

ART. VIII.—THE TIDES OF THE BAY OF FUNDY.—By M. MURPHY, C. E., *Provincial Government Engineer.*  
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AMONG the manifold phenomena coming daily within the range of our observations, there are but few more remarkable than the tides which break upon our shores.

In Nova Scotia we can have, really and truly, a general conception of their relative bigness. If we leave Bay Verte, in the Straits of Northumberland, proceed through the Strait of Canseau, follow the Atlantic shore to Cape Sable, and the Bay of Fundy to the head of Chiegnecto Bay, we might, with a well-appointed steam yacht, encompass our coast line, and complete within 20 miles of an entire circuit, inside the short space of 40 hours.

Within that circumscribed limit we would encounter, and might observe, many relative phases of tidal oscillation. Our departure is from a place where the flood tide cannot reach without losing in volume and in force, because of its shelter and remoteness. Our course is through the Strait of Canseau, where prevalent winds arrest the regular tidal flows, and press it forward through a long and narrow channel at irregular times and in fitful directions. Along the Atlantic they are, owing to a more conformable coast line, more normal and periodic, whilst in the Bay of Fundy they are augmented and turbulent. Yet they are all the result of the same tidal wave, which, rising in seas far south, rolls through the Atlantic, and in twelve hours, after passing the parallel of Cape Horn, is found pouring its flood along our shores. During the new and full moon the tides in Northumberland Strait rise from five to six feet; in the Strait of Canseau about five feet; along the Atlantic, from Canseau to Shelburne, six to seven feet. From Cape Sable to Briar Island they are influenced by the Bay of Fundy tides, rising at Briar Island to the height of twenty and one-half feet; and increase

as you ascend the bay, until at Chiegnecto they attain the height of fifty feet.

We can walk over the sands or mud flats of the Bay of Fundy, now dry, but in a few hours after comes a rushing torrent, a few hours more and the largest ship afloat could sail over the same ground which we occupied six hours ago. Again the same body of water is drawn back impulsively to again swing forward, and thus maintain its vibrating, rocking motion

To one unaccustomed to the approach of the great waves that daily inundate the bays and basins at the head of the Bay of Fundy, and pour their waters over the adjacent marshes and flats, their first observance is strikingly impressive. I had frequently observed rapid currents rush upwards against streams from the tides of the English Channel, and considered my experience justified a passive recognition of what I might expect from the phenomenal *bore* of this bay; but no,—my conceptions were very vague with regard to their relative magnitude and characteristics. Generally during spring tides, at the periods of the vernal and autumnal equinoxes, the greatest intensity being in the autumn season, attain their utmost pitch.

My first experience in Nova Scotia occurred near the mouth of the Maccan River, a small stream, emptying into Cumberland Basin. I was engaged at the time of low tide examining the foundations of the pier of a bridge, and owing to a bend in the river further down, did not notice its advent, although heralded by a desultory murmur as if proceeding from a distant waterfall. My more experienced companion gave the alarm, and led the way in doing so. To seek higher and drier ground was, of necessity, the work of the next two or three minutes; the water followed close on my heels until I got well up, and before I could pause, look back and take in the aspect. The bore had then passed on, upwards, leaving a veritable newly evolved stream of about fifteen feet deep, following more placidly in its wake; and all this within five minutes. The flood kept still rising, but without further indication of disturbance, until the set of the ebb tide about two hours afterwards. The Maccan is here narrow and shoal, and may be said to be favorable to the rapid growth of the ogre or

bore. Further down the river widens and receives easily the tidal wave from Cumberland Basin. As it ascends the stream it becomes more confined and crowded, until, from its own gravity, it rushes swiftly forward—hence the phenomenon we have witnessed.

Out in the Bays of Chiegnecto and Cobequid these flood tides exhibit different forms and phases, varying with the variable contour of the shore. At low tide spurs indicating shallow channels, estuaries and creeks, are conspicuous, with miles in extent of dry flats and marshes, looking as if the sea had altogether retired. Presently, however, the returning flood tide appears in the distance, tumbling and rolling with white breakers abreast. It rushes swiftly forward and digs deep into the red, soft mud, that but momentarily obstructs its advance. It frequently resembles the rapids of a great river, stretching across for miles, with alternating patches less turbulent, where in its path it meets with less resistance. Thus this tremulous tidal oscillation, with breakers tumbling from and over its crest threatening to overwhelm and engulf everything that impedes its progress, moves bodily onward until it reaches the heads of Shepody, Cumberland and Cobequid Bays. The mud flats are soon covered, and the creeks, estuaries and basins are full to the brim,—the *fiat* has been given, "Hitherto shalt thou come, but no further." Immediately the retreat commences, and the waters retire almost as rapidly as they came.

The flood tide carries with it the silt and mud, and deposits its load chiefly in the creeks and on the flats at the head of the bays. As I had a good opportunity of ascertaining the extent of this deposit, and although it is a digression from the subject of this Paper, it may be worth placing on record here. The old wooden bridge that crossed the Avon River at Windsor is being replaced by an iron bridge. The substructure consists of five pairs of steel cylinders, each tube having an internal diameter of five feet, and are secured to the limestone rock on which they rest. The bottom sections of these tubes stood, when placed in position, from three to six feet above the level of low tides, and were filled with concrete to a height of two feet,

above low water. One pair remained thus from the 19th of August until the 19th of December last (1887), just 122 days, when it became necessary to remove the mud or silt that had accumulated or was deposited by the tide within that time, so as to continue the concrete upwards; as the next succeeding section of tube required filling. There was within each tube a depth of 30 inches of fine sand and mud of the same consistency, or just as compact, as the ordinary deposits on the flats at low tide, a short distance down stream from the bridge. Allowing two tides for each 24 hours there would be deposits during each flood tide to a depth of decimal .012 of an inch. The Avon bridge is 10 miles up the river from Mines Basin, there would therefore be a more rapid deposition of the coarser sediments further down. The waves, acting with violence above the level of low tides abrade every cliff and bank within their reach. Exposed sandstone strata here so frequent, and beds of gravel and earth so easily removed are eroded, carried with them and deposited over long stretches of the inlets, flats and marshes. The roots of coarse grasses, striking deep into the muddy banks, bind earth, mud and sediment firmly together, whilst their growth upwards protects and retains the deposits. In this way the land-making process goes rapidly on, until the surface is lifted by the hand of nature to be within the reach of practical reclamation by the hand of man. Thus the dykes "that the hands of the farmer raised with labor incessant to shut out the turbulent waters" drain a rich alluvial soil of great natural fertility, capable of yielding for centuries, without the application of manure, abundant crops of grains and grasses; and in this manner over 43,000 acres of marsh land have already been reclaimed within the Province of Nova Scotia.

Man scarcely begins to realize such productions of nature until he considers the practicability of utilizing them. The early settlers were not slow in recognizing the value of these marshes and the feasibility of their acquisition by dyking.

The currents, too, are considered, studied and applied by the mariner, and made to subserve his purpose in bearing him rapidly along with more unerring precision than the no less

phenomenal trade winds. The fisherman also profits by the great height of the tide which, during the flood, comes with its large shoals of such fish as resort to the coast. These remain to feed until the return or ebb tide falls somewhat, and are trapped within wiers of wattles, that are made to run out past their line of retreat. Large quantities of herring, cod and shad thus left dry at low water, are carted to the smoke-houses prepared and packed in small cases and forwarded to the different markets. Smoked cod and herring from Digby, ("Digby Chickens") obtained in this way, form important items of export.

If we look at the bending of the great waves, as shewn by Whewall's chart of co-tidal lines around the continents of Africa and Europe, they seem to trend very like that sort of refraction which takes place on every shelving shore with respect to the common waves, which, whatever may have been their origin become always, as they spread, more and more, nearly parallel to that of the coast which they are approaching.

The tides result from the disturbing influence of the bodies within the Solar System, which cause a constant changing of the position of the ocean in accordance with their changes of position in relation to the surface of the earth; but they are not currents, they are merely undulations or oscillations of the ocean, although where obstructed by coast lines they form currents about the coast.

The ocean currents result from the great cosmical force of gravitation, drawing in all directions *from* the centre of the earth opposing terrestrial gravitation drawing *towards* earth's centre; thus forming a system of circulation within the position in which the ocean is held by gravitation without tending to change that position in relation to the surface of the earth; and these ocean currents would exist, even if the earth were not affected by the bodies of the Solar System, so that currents such as the Gulf Stream have no relation whatever to tidal movements.

The height of the tide is less in mid ocean than along the coast, and is greatly augmented where two coast lines converge. At St. Helena the rise is two or three feet; at the Azores three feet; and on the Atlantic coast of the United States from five

to twelve feet. In the Central Pacific the height is from two to four feet. The tidal wave becomes one of great strength where there are narrow channels to receive and discharge the waters. The movement may have the violence of a river torrent, when the entrance to bays is such as to temporarily dam up the waters, until the far advanced tide has so accumulated that it overcomes the resistance and passes on in a body.

“In some cases the whole tide moves in at once in a few great waves; this happens especially at the mouths of rivers where there is obstruction from sand bars and other favoring circumstances about the entrance. The phenomenon is called an eagre or bore. The most perfect examples are afforded at the mouths of the rivers Amazon, Hoogley, (one of the mouths of the Ganges) and Tsien-tang in China. In case of the last-mentioned river the wave plunges on like an advancing cataract four or five miles in breadth and thirty feet high and thus passes up stream to a distance of 80 miles at a rate of twenty-five miles per hour. The change from ebb to flow, tide is almost instantaneous. Among the Chusan Islands, just south of the bay, the tidal currents run through the funnel-shaped firth with a velocity of sixteen miles an hour. In the eagre of the Amazon the whole tide passes up stream in five or six waves, following one another in rapid succession, and each twelve to fifteen feet high.” *Dynamic Geology, Dana.* At St. Malo, near Cherbourg, France, and at Swansea and Chepstow, in the English Channel, they reach the respective elevations of 36 and 50 feet.

We might proceed with the following assumptions :

1. The tidal wave is a wave of translation moving parallel to the coast which it is approaching. (Dr. Whewell, Admiral Fitzroy.)

2. The tides are undulations or oscillations, and form currents when obstructed by coast lines. (Airy, Jordan, Dana.)

3. The currents of the ocean result from cosmical force of gravitation opposing terrestrial gravitation, and from *vis inertia*, or a crowding of the water in high latitudes. (Airy, Jordan, Enc.-Brit., Maury.)

4. The heights of the tides are less in mid ocean and are greatly augmented where coast lines converge. (Examples from Dana's Dynamic Geology.)

Referring to the chart before us, it will be seen that the co-tidal lines of Whewell follow and keep nearly parallel with the Nova Scotia coast as we would expect (1), and extend in like order along the shore of Massachusetts.

Our Nova Scotia coast extends its dip or slope far out to sea, and receives the advancing tidal roll, lifting it somewhat by the force of its own forward movement along the incline, until it breaks gently on the beach. A little later on, the same advancing volume sends its flood teeming in like manner along the Massachusetts and New England coast. Along Nova Scotia shore to Cape Sable it runs upward to the beach. Along Massachusetts coast it trends and runs in like manner to Cape Cod. Between these points it passes on without retardation or hindrance into the bay. These capes or prominences mark, respectively, the juncture of the flood tides, where partially arrested and in motion, and the commencement of the rips or rotary currents which they generate. (2.) Sailing directions say:—"The ebb stream across Nantucket shoals begins a short time before the tide has ceased to rise by the shore, and runs in a direction a little eastward of south, with no interval of slack water. It then gradually attains its greatest velocity, in a direction between south and west, after which it slackens, altering its direction a little westward of north. This is the commencement of the flood stream which gradually attains its greatest velocity, changing its direction to between north and east, or contrary to that of the ebb stream, after which it slackens and runs to the southward as before, thus completing an entire circuit in the direction of the hands of a watch. The flood and ebb streams are of equal duration, each running about  $6\frac{1}{2}$  hours, their minimum velocity being about one fourth of the maximum."

Now, let us see how the tides disport themselves at the eastern entrance from Cape Sable to Briar Island. "The flood

tide sets from Cape Sable to the north-westward, through the Seal, Mud, Tusket and Bald Islands, at the rate of two or three miles per hour, and in the channels among the islands it increases to four or five miles, thence taking the direction of the mainland it flows past Cape St. Mary, and then N. N. W. to Briar Island."

The times of high water at full and new moon are at Seal Island 9 h. ; Tusket Island, 9.33 ; Yarmouth Sound, 10.9 ; Cape St. Mary's, 10.30 ; and at Briar Island, 10.43.

It takes, then, 1 hour, 43 minutes, for the crest of the flood tide to advance between co-tidal parallels drawn through Seal and Briar Islands, representing a distance of 64 miles, whilst the same tidal wave advances across George's shoal, about the centre of the entrance to the Gulf of Maine, and reaches the shore of the State of Maine, a distance of 150 miles in the same time. The flood passes in freely and swiftly at the centre, crowded and tortuous at the sides.

Capes Cod and Sable are the portals of the flood-gate. Around the Nantucket shoals of the former the tide has a whirling motion, and around or between the latter and Briar Island there is the contest between the water pent up or backed by the shore and the water moving swiftly into the gulf in volume, which takes place at every change of tide, or before either force has gained or lost ascendancy; and here in this gulf we have the principal fountains of the abnormal tides of the Bay of Fundy.

About the centre of the opening to the gulf no unusual tidal oscillation is apparent until we cross an imaginary line drawn from Cape Cod to Cape Sable. No sooner have we advanced over the George's bank, and proceeded about forty or fifty miles northerly, than a remarkably sudden rise of tide presents itself, about four feet in fifty miles. Following the shores of Massachusetts, New Hampshire, and Maine, to Mount Desert, and crossing the bay from thence to Yarmouth, thus completing a circuit around the crescent, which the shore line resembles, we find the time of high water in the Gulf of Maine at full moon and change to be at



Place.		Time— h. min.	Spring— feet.	Neap— feet.
Plymouth	Harbour ..	11.35	10 $\frac{3}{4}$	9
Boston	" ..	11.12	11	9 $\frac{1}{2}$
Salem	" ..	11.13	11	9
Gloucester	" ..	11.02	10	9 $\frac{1}{4}$
Portsmouth	" ..	11.23	9 $\frac{1}{4}$	8 $\frac{3}{4}$
Portland	" ..	11.17	9 $\frac{1}{2}$	9
Bass	" ..	11.02	10	..
Mount Desert Island...		10.52	11	9

And on the Nova Scotia coast:

Cape Sable .....	8.30	8	5 $\frac{3}{4}$
Pubnico.....	9.25	12	10
Tusket Island.....	9.33	13	10
Jebogue.....	10.04	15	11 $\frac{3}{4}$

If we extend these observations further south we will find that the times of the spring tides F. and C., from Chesapeake Bay to Sandy Hook occur from 7.51 to 7.21 local time, and that they rise from 3 $\frac{1}{4}$  at the former to 5 $\frac{1}{2}$  feet at the latter place. From the western extremity of Long Island to Bridgeport the shore trends easterly, and the tidal wave courses along as well as upon it. The times are 10.12 and 11.11 respectively. Springs rise, 9 to 8 feet; neaps, 7 $\frac{3}{4}$  to 6 $\frac{1}{4}$  between these points.

Within the Gulf, as will be seen above, from Plymouth Harbour to Mount Desert it is high water flood tides about the same time. Springs rise from 10 to 11 feet; neaps about 9 feet. We may place this, the American side, as having, say, an abnormal height of from four to five feet. On the other horn of the crescent, from Cape Sable to Chebogue, the times are from 8.30 to 10.04. Springs rise from 8 to 15 feet; neaps, 6 $\frac{3}{4}$  to 11 $\frac{3}{4}$ , so that we have the abnormal height of tides of 7 to 8 feet on this, the Nova Scotia side, piled up before we enter the Bay of Fundy proper; and here we have the fountain, the beginning, of the Bay of Fundy tidal phenomena.

The problem which is suggested by these observations is not so complicated as it may at first seem to be, since a comparison of the effect is so accessible to observation. The great tidal

wave, striking the shore at Cape Cod and Cape Sable, and moving freely inward between these points imparts a whirling movement with a crowded rush around them like the whirl of water at the flood gate, or the piled up rotary ridge in the wake of the screw-propelling steamer. This circling current borne onward marks the advance of the flood tide. If we follow the movement of these accumulations from their sources we find them all converging during influx to the Bay. We quote the following from "Sailing Directions," U. S. East Coast, 1882 (page 4):

"As a general rule, between Nantucket Shoals and Cape Sable the ebb, or southerly stream, runs to the southward during the first  $4\frac{1}{2}$  hours, and the flood, or northerly stream, from the 6th to the 11th hour following the moon's superior and inferior meridian passages. The average velocity of each stream is one knot per hour, being greater in the shallow and less in the deep water. The times of turning of the flood or northerly, and ebb streams, correspond with the times of high and low water respectively at Boston and Portland. Westward of George's bank the stream runs half an hour later, and eastward of the same, half an hour earlier. Between George's bank and Nantucket shoals the flood stream commences at 5h. 37m. after the time of the moon's meridian passage, running for the first  $1\frac{1}{2}$  hours in a N.  $\frac{1}{2}$  W. direction, with a velocity of one knot per hour. For the next 3 hours the direction is N. by W., at the rate of  $1\frac{1}{2}$  knots, and during the last quarter N. by W. 1 knot."

In regard to the British, East Coast, North America, the Sailing Directions say—(p. 63.)

"Take notice that the flood and ebb tides set fairly N. W. and S. E., so that in taking the Tusket Passages you will have the flood in your favor; the ebb, the contrary. Observe also, that in taking, as we have said the more prudent course to the southward of Seal Island, and in setting course to the northward, that, if on the ebb, the tide does not catch you on the port bow, and cause you to bear up to clear the lurcher, and perhaps compel you to take the Grand Passage between

“*Briar Island and Long Island.* into the Bay of Fundy.” And in p. 66: “At the south entrance of St Mary’s Bay the flood “sets N. E. by N. at the rate of 7 knots.”

As in nature everything is repeated when similar conditions occur, we must, by not concealing even what is still imperfectly observed, call attention of future observers to special phenomena. According to my observations, it must not be forgotten that besides the crowding movements of the currents which we have followed so far, movements with very different forces, as for instance, the meeting of currents advancing from opposite directions caused by the tide itself, may take place. Currents of water, like currents of air meeting from various directions, create gyrations and form whirlpools. The celebrated Maelstrom, on the coast of Norway, is caused by such a conflict of streams. The late Admiral Beechey, R. N., in an interesting paper on tidal streams of the North Sea and English Channel,\* gave diagrams illustrative of many rotatory streams, a number of which occur between the outer extremities of the channel tide and the oceanic or parent wave, and says—“they are clearly to be accounted for by the streams acting obliquely on each other.”

Here in the bell mouth of this funnel or trough-shaped bay, we may again follow with the very simple assumption—that it is by this conflict of currents the water is still more lifted by crowding and rotatory action and continues onward as the flood increases, thus imparting the progressive lifting movement as far as Cape Chiegnecto, a distance of 100 miles. The confluence of these currents setting along converging coasts, — first marked by the tide rips between Briar Island and Mount Desert—impinging obliquely and rolling up the Bay with enormous progressive motion, create a vast force of horizontal translation; and this action is nearly as powerful at a great depth as at the surface. Such a wave, reflected from a rigid body, would produce a hydraulic pressure equal to that due to a little more than double its own height; a roller of 20 feet high would produce a pressure of over a ton per foot.

The tide floods the Bay of Fundy from Grand Manan to Cape

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\*See Phil. Transactions, Part II, 1851, on Tidal Streams of the North Sea and English Channel.

Chiegnecto, a distance of nearly 100 miles, within five hours; this could not be done from the currents alone. It is the translating movement that effects such performance. It is not an influx altogether, that fills up the Bay during that time—it is largely due to the piling up of the littoral waters within it. The currents seldom exceed ten miles per hour. The tidal wave, if unimpeded, or unobstructed by coasts, would travel round the earth in a lunar day of 24 hours. It is this wave that floods the Bay of Fundy (No. 1) as well as every other tidal bay, bight and recess on our planet.

It has been already said that the wave of translation affects the depths as well as the surface. Here there is very convincing proofs of this. Chiegnecto Bay, Minas Basin and Cobequid Bay are divergent arms, extending northerly and easterly from the head of the Bay of Fundy. The ebb tide nearly empties them, leaving here and there muddy pools and shallow channels. A regular flood tide refills them to a depth of from forty to fifty feet, whilst the mean level between these extremes is just the same as the mean level of the Atlantic Ocean along our shores, where the extremes of tide do not exceed eight feet, and nearly the same as the mean of Northumberland Straits, where they seldom exceed six feet.

But we are afforded an opportunity of giving a thorough practical application to this part of our theory. Referring to the report of the Chief Engineer of Public Works on Baie Verte Canal, Ottawa, 1874, Mr. Page says: "It may at once be stated, that "a daily record of the rise and fall of tides in Cumberland Basin, "was kept from the 13th August to the last day of December, "1870; and during that time there were between the 13th and "31st of August, four days; in September two days; in October "three days; in November one day; and none in December that "the tides did not rise to 86 feet. Between the 13th and 31st "of August there were ten days; in September fourteen days; "in October sixteen days; in November twenty days; and in "December twenty-two days, that the tides did not rise to over "88½ feet.

"Between the 13th and 31st of August, there were fifteen

“ days ; in September twenty-three days ; in October twenty-five  
 “ days ; in November twenty-three days ; in December twenty-five  
 “ days, that the tides did not rise to over  $90\frac{1}{2}$  feet (height of springs  
 “ full moon). The new moon spring tides in August, 1870, rose for  
 “ three days to, from 92 to  $92\frac{1}{2}$  feet ; and in each of the following  
 “ four months they were for five days from 92 to  $94\frac{1}{2}$  feet above  
 “ datum.

“ On the 25th of October, 1870, an exceptionally high tide of  
 “ 96 feet was observed ; and on the 5th of October, 1869, the  
 “ Saxby tide rose 100 feet above datum.”

Mr. G. E. Baillairge, Jr., Assistant Chief Engineer, says in  
 the same report :

“ Rise and fall of tides were registered every five minutes  
 “ except on Sundays and stormy days ; and the rate per hour in  
 “ each case is given at the respective dates, stated in tables for  
 “ each month. In cases where the daily tidal register is not  
 “ complete, the range and rates of the tides are based on those of  
 “ the corresponding tides in one of the other months. Night  
 “ tides not observed.”

“ SUMMARY.

Mean tide level of Bay of Fundy.

Year.	Month.	Half tide or mean level for each month.
1870	August.	70.37
	September.	70.41
	October.	70.85
	November.	70.90
	December.	71.01
Half tide line or mean level of the sea. . . . .		70.71 ”

Half tide elevation, or mean level between high and low

water referred to datum, which is from 47 to 50 feet below low water Spring tides.\*

BAIE VERTE:

Half tide or mean level of sea 1870 and '71, from August till May 10th was about 71.54. So that the mean level of sea at half tide is just 10 inches higher at Baie Verte than at Cumberland Basin.

It is also well worthy of remark that the Bay of Fundy tides seldom rise to a greater height above the main level of the sea than 22 feet; and the great Saxby tide did not rise to a greater height above the same level than 29 feet.

The tidal wave, then, on its retreat scoops back with it just as much water in depth, below the mean level of the sea as it carries in with it in its advance above the level.

It would be a great error then, to say that the tides rise in the Bay of Fundy above the level of the sea fifty or sixty feet, because they do not rise more than about half that height above sea level. But it would be correct to say, between the level of lowest and highest water, there is a difference of level of from 50 to 60 feet.

The oscillations of the tidal vertex, or daily elevation of high tide above datum, between tides occurring at full and new moon, and those occurring at the moon's quarters, in the Bay of Fundy, are not, relatively considered, proportional to the difference between the respective heights of springs and neaps in places where those abnormal tides do not occur. The minimum level that was reached by neaps during high tide was about 85 feet above datum, whilst the height of springs seemed to turn about 94, having a difference only of about 9 feet, or say as 9 to 8. The universal law of gravitation when the sun and moon are acting in conjunction, as at the full moon, and when the moon is acting alone, as at the quarters, would be as 9 to 5 nearly. Thus the translating, impinging or crowding

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\* Care must be taken not to confuse the heights given in the above *datum* with the height above low water. For the convenience of levelling or obtaining levels of surface, the Engineer invariably computes all heights from an arbitrary level taken well down below the lowest point of surface which he calls *datum*, so as to avoid minus quantities in computation. The heights given here are about 50 feet below low water. The height, therefore, above low water for main level of sea will be 20.71 feet.

forces exerted do not give anything like the results equivalent to the initial degree of exertion at work at the entrance to the Bay. It is generally observed that when any unusually high tides occur, such as from prevalent southerly winds, or from causes such as produced the Saxby tide, those extremely high tides will maintain themselves for several recurring oscillations. They seem to swing like a pendulum after receiving a sudden impulsive motion, until after some time they settle again into their normal condition.

The tidal waves of the Bay of Fundy, as well as the waves of the atmosphere, teach us how great mechanical effects can be produced by the concentration of energy or power from small sources. The study of them may not only be interesting but instructive.