 81 paces south-southeast of Coast and Geodetic Survey Δ Wyer. The stone is firmly planted in the sand and in 1887 projected about 2 feet above the surface. It measures 8 inches on the face and is 5 inches thick. On the western side is cut this symbol, $\frac{WLE}{1886}$. A notch was hammered into the top of the stone and the rod held therein. Elevation: 79.10 feet above mean low water; 75.81 feet above half tide level.

Bench mark VIII (1888), Nauset Beach Beacons, established in connection with the physical hydrographic survey of Cape Cod Peninsula, 1886 to 1889, is the center of the top of a granite stone set in the sand, projecting about 5 inches above the ground. The upper portion is dressed, the top being about 6 inches square. Into the top face are cut the letters "U. S. L. H. E." The stone is about 11 paces north of the northern one of the three Nauset lights and is on the northeast corner of the lighthouse establishment. Elevation: 74.54 feet above mean low water; 71.25 feet above half tide level.

Bench mark IX (1888), Nauset Beach Beacons, established in connection with the physical hydrographic survey of Cape Cod Peninsula, 1886 to 1889, is a horizontal line cut in a copper bolt about $\frac{3}{8}$ inch in diameter set in one of the bricks of the foundation wall of the frame dwelling house of the keeper of the three Nauset lights. The brick is on the northeast corner of the north side of the house. It is the third brick down, counting from the top. On the brick below are cut the letters "B. M." Elevation: 76.57 feet above mean low water; 73.28 feet above half tide level.

Bench mark X (1888), Nauset Beach Beacons, established in connection with the physical hydrographic survey of Cape Cod Peninsula, 1886 to 1889, is the top of the granite post which marks the northwest corner of the lighthouse reservation. The upper portion of the post is dressed, the top surface being about 6 inches square, and has the letters "U. S. L. H. E." cut in it. The rod was held at the intersection of the diagonals joining the corners. Elevation: 70.08 feet above mean low water; 66.79 feet above half tide level.

Bench mark VII (1888), Nauset Beach Beacons, established in connection with the physical hydrographic survey of Cape Cod Peninsula, 1886 to 1889, is the top of a copper bolt $\frac{1}{2}$ inch in diameter sunk into the eastern face of Enoch Rock about 7 feet from the ground. The bolt is fastened into the rock with brimstone and projects about 1 inch above the surface. The rod was held on top of the bolt. The letters "B. M." are cut into the face of the rock just above the bolt. The rock is one of those boulders of the glacial period. The portion above the ground is about 15 feet high and 100 feet in circumference at the base. It is situated about $\frac{3}{4}$ mile westward of the Nauset Life Saving Station at North Eastham, Cape Cod. Elevation: 66.99 feet above mean low water; 63.70 feet above half tide level.

The elevations of tide planes at Nauset Beach Beacons referred to mean low water are as follows:

Highest tide	-----	Feet	10. 50
Mean high water	-----		6. 58
Half tide level	-----		3. 29
Mean low water	-----		0. 00
Lowest tide	-----		-3. 50

NAUSET HARBOR ENTRANCE, CAPE COD

The elevation of the following bench mark is based on 27 high waters and 26 low waters observed during the period September 15 to October 4, 1887.

Bench mark I (1887), Nauset Harbor Entrance, established in connection with the physical hydrographic survey of Cape Cod Peninsula, 1886 to 1889, is a copper bolt set with lead in a large granite boulder on the beach nearly west of the Humane House. It is the only large boulder on the beach on the west side of the channel about $\frac{1}{4}$ mile from the entrance to Nauset Harbor. The bench mark is almost in front of the northern one of three houses on top of the hill about 500 feet distant. Elevation: 11.53 feet above mean low water; 8.53 feet above half tide level.

Bench mark II (1887), Nauset Harbor Entrance, established in connection with the physical hydrographic survey of Cape Code Peninsula, 1886 to 1889, is a copper bolt $\frac{1}{2}$ inch in diameter set with lead in a large granite boulder which is situated on the slope of the bluff about 1,300 feet to the southward of bench mark I. It is on the larger of two boulders lying side by side at the south end of the bluff and is nearly 330 feet southeast of the southern one of three houses on the top of the hill. Elevation: 28.46 feet above mean low water; 25.46 feet above half tide level.

The elevations of tide planes at Nauset Harbor Entrance referred to mean low water are as follows:

	Feet
Highest tide	10. 00
Mean high water	6. 00
Half tide level	3. 00
Mean low water	0. 00
Lowest tide	-3. 50

CHATHAM LIGHT, CAPE COD

The elevation of the following bench mark is based on 50 high waters and 50 low waters observed during the periods September 29 to October 26, 1886; September 19 to 29, 1887; and June 27 to July 7, 1888, each series being corrected to mean values by comparison with simultaneous observations at Sandy Hook, N. J.

Bench mark IV (1887), Chatham Light, established in connection with the physical hydrographic survey of Cape Cod Peninsula, 1886 to 1889, consists of a square horizontal surface, inclosed by lines cut into the top facing of the concrete foundation just south of where the lightning rod enters the earth. The bench mark surface is about $1\frac{1}{2}$ inches square. The letters "U. S. C. S." are cut above the mark and the figures "87" below the mark. Elevation: 44.14 feet above mean low water; 40.78 feet above half tide level.

The elevations of tide planes at Chatham Light referred to mean low water are as follows:

	Feet
Highest tide	10. 00
Mean high water	6. 72
Half tide level	3. 36
Mean low water	0. 00
Lowest tide	-3. 00

MONOMOY POINT

The elevations of the following bench marks are based on 380 high waters and 376 low waters from a number of short series of tides observed during the years 1886, 1887, 1889, 1890, 1894, 1895, 1902, and 1906.

Bench mark 10 (1906), Monomoy Point, is the top surface of the northeast corner of a $\frac{3}{4}$ -inch iron plate which acts as a corner to a cement cesspool, situated about 4 feet northwest from the southwest corner of the Monomoy Point Life Saving Station. Just below the bench mark a small cross is cut in the cement of the cesspool. Elevation: 17.13 feet above mean low water; 15.26 feet above half tide level.

Bench mark 11 (1906), Monomoy Point, is the point nearest to the life-saving station in the top surface of a cement cistern opening. The cistern is about 10 feet west-northwest from bench mark 10. The opening has a movable stone cover $2\frac{1}{2}$ inches thick which is moved aside for observing on the bench mark. No identification mark could be made. Elevation: 20.86 feet above mean low water; 18.99 feet above half tide level.

The elevations of tide planes at Monomoy Point referred to mean low water are as follows:

	Feet
Highest tide	6. 00
Mean high water	3. 74
Half tide level	1. 87
Mean low water	0. 00
Lowest tide	-2. 50

POINT GAMMON, NANTUCKET SOUND

The elevation of the following bench mark is based on 84 high waters and 78 low waters observed during the period September 2 to October 21, 1854.

Bench mark 1 (1854), Point Gammon, is the top of an iron bolt set into the top of a large boulder about 360 feet offshore southeasterly from the old light-house tower. This boulder has more of its surface exposed at high water than any of the other rocks in the vicinity. Elevation: 7.18 feet above mean low water; 5.51 feet above half tide level.

The elevation of tide planes at Point Gammon referred to mean low water are as follows:

	Feet
Highest tide -----	6.00
Mean high water -----	3.34
Half tide level -----	1.67
Mean low water -----	0.00
Lowest tide -----	-2.50

HYANNISPORT

The elevations of the following bench marks are based on 438 high waters and 438 low waters observed during the years 1855, 1874, 1888, 1895, 1896, 1902, and 1907.

Bench mark 2 (1888), Hyannisport, is a horizontal line cut into a square granite block in the second line of stones from the top of the breakwater on the inner side, about 560 feet from its northwest end. It is marked by the letters "U. S. C." on the same level as the bench mark and to the left of it. Elevation: 8.83 feet above mean low water; 7.20 feet above half tide level.

Bench mark 3a (1909), Hyannisport, is the highest point of the second large gray boulder just south of the wharf of the Hyannisport Improvement Association. Elevation: 8.54 feet above mean low water; 6.91 feet above half tide level.

Bench mark 4 (1902), Hyannisport, is a cross cut on the outcrop of a small boulder in the back yard of Mr. Slack's house on the street at the Hyannisport Improvement Association Wharf. Elevation: 1876 feet above mean low water; 17.13 feet above half tide level.

Bench mark 5 (1902), Hyannisport, is a cross cut in the highest portion of the post of the stone fence around the house just to the eastward of Mr. Slack's house. Elevation: 17.72 feet above mean low water; 16.09 feet above half tide level.

Bench mark 6 (1907), Hyannisport, is the highest point on a granite boulder about 3 feet through, round at the top, which is the support for a small wooden boathouse situated at the south side of the entrance to the Hyannisport Improvement Association Pier. The boulder is on the western side of the house, about 4 feet from the northwest corner, and projects 2 or 3 feet from the house. The highest point is about in the center of the boulder. Elevation: 8.12 feet above mean low water; 6.49 feet above half tide level.

Bench mark 7 (1907), Hyannisport, is the highest point of a granite stone projecting about 4 or 5 inches above the ground. The part in sight is about a foot long and 3 or 4 inches wide. The highest part is on the south central part of the stone and is well determined. The stone is at the outer edge of the sidewalk in line with the southern face of the stone retaining wall on the northwest corner to the northwest of the two streets meeting at the Hyannisport Improvement Association Pier. Elevation: 10.45 feet above mean low water; 8.82 feet above half tide level.

Bench mark 8 (1909), Hyannisport, is the top surface of the first concrete step going up from the street to the lawn at the north edge of Mr. Slack's property. The middle part of the north end of the step is the reference point. Elevation: 10.66 feet above mean low water; 9.03 feet above half tide level.

The elevations of tide planes at Hyannisport referred to mean low water are as follows:

	Feet
Highest tide -----	6.00
Mean high water -----	3.26
Half tide level -----	1.63
Mean low water -----	0.00
Lowest tide -----	-2.50

NANTUCKET, NANTUCKET ISLAND

The elevations of the following bench marks are based on 112 high waters and 112 low waters observed at Swan's Wharf during the period June 20 to August 30, 1894, reduced to mean values by comparison with simultaneous observations at Fort Hamilton, N. Y., where the datum is based on 30 years of observations.

Bench mark 1 (1854), Nantucket, is the center of a cross on the head of a copper bolt which was set into the face of a large stone near the head of Commercial Wharf, on the south side. It is about 16 feet east of the angle formed by a tumble-down extension (1894) along the shore to the south. Elevation: 4.28 feet above mean low water; 2.73 feet above half tide level.

Bench mark 7 or Meridian Stone (1894), Nantucket, is the top of a marble slab about 1 foot square in the brick sidewalk at the northeast corner of the Sandford estate at the southwest corner of Broad and South Water Streets and across the street from the Covil & Pease livery stable. Elevation: 8.92 feet above mean low water; 8.19 feet above half tide level.

Bench mark 10a (1910), Nantucket, is the top of a granite post about 8 inches square on the end, projecting about 4 inches above the ground. The top is marked by a cross. In 1910 this granite post was found situated in the beach grass about 100 feet from the tip of Brant Point and may possibly be "Stone 42 U. S. Engineers." Elevation: 5.73 feet above mean low water; 4.18 feet above half tide level.

Bench mark 11a (1910), Nantucket, is a cross on top of a granite post on the line of the western jetty and is about 675 feet from the water. It is about 75 feet north of a line from Brant Point Lighthouse to the old range beacon nearest the shore. It is just to the west of the road running down to the Cliff Beach bathhouses. This granite post was found in place and was probably put there by the United States Army Engineers. Elevation: 9.65 feet above mean low water; 8.10 feet above half tide level.

Bench mark 14 (1910), Nantucket, is a cross cut into the retaining wall in front of Mr. Winshall's cottage on the north side of Brant Point to the westward of the lighthouse reservation. It is close up to the house, on the western retaining wall. Elevation: 9.65 feet above mean low water; 8.10 feet above half tide level.

Bench mark 15 (1910), Nantucket, is a cross cut into the concrete around the flagpole set up on the lawn in front of Mr. Winshall's cottage on the north side of Brant Point to the westward of the lighthouse reservation. Elevation: 9.67 feet above mean low water; 8.12 feet above half tide level.

Bench mark 16 (1910), Nantucket, is a cross cut in the top of the northwest retaining wall of the second cottage to the eastward of Mr. Winshall's cottage on Brant Point. The retaining wall is made of rough masonry capped by a cement top. Elevation: 8.71 feet above mean low water; 7.16 feet above half tide level.

Bench mark 17 (1910), Nantucket, is the northwest corner of the oil house on the lighthouse reservation on Brant Point. The foundation is stepped inward by two steps. The point chosen for the bench mark is the top of the upper step. Elevation: 4.88 feet above mean low water; 3.33 feet above half tide level.

Bench mark 18 (1910), Nantucket, is the southwest corner of the oil house on the lighthouse reservation on Brant Point. The point chosen for the bench mark is the top of the upper step of the foundation, which is similar to bench mark 17 on the northwest corner. Elevation: 4.91 feet above mean low water; 3.36 feet above half tide level.

Bench mark 19 (1910), Nantucket, is marked by a cross on the top of a marble stone about 3 by 3 inches square on top set in the asphalt sidewalk in the rear of Driftwood Cottage, about 3 or 4 feet eastward of the entrance to the cottage grounds. Driftwood cottage is on the south side of the road leading from Brant Point. Elevation: 5.45 feet above mean low water; 3.90 feet above half tide level.

Bench mark 20 (1910), Nantucket, is the top of a granite stone about 8 by 8 inches on top, with the letters "U. S. L. H. E." cut in the upper surface. It is one of the boundary stones between the Brant Point Lighthouse Reservation on the tip of the point and the first cottage to the westward on the south side of the point. It is on the fence line dividing the two properties and is from 6 to 8 feet southward of a gate in the fence. Elevation: 8.29 feet above mean low water; 6.74 feet above half tide level.

The elevations of tide planes at Nantucket referred to mean low water are as follows:

	Feet
Highest tide -----	5.50
Mean high water -----	3.10
Half tide level -----	1.55
Mean low water -----	0.00
Lowest tide -----	-2.50

GREAT POINT, NANTUCKET ISLAND

The elevation of the following bench mark is based on 103 high waters and 100 low waters observed during the periods August 16 to October 21, 1890, and July 20 to August 30, 1901.

Bench mark 1 (1890), *Great Point*, is a horizontal line cut in the masonry on the east side of the lighthouse on Great Point. It is about 2 feet above the ground embanked against the tower and is marked $\frac{\text{"(USCS)."}}{1890}$ Elevation: 12.87 feet above mean low water; 11.31 feet above half tide level.

The elevations of tide planes at Great Point referred to mean low water are as follows:

	Feet
Highest tide.....	5.50
Mean high water.....	3.12
Half tide level.....	1.56
Mean low water.....	0.00
Lowest tide.....	-2.50

WAUWINET, NANTUCKET ISLAND

The elevation of the following bench mark is based on 108 high waters and 109 low waters observed during the period July 18 to September 20, 1890.

Bench mark 1 (1890), *Wauwinet*, is the center of a granite post marking Δ station Squam Head (2). The post projects about 8 inches above the ground and has a round hole drilled in the center. It is on a small hill about 1.310 feet south of Wauwinet Hotel. Elevation: 44.00 feet above mean low water; 42.34 feet above half tide level.

The elevations of tide planes at Wauwinet referred to mean low water are as follows:

	Feet
Highest tide.....	6.00
Mean high water.....	3.32
Half tide level.....	1.66
Mean low water.....	0.00
Lowest tide.....	-2.50

SIASCONSET, NANTUCKET ISLAND

The elevation of the following bench mark is based on 66 high waters and 65 low waters observed during the period August 6 to October 23, 1854, at Siasconset and by spirit-level connection with half tide level at Nantucket.

Bench mark 1 (1854), *Siasconset*, is a 2-inch square cavity cut $\frac{3}{4}$ inch deep, surrounded by a 6-inch circle cut in a rock near highest point. On west side of the rock are cut the letters "C. S." The point of reference is at the bottom of the cavity. The rock is situated 400 feet from edge of the bank in corner of field belonging to Seth Mitchell. This field is on the south side of the public street and directly west of "Great Gutch." Sankaty Head Light bears directly north from the rock. This is the largest rock in the village and measures 5 feet north and south by 4 feet east and west and is 3 feet high. In July, 1910, the bench mark was found in good order, and the rock was in an inclosure near the northwest corner of the Ocean View Hotel and opposite the tennis grounds east of the Casino. Elevation: 38.09 feet above mean low water; 37.47 feet above half tide level.

The elevations of tide planes at Siasconset referred to mean low water are as follows:

	Feet
Highest tide.....	5.00
Mean high water.....	1.24
Half tide level.....	0.62
Mean low water.....	0.00
Lowest tide.....	-2.50

TUCKERNUCK ISLAND

The elevation of the following bench mark is based on 66 high waters and 65 low waters observed during the period August 9 to October 9, 1889.

Bench mark (1889), *Tuckernuck Island*, is the highest point of sand-colored, elliptical-shaped stone nearly embedded in the sand on the beach at about high-water mark on the northern shore of the island near the northwest end of

East Pond. The letters "C. S." are marked on the top of the stone. Elevation: 3.80 feet above mean low water; 2.48 feet above half tide level.

The elevations of tide planes at Tuckerneck Island referred to mean low water are as follows:

	Feet
Highest tide.....	5.60
Mean high water.....	2.64
Half tide level.....	1.32
Mean low water.....	0.00
Lowest tide.....	-2.50

EDGARTOWN, MARTHAS VINEYARD

The elevations of the following bench marks are based on 33 high waters and 30 low waters observed during the period August 24 to September 26, 1891, reduced to mean values by comparison with simultaneous observations at Bristol, R. I.; 22 high waters and 22 low waters observed during the period June 7 to June 21, 1901, reduced to mean values by comparison with simultaneous observations at Fort Hamilton, N. Y.; and 17 high waters and 16 low waters observed during the period September 24 to October 3, 1928, reduced to mean values by comparison with simultaneous observations at Fort Hamilton, N. Y. A direct mean of the three series was taken.

Bench mark 5 (1891), *Edgartown*, is the surface inclosed by a 2-inch circle cut into the top face of the stone forming the north corner of the foundation of the Edgartown Lighthouse. Elevation: 6.89 feet above mean low water; 5.89 feet above half tide level.

Bench mark 6 (1928), *Edgartown*, is a Coast and Geodetic Survey standard disk, stamped "6/1928," in the foundation of the Edgartown National Bank, formerly Marthas Vineyard Bank. It is set in a drill hole about 1 foot from the level of the sidewalk, in the lower granite block near the northeast corner. Elevation: 12.68 feet above mean low water; 11.68 feet above half tide level.

Bench mark 7 (1928), *Edgartown*, is a Coast and Geodetic Survey standard disk, stamped "7/1928," set in a drill hole flush with the surface of the top of the wall. It is in the northeast corner of Doctor North's concrete sea wall close to the border of the Studley House grounds. Elevation: 4.70 feet above mean low water; 3.70 feet above half tide level.

Bench mark 8 (1928), *Edgartown*, is a Coast and Geodetic Survey standard disk, stamped "8/1928," at the southwest inner corner of the New York, New Haven & Hartford steamboat wharf, 10 feet from the outer edge of wharf and 140 feet from the southeast corner dolphin. It was set in the top of a granite block about 4 feet long and 3½ feet wide, which is the third granite block from the wood-decked portion of the dock on the south side. Elevation: 5.14 feet above mean low water; 4.14 feet above half tide level.

The elevations of tide planes at Edgartown referred to mean low water are as follows:

	Feet
Highest tide.....	4.50
Mean high water.....	2.00
Half tide level.....	1.00
Mean low water.....	0.00
Lowest tide.....	-2.50

OAK BLUFFS, MARTHAS VINEYARD

The elevations of the following bench marks are based on 18 high waters and 17 low waters observed during the period October 3 to October 12, 1928, reduced to mean values by comparison with simultaneous observations at Fort Hamilton, N. Y.

Bench mark 1 (1928), *Oak Bluffs*, is a Coast and Geodetic Survey standard disk, stamped "1/1928," set in a standard drill hole on the top of an outcropping rock in Ocean View Park, near the south curb of Amoskeag Avenue, between Ocean and Sea View Avenues. The rock is 3 feet from the curb of Amoskeag Avenue, 40 feet from Ocean Avenue, and 11.2 feet from Sea View Avenue. Elevation: 15.90 feet above mean low water; 14.90 feet above half tide level.

Bench mark 2 (1928), *Oak Bluffs*, is a Coast and Geodetic Survey standard disk, stamped "2/1928," set in a drill hole on the top of the concrete sea wall 44 feet south of the concrete wall forming the south inshore end of the steamboat wharf. The mark is approximately 14 feet from high-water line and 20 feet from Sea View Avenue curb. Near the mark the sidewalk, or promenade,

of Sea-View Avenue is elevated about 7 feet above the lower concrete sea wall in which the mark is placed. Elevation: 10.07 feet above mean low water; 9.07 feet above half tide level.

Bench mark 3 (1928), *Oak Bluffs*, is a Coast and Geodetic Survey standard disk, stamped "3/1928," located on the concrete sea wall extending northward from the steamboat wharf to the south jetty of the entrance to Lake Anthony. The mark is about 150 feet south of the south jetty and 100 feet east of the curve of Circuit and Sea View Avenues. There is a break in the elevation of the top of the wall about 2 feet north of the mark. Elevation: 10.11 feet above mean low water; 9.11 feet above half tide level.

The elevations of tide planes at Oak Bluffs referred to mean low water are as follows:

	Feet
Highest tide -----	4.50
Mean high water -----	2.00
Half tide level -----	1.00
Mean low water -----	0.00
Lowest tide -----	-2.50

NO MANS LAND, SOUTHWEST OF MARTHAS VINEYARD

The elevation of the following bench mark is based on 128 high waters and 125 low waters observed during the periods July 6 to October 27, 1888, and July 16 to October 19, 1889.

Bench mark 1 (1857), *No Mans Land*, is the bottom of a hole $\frac{1}{4}$ inch square and 1 inch deep, cut in the top of a large boulder about 50 feet from ordinary high-water line off the north shore of the island. The boulder is partly buried in the stony and clayey bottom. The lower part of the boulder is about 10 feet in diameter north and south and 8 feet east and west. The letters "C. S." are cut near the bench mark. In 1887 the boulder was said to be under wharf. Elevation: 1.16 feet above mean low water; 0.44 feet *below* half tide level.

The elevations of tide planes at No Mans Land referred to mean low water are as follows:

	Feet
Highest tide -----	5.50
Mean high water -----	3.20
Half tide level -----	1.60
Mean low water -----	0.00
Lowest tide -----	-2.50

GAY HEAD (MENEMSHA BIGHT), MARTHAS VINEYARD

The elevations of the following bench marks are based on 166 high waters and 176 low waters observed during the periods August 8 to October 6, 1855, and July 13 to October 4, 1887.

Bench mark 1 (1855), *Gay Head*, is the lower edge of three sides of a square within a circle cut in the face on north side of a large boulder, or solitary rock, about 45 feet in circumference, standing about 6 feet above the ground and 567 feet west of the tide gauge. The gauge was located on a small wharf in Menemsha Bight to the eastward of the entrance to Menemsha Pond. Gay Head Light bears exactly west from the rock. Elevation: 13.97 feet above mean low water; 12.46 feet above half tide level.

Bench mark 3 (1888), *Gay Head*, is upon a shoulder of an irregular pyramidal-shaped granite boulder lying upon a ridge in a valley about 380 feet westerly from the land end of the Old Colony Railroad Steamboat Co. wharf. This boulder can be seen from the Windsor Hotel in a northwesterly direction about 300 feet distant. Elevation: 69.84 feet above mean low water; 68.33 feet above half tide level.

Bench mark 4 (1888), *Gay Head*, is the highest point of a large granite boulder near the northwest curve of the beach, with its base below low-water mark. It is a conspicuous object from the wharf at Gay Head, from the head of which it bears about due west (true) and is about 780 feet distant. It is the "Wash" triangulation station and is the northwest rock on Gay Head Beach. Elevation: 14.07 feet above mean low water; 12.56 feet above half tide level.

Bench mark 5 (1888), *Gay Head*, is the highest point of a large granite boulder at high-water line near the southwest curve of the beach at Gay Head and is a marked object seen from any part of the cliff north of the lighthouse. It is about 1.100 feet west by south from the lighthouse. Elevation: 16.32 feet above mean low water; 14.81 feet above half tide level.

Bench mark 6 (1888), Gay Head, is the center of a small square granite block marking the northwest corner of the Gay Head Lighthouse grounds. It is about 230 feet northwesterly from the lighthouse. Elevation: 137.48 feet above mean low water; 135.97 feet above half tide level.

Bench mark 7 (1888), Gay Head, is on granite circular base of the tower of Gay Head Lighthouse, directly beneath the north window. Elevation: 134.06 feet above mean low water; 132.55 feet above half tide level.

The elevations of tide planes at Gay Head referred to mean low water are as follows:

	Feet
Highest tide -----	5.50
Mean high water -----	3.02
Half tide level -----	1.51
Mean low water -----	0.00
Lowest tide -----	-2.50

CEDAR TREE NECK, MARTHAS VINEYARD

The elevation of the following bench mark is based on 20 high waters and 25 low waters observed during the period September 12 to October 8, 1887:

Bench mark 2 (1887), Cedar Tree Neck, is a cross cut in the southeast face of a rock at the northeast end of water fence extending from pond to Vineyard Sound at Cedar Tree Neck. Elevation: 2.78 feet above mean low water; 1.62 feet above half tide level.

The elevations of tide planes at Cedar Tree Neck referred to mean low water are as follows:

	Feet
Highest tide -----	5.00
Mean high water -----	2.32
Half tide level -----	1.16
Mean low water -----	0.00
Lowest tide -----	-2.50

WEST CHOP LIGHT, MARTHAS VINEYARD

The elevation of the following bench mark is based on 58 high waters and 53 low waters observed during the period August 9 to November 9, 1887:

Bench mark 2 (1887) is the top of the southeast corner of the brick foundation of the Elijah Cleveland house southeasterly from the lighthouse. Elevation: 12.24 feet above mean low water; 11.44 feet above half tide level.

The elevations of tide planes at West Chop Light referred to mean low water are as follows:

	Feet
Highest tide -----	4.50
Mean high water -----	1.60
Half tide level -----	0.80
Mean low water -----	0.00
Lowest tide -----	-2.50

COTTAGE CITY, MARTHAS VINEYARD

The elevation of the following bench mark is based on 11 high waters and 14 low waters observed during the period October 12 to November 4, 1887:

Bench mark 1 (1887), Cottage City, is the highest point of a large boulder at the low-water line about 60 meters northwest from the boat landing and is covered at high water. There is another boulder due west from the bench mark, near the sea wall and above high-water mark. Elevation: 2.09 feet above mean low water; 1.12 feet above half tide level.

The elevations of tide planes at Cottage City referred to mean low water are as follows:

	Feet
Highest tide -----	4.50
Mean high water -----	1.94
Half tide level -----	0.97
Mean low water -----	0.00
Lowest tide -----	-2.50

FALMOUTH, VINEYARD SOUND

The elevation of the following bench mark is based on 126 high waters and 126 low waters observed during the period June 4 to August 7, 1888:

Bench mark 3 (1888), Falmouth, is a cross within a circle on the large inside granite rock of foundation of stone wharf of boathouse at the northeast corner

of the boathouse. The horizontal line of the cross is the reference mark. Elevation; 3.71 feet above mean low water; 3.05 feet above half tide level.

The elevations of tide planes at Falmouth referred to mean low water are as follows:

	Feet
Highest tide -----	4.00
Mean high water -----	1.32
Half tide level -----	0.69
Mean low water -----	0.00
Lowest tide -----	-2.50

NOBSKA POINT, VINEYARD SOUND

The elevations of the following bench marks are based on 152 high waters and 153 low waters observed during the periods July 24 to August 28, 1852; August 19 to September 30, 1854; September 13 to October 6, 1887, at Nobska Point, and August 17 to October 27, 1887, at United States Fish Commission Wharf, Woods Hole, referred to Nobska Point by spirit levels:

Bench mark 1 (1852), Nobska Point, is the top of a large pointed rock at end of stone wall about 1,800 feet northwest of Nobska Point, close to high-water mark. The letter "M" is cut in the summit. Elevation: 9.63 feet above mean low water; 8.86 feet above half tide level.

Bench mark 9 (1913), Nobska Point, is the center of a circle cut on the top of largest granite boulder in a cluster of boulders just above the high-water mark. The boulder is about 400 feet west-southwest of Nobska Light. Elevation: 10.01 feet above mean low water; 9.24 feet above half tide level.

The elevations of tide planes at Nobska Point referred to mean low water are as follows:

	Feet
Highest tide -----	4.00
Mean high water -----	1.54
Half tide level -----	0.77
Mean low water -----	0.00
Lowest tide -----	-2.00

WOODS HOLE, UNITED STATES FISH COMMISSION WHARF

The elevations of the following bench marks are based on 152 high waters and 153 low waters observed during the periods July 24 to August 28, 1852; August 19 to September 30, 1854; September 13 to October 6, 1887, at Nobska Point, referred to Woods Hole by spirit levels, and August 17 to October 27, 1887, at United States Fish Commission Wharf, Woods Hole.

Bench mark 4 (1887), Woods Hole, is the horizontal line between the letters "C—S," cut on the southwest corner granite capstone on the outer end of the United States Fish Commission Wharf. In 1913 it was reported to be on the south face at end of east pier, well under plank wharf. Elevation: 3.63 feet above mean low water; 2.75 feet above half tide level.

Bench mark 5 (1913), Woods Hole, is a copper bolt with cross set in granite foundation of the United States Bureau of Fisheries office building, about 6 feet from the northeast corner. The bolt is about 6 inches from the west wall and about 3 feet above the ground. Elevation: 10.76 feet above mean low water; 9.88 feet above half tide level.

Bench mark 6 (1913), Woods Hole, is the central horizontal line in a bronze tablet on north side of Professor Baird's monumental rock northeast of the United States Fish Commission eastern building. Elevation: 12.26 feet above mean low water; 11.38 feet above half tide level.

Bench mark 7 (1913), Woods Hole, is a Coast and Geodetic Survey standard disk set in the west side of granite foot sill on west side of front entrance steps of the Marine Biological Laboratory, a red brick building set on about 500 piles and located about 200 feet east of the United States Fish Commission property. Elevation: 13.00 feet above mean low water; 12.12 feet above half tide level.

Bench mark 8 (1913), Woods Hole, is the horizontal line of a cross cut in granite block on south side of Crane's Wharf on east side of Parker Neck and is just below a drill hole. Elevation: 5.46 feet above mean low water; 4.58 feet above half tide level.

The elevations of tide planes at Woods Hole referred to mean low water are as follows:

	Feet
Highest tide -----	4.00
Mean high water -----	1.76
Half tide level -----	0.88
Mean low water -----	0.00
Lowest tide -----	-2.00

TARPAULIN COVE, NAUSHON ISLAND, VINEYARD SOUND

The elevation of the following bench mark is based on 56 high waters and 54 low waters observed during the period August 1 to October 8, 1887.

Bench mark 1 (1887), *Tarpaulin Cove*, is a cross cut on the east face of a granite boulder about 4 feet in length and breadth and standing about 4 feet above the ground, located on the beach southeast from boathouse. Elevation: 6.90 feet above mean low water; 5.73 feet above half tide level.

The elevations of tide planes at Tarpaulin Cove referred to mean low water are as follows:

	Feet
Highest tide -----	5.00
Mean high water -----	2.34
Half tide level -----	1.17
Mean low water -----	0.00
Lowest tide -----	-2.50

ROBINSONS HOLE, PASQUE ISLAND

The elevation of the following bench mark is based on 56 high waters and 57 low waters observed during the period September 13 to October 15, 1901, reduced to mean values by comparison with simultaneous observations at Fort Hamilton, N. Y., where the datum is based on 30 years of observations.

Bench mark 1 (1901), *Robinsons Hole*, is a triangle cut into the top surface at the southeast corner of the large flat rock used as a landing place at the point where the wharf meets the shore line on the eastern end of the island: Elevation: 7.40 feet above mean low water; 5.75 feet above half tide level.

The elevations of tide planes at Robinsons Hole referred to mean low water are as follows:

	Feet
Highest tide -----	6.00
Mean high water -----	3.30
Half tide level -----	1.65
Mean low water -----	0.00
Lowest tide -----	-2.50

PENIKESE ISLAND, BUZZARDS BAY

The elevation of the following bench mark is based on 12 high waters and 11 low waters observed during the period September 6 to 12, 1878, reduced to mean values by comparison with simultaneous observations at Clark Point, Buzzards Bay, where the datum is based on 482 high waters and 485 low waters.

Bench mark 1 (1878), *Penikese Island*, is a triangle cut in a granite rock a little to the south of the line of the southern edge of the wharf of the Agassiz School. In 1896 the top of the rock was reported to be even with the ground and 6 or 8 feet above the level of the wharf. Elevation: 12.52 feet above mean low water; 10.72 feet above half tide level.

The elevations of tide planes at Penikese Island referred to mean low water are as follows:

	Feet
Highest tide -----	6.00
Mean high water -----	3.60
Half tide level -----	1.80
Mean low water -----	0.00
Lowest tide -----	-2.50

WEST FALMOUTH, HOG ISLAND HARBOR, BUZZARDS BAY

The elevation of the following bench mark is based on 10 high waters and 9 low waters observed during the period September 6 to 11, 1878, reduced to mean values by comparison with simultaneous observations at Clark Point, Buzzards Bay, where the datum is based on 482 high waters and 485 low waters.

Bench mark 1 (1878), *West Falmouth*, is a triangle cut in a granite rock under the corner of the stone fence, about 230 feet east of wharf, 312 feet from the rail-

road track, and 79 feet from the nearest division fence. Elevation: 10.81 feet above mean low water; 8.76 feet above half-tide level.

The elevation of tide planes at West Falmouth referred to mean low water are as follows:

	Feet
Highest tide.....	6.50
Mean high water.....	4.10
Half tide level.....	2.05
Mean low water.....	0.00
Lowest tide.....	-2.50

BACK RIVER HARBOR

The elevations of the following bench marks are based on 115 high waters and 114 low waters observed during the period September 6 to November 5, 1878:

Bench mark 1 (1860), *Back River Harbor*, is the space within a circle on the top of a large boulder situated 309 feet eastward of tide gauge of 1860, which was located in front of Mr. Cahoon's house. The boulder is covered at extreme high water. Elevation: 4.26 feet above mean low water; 2.18 feet above half tide level.

Bench mark 2 (1912), *Back River Harbor*, is the center of a ½-inch hole, drilled horizontally ½ inch deep in a rock in the southeast corner of spring house, which is about 30 feet west of Cahoon's house. The hole is at the intersection of a horizontal and vertical line drilled in the rock. The hole is 3 inches from the ground and 9½ inches from the corner of the spring house. Elevation: 18.04 feet above mean low water; 15.96 feet above half tide level.

Bench mark 3 (1912), *Back River Harbor*, is the highest point of concrete on the southeast corner of shore end of pier of Parkinson's Wharf. Elevation: 8.92 feet above mean low water; 6.84 feet above half tide level.

The elevations of tide planes at Back River Harbor referred to mean low water are as follows:

	Feet
Highest tide.....	6.50
Mean high water.....	4.16
Half tide level.....	2.08
Mean low water.....	0.00
Lowest tide.....	-2.50

MARION, SIPPICAN HARBOR

The elevations of the following bench marks are based on 29 high waters and 33 low waters observed during the period September 30 to November 20, 1912.

Bench mark 3 (1912), *Marion*, is a piece of ¾-inch brass shafting cemented in a hole drilled in a rock and projects 1½ inches above the top of the rock. The rock is 60 feet south of Long Wharf and 42 feet east of shore line. To the southeast is another rock, flatter and somewhat lower, in the corner of which is a ringbolt 19 feet from bench mark, and in the center a drill hole ½ inch in diameter and 2 inches deep, which is 16 feet from the bench mark. Both rocks are under water at high tide. Elevation: 3.57 feet above mean low water; 1.49 feet above half tide level.

Bench mark 4 (1912), *Marion*, is the top of a bolt placed horizontally in a rock on south side of Long Wharf and is 112 feet from outer end of wharf. The bolt (or spike) is surrounded by a 5-inch drilled circle, and 9 inches west of it there is a similar spike, except that its head is not chipped on upper side as bench mark is. The bench mark is 20 feet below top of wharf. Elevation: 5.78 feet above mean low water; 3.70 feet above half tide level.

Bench mark 5 (1912), *Marion*, is a Coast and Geodetic Survey standard disk inserted in vertical face of rock on the north side of Long Wharf, 12 feet from the top and 116 feet from the outer end of wharf. Elevation: 5.84 feet above mean low water; 3.76 feet above half tide level.

Bench mark 6 (1912), *Marion*, is the center of a ½-inch hole drilled 1 inch deep at the intersection of horizontal and vertical lines. The hole is in the vertical face of a rock on the outer end of Town Wharf, 17 feet from the south side and 32 feet from the north side of wharf. Elevation: 7.44 feet above mean low water; 5.36 feet above half tide level.

The elevations of tide planes at Marion referred to mean low water are as follows:

	Feet
Highest tide -----	6.50
Mean high water -----	4.16
Half tide level -----	2.08
Mean low water -----	0.00
Lowest tide -----	-2.50

MATTAPOISETT, BUZZARDS BAY

The elevations of the following bench marks are based on 14 high waters and 13 low waters observed during the periods September 6 to 11, 1878, and June 27 to 30, 1910, reduced to mean values by comparison with simultaneous observations at Clark Point, Buzzards Bay, where the datum is based on 482 high waters and 485 low waters.

Bench mark 1 (1878), Mattapoisett, is marked by a triangle cut on a stone at the southeast corner of the sail loft, which is the first house north of the wharf. In 1913 the triangle was recovered on top of a flat stone 1 foot northeast of the southeast corner of the present foundation, but very indistinct. Elevation: 8.20 feet above mean low water; 6.13 feet above half tide level.

Bench mark 3 (1910), Mattapoisett, is the top of a boundary stone set in the road in the south prolongation of the west side of sail loft and Griffins store. The top of the stone is 6 inches square and has a drill hole in the center. It is slightly below the surface of the road. Elevation: 7.10 feet above mean low water; 5.03 feet above half tide level.

Bench mark 4 (1910), Mattapoisett, is the bottom of hole $2\frac{1}{4}$ inches square and about $\frac{3}{4}$ inch deep in the center of the top of a cement block 8 inches square and 22 inches long. The letters "U. S. B. M." are cut in the block, which projects about 2 inches above the surface of the ground. It is 49 feet from the southeast corner of the sail loft, 54 feet from the southwest corner of the sail loft, 24 feet from fish house, and 117 feet from northwest corner of wharf and shore wall. Elevation: 6.88 feet above mean low water; 4.81 feet above half tide level.

The elevations of tide planes at Mattapoisett referred to mean low water are as follows:

	Feet
Highest tide -----	6.50
Mean high water -----	4.14
Half tide level -----	2.07
Mean low water -----	0.00
Lowest tide -----	-2.50

CLARK POINT, BUZZARDS BAY

The elevations of the following bench marks are based on 482 high waters and 485 low waters observed during the periods August 19 to December 2, 1878; May 27 to December 16, 1895; April 9 to December 7, 1896; and July 12 to October 22, 1897.

Bench mark 1 (1878), Clark Point, is the lower edge of first seam in the stone front of Fort Rodman under the lower tier of embrasures on its southwest face, below the center of lower south gun port. It is marked by "B. M." painted on wall and black line below the bench mark. Elevation: 10.65 feet above mean low water; 8.72 feet above half tide level.

Bench mark 4 (U. S. Army Engineers), Clark Point, is a copper bolt set vertically in the south wall of Fort Rodman wharf, about 300 feet east of shore end. Elevation: 7.97 feet above mean low water; 6.04 feet above half tide level.

Bench mark 5 (1913), Clark Point, is the top of $\frac{5}{8}$ -inch copper bolt set in wall south of bench mark 1 and abreast of it. Elevation: 10.62 feet above mean low water; 8.69 feet above half tide level.

The elevations of tide planes at Clark Point referred to mean low water are as follows:

	Feet
Highest tide -----	6.50
Mean high water -----	3.86
Half tide level -----	1.93
Mean low water -----	0.00
Lowest tide -----	-2.50

NEW BEDFORD, BUZZARDS BAY

The following bench marks are referred to the half tide level at Clark Point by spirit-leveling connections in 1913; the references to mean low water

are based upon the relations established through several short series of observations in New Bedford Harbor.

Bench mark 6 (1895), *New Bedford*, is the center of a cross with two holes cut in the side of the stone coal wharf at the foot of Wamsutta Street, 4¼ feet below top and about two-thirds of the length of the slip toward the outer end of wharf. Elevation: 3.60 feet above mean low water; 1.60 feet above half tide level.

Bench mark 8 (1913), *New Bedford*, is a Coast and Geodetic Survey standard disk set in the foundation of the stone building at the corner of Wamsutta and Front Streets. The mark is on the east face of the mill, 4 feet north of the southeast corner and 3 feet above the ground. Elevation: 11.58 feet above mean low water; 9.58 feet above half tide level.

Bench mark 9 (1913), *New Bedford*, is a drill hole about ¼ inch deep on the highest projection of the northeast corner of foundation of brick storehouse on the south side of Wamsutta Street about midway between Acushnet Avenue and the coal dock. Elevation: 9.98 feet above mean low water; 7.98 above half tide level.

The elevations of tide planes at New Bedford referred to mean low water are as follows:

	Feet
Highest tide	6.50
Mean high water	4.00
Half tide level	2.00
Mean low water	0.00
Lowest tide	-2.50

NONQUITT, BUZZARDS BAY

The elevation of the following bench mark is based on 7 high waters and 6 low waters observed during the period August 14 to August 17, 1895, reduced to mean values by comparison with simultaneous observations at Clark Point, Buzzards Bay, where the datum is based on 482 high waters and 485 low waters.

Bench mark 2 (1895), *Nonquitt*, is the center of a cross cut on a shelving ledge of rock just north of where the wharf reaches the shore. Elevation: 5.19 feet above mean low water; 3.29 feet above half tide level.

The elevations of tide planes at Nonquitt referred to mean low water are as follows:

	Feet
Highest tide	6.50
Mean high water	3.80
Half tide level	1.90
Mean low water	0.00
Lowest tide	-2.50

WESTPORT HARBOR, BUZZARDS BAY

The elevations of the following bench marks are based on 53 high waters and 59 low waters observed during the period June 19 to September 28, 1914:

Bench mark 1 (1914), *Westport Harbor*, is a Coast and Geodetic Survey standard disk set with cement in granite ledge on Charlton's Wharf, 30.3 feet from southwest corner of shed on wharf, 39.2 feet from end of concrete wall at southern end of wharf. Elevation: 6.45 feet above mean low water; 4.90 feet above half tide level.

Bench mark 2 (1914), *Westport Harbor*, is a Coast and Geodetic Survey standard disk set with cement in the granite fence which marks the eastern boundary of the Charlton property. The fence stands about 4 feet high, and the bench mark was placed in the outside vertical face about 2 feet from the ground. It is 283.6 feet from corner of granite fence and 42.0 feet from well which lies on line at right angles to fence from the bench mark. Elevation: 7.79 feet above mean low water; 6.24 feet above half tide level.

Bench mark 3 (1914), *Westport Harbor*, is a Coast and Geodetic Survey standard disk set with cement in granite boulder about 5 feet in diameter. At extreme high tides the water just touches the boulder, which stands about 1 foot above the sand. It is 92.5 feet from corner of granite fence and 13.5 feet from southwest corner of boathouse. Elevation: 4.79 feet above mean low water; 3.24 feet above half tide level.

The elevations of tide planes at Westport Harbor referred to mean low water are as follows:

	Feet
Highest tide	5.50
Mean high water.....	3.10
Half tide level.....	1.55
Mean low water.....	0.00
Lowest tide.....	-2.50

FALL RIVER

The elevations of the following bench marks are based on eight high waters and eight low waters observed during the period September 8 to October 15, 1861, reduced to mean values by comparison with simultaneous observations at Boston Navy Yard, where the datum is based on 40 years of observations:

Bench mark 1 (1861), *Fall River*, is the horizontal bar of the letter "H" cut into a stone on the western side of the American Print Works, about 1 foot from the ground and 3 feet from the northern corner. Elevation: 8.47 feet above mean low water; 6.27 feet above half tide level.

Bench mark 2 (1861), *Fall River*, is the end of a screw bolt or rod projecting from an iron plate on the western side of the American Print Works, about 6 feet above the ground and 0.8 foot from the northern corner of the building. The screw bolt on rod is used for holding the building together, the walls being of stone rubblework. Elevation: 13.81 feet above mean low water; 11.61 feet above half tide level.

The elevations of tide planes at Fall River referred to mean low water are as follows:

	Feet
Highest tide	7.50
Mean high water.....	4.40
Half tide level.....	2.20
Mean low water.....	0.00
Lowest tide.....	-3.00

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