action, and to suggest the remedial agencies that should be applied to counteract those that have produced or threaten injury.

I shall endeavor to present such views as I find justified by a careful consideration of the subject, supplemented by my personal observation during last season's operations on the iron pier, from May to November.

The general effects may be set down as two in number, viz:

First. The advance northward and westward of the point of the cape.

Second. The decrease in depth of the anchorage sheltered by the works.

As these are believed to be distinct in character, and due to measurably independent causes, they will be considered separately.

Referring to the chart and comparing the lines of 1828 and 1877, the high-water mark on the sea-beach is seen to have encroached upon the land for an average width of about 500 feet to as great a distance southward as the curves enable us to trace the action. The material thus eroded from the outer shore has been carried northward, and mainly deposited at the point of the cape, but partly swept along the inner beach.

The result has been that the cape has projected itself in a general north-northwest direction for a distance of about 750 feet, so that the present high-water mark lies where Lieutenant Sherburne, U. S. N., in 1828, found "no bottom" at 12 fathoms.

The fathom contours have made a corresponding advance, and, in addition, a considerable filling has taken place along the shoal to the westward of the cape.

About 500 feet east of the iron pier is a neutral point, where the high-water lines all unite, the fathom curves in front of this point exhibiting also a remarkable tendency to stability. The filling, therefore, due to the movement at the cape terminates here. The causes producing this action are susceptible of the following explanation: The ebb tides, emerging from the bay with an off-shore set, have little or no effect upon the outer beach, which is also protected in a great measure from the full action of northeast storms by the shoal called the "Hen and Chickens," stretching southeastwardly from the cape for about 4 miles.

On the other hand, the flood-tides impinge upon the shore with a northwestwardly inclination, and are powerfully aided in their action by the south and southeast winds, against which no barrier exists.

The result of this inequality of forces is seen in the erosion of the beach and the transportation northward of the sands.

The deflection of the ebb-tide by the breakwater and the escape of a large portion of its current eastwardly through the "Gap" have hitherto prevented its interference with this process; but it would seem that as the cape has now passed considerably beyond the line of the breakwater prolonged, its further progress should soon be arrested.

A rough comparison of the deposits between 1863 and 1877 with those between 1828 and 1863 encourages this supposition, for the ratio is only about one-third that of the intervals in years.

It is to be observed, however, that although the progress northward of the cape may be checked, the deposit along the inner beach will still continue, though in diminished amounts, unless otherwise counteracted.

The second change in the harbor is, however, vastly more important and alarming.

In 1828 the 24-foot contour was the dominating curve of the anchorage. Coming down from the cape, it left the shore near the head of the present iron pier, bending northeast for 2,000 feet, and thence curving to the west-northwest through the middle of the harbor. In 1877 the 24-

foot curve has nearly disappeared. With the exception of a small area south of the ice-breaker, maintained by the currents through the gap, and of a deep excavation near the eastern end of the breakwater, due to the inrush of the flood, the 24-foot basin has shrunk to a narrow area, half a mile long and 200 or 300 feet wide, in the eastern portion of the harbor, still clinging tenaciously to its positon near the pier, but evidently in rapid process of obliteration from the closing together of its margins.

The 18-foot curve, which in 1828 occupied a relatively unimportant space in the southwest, has in 1877 become the controlling feature. One branch, leaving the west end of the breakwater and dipping slightly to avoid the gap, passes west with a northerly inclination; the other branch, starting from the same point and following the foot of the breakwater for two-thirds its length, bends southwest to a point 1,200 feet west of the pier, and thence goes eastwardly. Between these two branches, which include the greater as well as the most valuable part of the anchorage, is now found on an average but 16 feet of water, with a yearly decreasing depth.

This decrease is not chiefly, nor even in any great degree, due to the extension of the shoal near the breakwater light. This shoal began to form contemporaneously with the construction of the breakwater, and, protected from both ebb and flood tides, has continued to grow ever since. But in October, 1843, Major Bache refers to this shoal as the "only one from which any evil effects have arisen"; states that although it had continued gradually to increase since attracting attention in 1834, its rate of increase was decreasing, and expresses the hope that its ultimate development had been attained.

It appears that this hope was measurably justified, since in 1863 the 18-foot curve embracing this shoal had not greatly increased in area; but the advance from the southwest of the opposite 18-foot curve had at this time enabled it to effect a junction with the shoal, followed by its wide separation into the two branches shown in 1877.

This union took place about 1861 or 1862, 200 or 300 feet outside the 24-foot curve of 1828, as is evidenced by the peculiar disposition of the red curves at this point. Had the "gap" between the ice-breaker and the breakwater been closed at any time previous to 1863, so as to compel the full flow of the ebb to traverse the harbor, this union could not have occurred, and the shoal under the breakwater would not probably have extended beyond a line drawn through the west end of the ice-breaker parallel to the breakwater. Were the gap now to be closed, it is more than likely that the shoal area would again be divided. It is certain that a considerable increase in depth would almost immediately follow.

The project of closing the gap has often been considered and frequently recommended, but mainly with reference to the increasing demand for additional protection and harbor space.

Of the great desirability and even necessity of so doing I can see no room for doubt. It would at once double the barrier against the northeast gales, quadruple the available area, and materially increase the depth of the anchorage, besides tending to repress the encroachments at the cape.

The principal objection urged against a complete closure has been the supposed danger attending further interference with the currents.

Since in the absence of such interference a marked deterioration has taken place and is still progressing, it would appear that an active interposition is now imperatively demanded.

The real source of peril, however, lies in the formidable shoaling coming from the southwest, shown by the rapid advance of the contours, and against this certain danger the remedies hitherto proposed would be of little effect.

The 15-foot curve of 1877, shown on the chart, is about to occupy the position of the 18-foot curve of 1842. A few years later, and it cannot be doubted that it will have inclosed the area now embraced by the 18-foot curve of 1877, with the 12-foot curve pressing on in rear.

The accumulation of material in the upper part of the harbor is attributable to causes similar to those at the cape (though opposite in direction), and, like them, acting in part independently of the works.

To the westward the shore-line of the bay curves gradually to the northwest and north-northwest, and down this shore the winds from the northwest quadrant, at times the severest that blow in the bay, sweep unobstructed, and strongly agitating the shoal water adjacent to the beach, aid the ebb tides to drive the sands and mud along the bottom.

Since the ebb tides must to a certain extent preponderate, any wind sufficient in force to stir the bottom will add its effect, and the consequence is the gradual transfer of material to the southward, and its accumulation in the concavity in front of Lewes.

Previous to the construction of the breakwater the flood tides, enjoying freer entrance, and the northeast winds acting with unrestricted force, sufficed to maintain the equilibrium which gave the anchorage its former regimen, but under cover of the works this accumulation has been enabled to creep down towards the cape.

These movements along the bottom take place mainly between the 18-foot curve and the shore. At greater depths it is probable that the wave action is not sufficient to loosen the sticky bottom.

It remains to consider the remedies that should be applied.

If I am right in my interpretation of the observed phenomena, it will be necessary to arrest absolutely the shoaling from the westward by constructing a continuous jetty from high-water mark out to at least the present 15-foot curve. As a compromise between cost and space secured, the jetty might commence at a point about 300 yards west of the present railroad pier, near the site of the old United States pier, and extend towards a point on the line of the ice-breaker prolonged westward its own length. The direction of this line would be about N. by E. $\frac{1}{2}$ E.

At the same time, the gap should be closed by connecting the west end of the breakwater with the east end of the ice-breaker, first laying a floor of rock along the whole line to avoid excavations, and afterwards adopting a modified profile, and using dimension stone, as recommended by General Barnard in 1853. The cost of this project he estimated then at $500,000. It should not exceed that sum now.

The logical completion of this project contemplates a prolongation of both jetty and ice-breaker to a common point, and consequently the eventual transformation of the harbor into a closed basin, with a single entrance from the cape, through which the tides should ebb and flow, and with an area of about one square mile; but it is believed that for many years to come the flow of the tides between the jetty and the ice-breaker would be attended with no other ill effects than the admission of ice into the harbor and a shoaling at the inner angle of the jetty, not greater, however, than is now going on.

The jetty, being protected from all easterly winds, and evading the full force of north-northwest gales by its direction, need not be constructed of stone, but much more cheaply of two parallel rows of 12-inch by 12-inch timber piling, thoroughly creosoted as protection against the worm,

and sunk solidly into the bottom by aid of the water-jet. The two rows to be 10 feet apart, the piles in close contact, and the joints made tight, either with battens on the inside or more efficaciously by 2-inch by 3-inch tongue-pieces driven into central grooves cut out of the adjoining piles. Each pair of piles to be connected by cross-pieces, and the space between filled with sand or other material. Such a construction should not cost to exceed $75 per foot run.

Without going into details, and accepting General Barnard's estimate of $500,000 for closing the gap, a like amount would prolong the ice-breaker westward its own length, and $1,000,000 more should connect it with the shore. In other words, $2,000,000, an amount less than the cost of the present imperfect works, would suffice to construct this basin sufficient in capacity to contain half the vessels engaged in the coasting trade of the United States, and which a tax upon tonnage so small as not to be felt would thereafter maintain.

The alternative of some project such as this for the improvement and perfection of the Breakwater Harbor is the construction of a new harbor in another position. The natural basin formed by the "Shears," about 2 miles northwest of the ice-breaker, suggests itself as suitable for this purpose, and possesses great and undoubted advantages therefor; but the cost of forming a harbor here would be very heavy, at least three or four times as great as that of the works now suggested, and in this case as well the logical outcome would be the eventual construction of a closed basin.

The utility of the Breakwater Harbor has been repeatedly illustrated and explained in previous reports. I shall not, therefore, insist upon so obvious a fact, further than to say that during any heavy storm the vessels seeking its shelter would, with their cargoes, equal in value half its entire cost.

For the arrest of the movement of the cape, it will probably suffice to construct small jetties perpendicular to the shore, and at sufficiently short intervals to enable them to render mutual aid. These could be constructed of double rows of heavy stakes, driven in and wired together at the top, and the intervals filled with brush. The material can be obtained close at hand from the pine forests of the cape, and the jetties would cost little more than the labor.

The suggested modifications of the present works are shown upon the chart in dotted lines.

I am, colonel, very respectfully, your obedient servant,

WILLIAM LUDLOW,
Captain of Engineers.

Col. J. N. MACOMB,
Corps of Engineers, U. S. A.

P. S.—It will be seen from the above report that the newspaper article, though probably written with the praiseworthy object of attracting attention to the perilous condition of the harbor, goes far beyond the true facts of the case, and loses in force by numerous misstatements and erroneous inferences, among others the following:

> Since this work [the Delaware Breakwater] was finished the point of the cape has extended between 700 and 800 yards due north.

The breakwater was completed in 1869. Mr. Rodney attributes to the cape an advance of 100 yards annually. Its actual advance has been 800 feet in 50 years, or an average of 16 feet per year.

The point of the cape is not now 400 yards beyond the new beacon. It is only half that distance.

It is not at all impossible for a square-rigged vessel to enter the harbor from the cape during a southeast gale. I saw them do so last summer.

The course from the cape to the inner harbor is due west. This course puts a southeast wind on the vessel's quarter, than which, it is needless to say, nothing could be more favorable. Even with a gale from the south, a square-rigged vessel could make the harbor from the cape. As a matter of fact, square-rigged vessels seldom enter the inner harbor from any direction, and for two reasons, viz, the depth of water is insufficient and the harbor in stormy weather is full of small vessels. Referring to the injury to the harbor occasioned by the gap, Mr. Rodney says that the depth through this opening has increased from 3½ fathoms to 12 fathoms; an increase of 51 feet.

By the survey of 1828 the average depth was originally 27 feet. It is now about 31 feet; an increase of 4 feet only. On the margin of the deep excavation north of the breakwater light the depth exceeds this; but even here a vessel entering the gap drawing 30 feet of water would bring up on the line of the south side of the breakwater prolonged.

The "shoal reaching to the shore" has been discussed in my report. It has 16 feet upon it instead of 12, as the article states.

The iron pier constructing by the government stands upon piles 8 inches in diameter and 21 feet apart. It has, of course, had no effect whatever upon the harbor, unless slightly to deepen the water in its immediate vicinity, and has cost $100,000 less than he says.

The vessels lost during recent gales were compelled, for want of space, to anchor beyond the shelter of the works. The writer omits to say that although 12 vessels might be lost, 150 others, worth $1,000,000, were enabled to ride out the gale in safety.

Were Mr. Rodney's assertions to be accepted as literally true, no captain of a vessel larger than a fishing smack would attempt to enter the harbor, and he only by daylight and in fair weather.

Giving the author credit for sincerity of purpose, such loose and extravagant statements only prejudice the cause they seek to aid, from the natural reaction that ensues upon a discovery of their unreliability. The actual condition of things at the Breakwater Harbor is sufficiently threatening to excite alarm without the publication of sensational articles, calculated, if of any effect, to impair the already reduced usefulness of a great national work.

Respectfully,

WM. LUDLOW,
United States Engineer.

E 17.

PORT WARDENS' LINE, PHILADELPHIA, PENNSYLVANIA.

The charts of the topographical and hydrographical survey of the city front not having been completed at the date of this report, this question remains as last reported.

E 18.

SURVEY OF MANASQUAN RIVER, NEW JERSEY.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., January 27, 1879.

GENERAL: I beg leave to submit herewith the report of Capt. William Ludlow, Corps of Engineers, U. S. A., upon the survey of the Manasquan River, and presenting a project and estimate of improving the river, and opening and protecting its inlet from the Atlantic Ocean, so as to make it available for purposes of commerce, and to afford a harbor of refuge for coasters upon the long reach of unbroken shore of New Jersey.

I remain, very respectfully, your obedient servant,

J. N. MACOMB,
Colonel of Engineers.

Brig. Gen. A. A. HUMPHREYS,
Chief of Engineers, U. S. A.

REPORT OF CAPT. WILLIAM LUDLOW, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., January 24, 1879.

COLONEL: I have the honor to submit the following report on the survey and examination of the Manasquan River, New Jersey, with a project and estimates for its improvement.

The Manasquan drains with its tributaries an area of over 80 square miles, and discharges into the Atlantic half way between Sandy Hook and Barnegat Inlet, which are 50 miles apart.

About 5 miles above its mouth it enlarges from a stream 100 to 150 feet wide, to a basin of great natural beauty, about 2 miles long and averaging a quarter of a mile in width, with deeply indented shores rising from the water to a height of from 15 feet to 40 feet. The average depth of the basin is between 3 and 4 feet. At its lower end it contracts to 800 feet, and is spanned by a wooden trestle bridge of corresponding length.

The lower basin begins at this bridge, and with its axis convex to the southward gradually widens and again contracts. It is about 3 miles long, and averages one-third of a mile in width, with a depth of 5 feet. A wooden trestle bridge 1,900 feet long crosses it about a mile from the sea, and an island lies near the head.

The shores of the lower basin are similar to those of the upper basin; but as they approach the sea the meadows interpose, and the banks gradually become lower. A considerable portion of the lower third of the basin is occupied by marsh lands.

The inlet at the date of the survey had the position shown on the chart, with about 1 foot to 18 inches of water at low-water on the bar; and was slowly working to the northward by wearing away the main beach on the north side of the lowest bend, the south beach following.

Subsequent to the heavy storm of October 23, ultimo, the inlet broke out nearly in the position of the proposed jetties. This action is entirely characteristic of the habit of the inlet. Its normal and effective position is the present one, viz: On the prolongation of the inner neck which does not vary. At such times the low-water depth on the bar is from 3 to 4 feet, or more. The inlet does not, however, remain in this position, but gradually forms the S shown on the chart from the northward movement of the sands along the front beach.

The main stem of the S lengthens by degrees and the inlet advances northwardly, eating its way through the beach, but always maintaining its connection with the inner neck, and constantly becoming more obstructed, until its discharge nearly ceases. On one such journey northward the inlet reached a point near the present life-saving station, and in consequence the river was filled with nearly-stagnant water, giving rise to disease and causing great mortality among the fish. The inhabitants of the neighborhood combined and dug the inlet through at the proper place, with the result of immediate relief. Such extreme cases are rare and the inlet after traveling a few

hundred yards, generally under the influence of strong westerly winds, breaks through without artificial aid. At such times a rise of tide is felt at the lower bridge of over 2 feet, and the smaller coasting vessels are enabled to enter freely.

The intractability of the inlet has always been the most serious obstacle to the use and improvement of the river, cut off as it is from communication other than by sea; and the consideration of methods for controlling this important feature, and at the same time securing other desirable modifications of the existing conditions, have for many years engaged the attention of those interested in the locality. The favorite project has been the construction of a canal to connect the waters of Barnegat Bay with those of the Manasquan.

This plan took shape some forty years ago. A charter was obtained from the State, commissioners were appointed, and a considerable sum of money raised by subscription. The funds collected were, however, insufficient for the construction of the canal, and the work was never begun.

High water at the head of Barnegat being synchronous with low-water in Manasquan, it was claimed that by means of a canal a material increase of the discharge through Squan Inlet could be gained, sufficient to maintain it. To prevent an interchange in the opposite direction two locks were provided for in the project. A map was shown me, represented to be a copy of that used by the commissioners, exhibiting what purported to be a line of levels along the projected route, and indicating a difference of level between high-water at Barnegat and low-water at Squan of over 4 feet, a difference which would not seem to be justified by any known or imaginable data. A prolonged southerly wind would, no doubt, hold back the water in the upper reaches of Barnegat Bay, but only a heavy gale could enable it to reach the height given on the map. In order to settle this point satisfactorily, a line of levels was twice run, following a transit and chain line from the tide-gauge on the lower bridge to the gauge at the head of Barnegat. The work was through a wooded country and necessarily rapid. The two lines consequently differ by three-tenths of a foot, but the error is not material. The result by both is that the mean low-water at Squan during the week's observations was higher than that at Barnegat. One line made this difference 0.90 foot the other 0.60 foot. The less amount is equal to the average rise and fall of tide at both ends of the line, so that mean high-water in the bay only reached the level of mean low-water in the river.

Two days of strong southerly winds are included within the week of comparison, without counterbalancing northerly winds, and therefore the most favorable conditions were introduced in the proportion of 2 out of 7 in making up the average.

The tidal curves for both places are plotted on an accompanying sheet, the abscissas being times and the ordinates heights of tide above mean low-water, the less difference, viz, 0.6 foot, being taken as a datum. Only on the two day of southerly winds does the Barnegat curve rise above the other.

This comparison of the levels disposes of the argument in favor of the canal project. For other reasons than engineering ones the canal might be desirable as supplying a link in a possible future chain of inland navigation down the coast of New Jersey from Sandy Hook to Delaware Bay, but cannot be recommended as any part of a project for the improvement of Manasquan River until, at least, other and more important features shall have received attention.

Above the Upper Basin the river is an exceedingly attractive and picturesque stream, with a rapid current and usually gravelly bed, and depth of from 2 to 10 feet. It is at present greatly obstructed with fallen trees, forming the nucleus for bars and shoals which the stream itself would level were the trunks and logs taken out. The river would then be navigable for some five or more miles above the Upper Basin, opening up a valuable and fertile valley. Owing to the frequent obstructions, this valley in times of freshets is overflowed and much property destroyed. The whole country in the vicinity of the Manasquan is rapidly increasing in value, and only awaits proper facilities to develop its resources.

The following project for the improvement of the Manasquan is respectfully submitted:

To construct the piers of the form and dimensions and in the positions shown upon the chart, for the purpose of controlling the inlet and concentrating the scouring action of the ebb.

Assuming that the mean rise and fall in the Lower Basin will be 1½ feet, it is estimated that the discharge will be sufficient to maintain a low-water depth of 10 or 12 feet in the middle of the gorge, and 6 or 7 feet on the bar which will form exterior to the outward wings.

This bar will be exposed to the action of the littoral currents due to the northwesterly direction of the tidal wave and the effect of winds, and will not probably rise to a height above that given.

It is proposed to construct these jetties of 12 inches by 12 inches squared timber, grooved on the sides in contact for the insertion of a tongue.

The piles to be driven, chisel-pointed, with the aid of a water-jet applied to the toe, the pipe being carried down the groove and subsequently withdrawn. The main portion of each jetty to consist of two rows of such piling, 8 feet apart and braced together, and the space between filled with sand, covered with a protecting layer of stone. The outward ends to terminate in a crib of the same construction, 10 feet square, to give greater stability and to serve as foundation for day-marks to show the entrance.

The axis of the jetty is in near conformity to the general direction of the outflow, and its position is such as to admit of the inner wings making equal angles with it while reaching points on either side where the ends will not be endangered.

The outer wings also make equal angles with the axis, and as nearly as possible, without being too much inclined to the shore, face the tidal wave.

The dredging estimated for is shown in shaded areas on the chart.

For the improvement of the river above the Upper Basin, all that would seem to be required at the present time is the removal from the bed of the obstructing logs and snags.

The estimated cost of the improvement is as follows:

1st.	For the jetties (all timber to be thoroughly creosoted)—	
	Lumber	$18,000 00
	Iron	362 00
	Labor	2,585 50
	Stone	590 00
	Supervision, &c	1,012 50
	Total	22,550 00
2d.	Dredging 141,853 cubic yards, at 20 cents	28,370 00
3d.	Removal of wrecks	200 00
4th.	Removing snags, &c., from river proper	1,000 00
	Total	52,120 00

Manasquan is at present measurably without commerce. Whenever the inlet is in such condition as to admit of navigating it, vessels enter with freights, but the uncertainty must, so long as it exists, operate as an effectual bar to the growth of any permanent trade. That this would rapidly follow in the train of a successful improvement may be considered assured, but there is another and even more important point of view from which the question of improving the inlet may be regarded. The coast of New Jersey is singularly destitute of harbors that can be used by coasters in time of danger or distress, while the number of such vessels is becoming very great, and the disasters increasing correspondingly in frequency. The difficulty with all the inlets on the coast, and the insuperable obstacle that forbids their being used as harbors of refuge, is the instability of their channels and the impossibility, in the absence of daily observations, of determining the point at which the best water can be found.

Were the Manasquan Inlet available for vessels even of moderate draft, and the interior space slightly increased, as proposed, many would therein find safety that might otherwise be driven upon the beach.

The work of the survey was conducted as explained in the accompanying report from Mr. Emil Mahlo, and the results are therein given in a tabular form.

For the map of the Manasquan above the "old bridge" I am indebted to Mr. Hal. Allaire, of Allaire, N. J., who kindly placed at my disposal the field-notes of a compass and chain survey of the river recently made.

The line of levels was begun at the lower bridge, for convenience of reference to the tide-gauge, and thence run southwardly in the most direct course to Barnegat, under the guidance of one supposed to be familiar with the locality. It was found, however, that the marshes near the head of the bay were not well adapted to leveling operations, and a detour was made to the westward for the purpose of reaching the bay at a point where the fast land approaches the shore.

The accompanying papers are as follows:

1. A general chart of the river, with transit line and profile, to Barnegat Bay (two sheets):
2. An enlarged chart of the entrance, with details of the proposed works:
3. Report of Mr. Emil Mahlo, assistant; and,
4. Comparative sheet of tidal curves.

Very respectfully, your obedient servant,

WILLIAM LUDLOW,
Captain of Engineers, Brevet Lieutenant-Colonel, U. S. A.

Col. J. N. MACOMB,
Corps of Engineers, U. S. A.

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The dredging estimated for is shown in shaded areas on the chart.

For the improvement of the river above the Upper Basin, all that would seem to be required at the present time is the removal from the bed of the obstructing logs and snags.

The estimated cost of the improvement is as follows:

1st.	For the jetties (all timber to be thoroughly creosoted)—	
	Lumber	$18,000 00
	Iron	362 00
	Labor	2,585 50
	Stone	590 00
	Supervision, &c	1,012 50
	Total	22,550 00
2d.	Dredging 141,853 cubic yards, at 20 cents	28,370 00
3d.	Removal of wrecks	200 00
4th.	Removing snags, &c., from river proper	1,000 00
	Total	52,120 00

Manasquan is at present measurably without commerce. Whenever the inlet is in such condition as to admit of navigating it, vessels enter with freights, but the uncertainty must, so long as it exists, operate as an effectual bar to the growth of any permanent trade. That this would rapidly follow in the train of a successful improvement may be considered assured, but there is another and even more important point of view from which the question of improving the inlet may be regarded. The coast of New Jersey is singularly destitute of harbors that can be used by coasters in time of danger or distress, while the number of such vessels is becoming very great, and the disasters increasing correspondingly in frequency. The difficulty with all the inlets on the coast, and the insuperable obstacle that forbids their being used as harbors of refuge, is the instability of their channels and the impossibility, in the absence of daily observations, of determining the point at which the best water can be found.

Were the Manasquan Inlet available for vessels even of moderate draft, and the interior space slightly increased, as proposed, many would therein find safety that might otherwise be driven upon the beach.

The work of the survey was conducted as explained in the accompanying report from Mr. Emil Mahlo, and the results are therein given in a tabular form.

For the map of the Manasquan above the "old bridge" I am indebted to Mr. Hal. Allaire, of Allaire, N. J., who kindly placed at my disposal the field-notes of a compass and chain survey of the river recently made.

The line of levels was begun at the lower bridge, for convenience of reference to the tide-gauge, and thence run southwardly in the most direct course to Barnegat, under the guidance of one supposed to be familiar with the locality. It was found, however, that the marshes near the head of the bay were not well adapted to leveling operations, and a detour was made to the westward for the purpose of reaching the bay at a point where the fast land approaches the shore.

The accompanying papers are as follows:

1. A general chart of the river, with transit line and profile, to Barnegat Bay (two sheets):
2. An enlarged chart of the entrance, with details of the proposed works:
3. Report of Mr. Emil Mahlo, assistant; and,
4. Comparative sheet of tidal curves.

Very respectfully, your obedient servant,

WILLIAM LUDLOW,
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Col. J. N. MACOMB,
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