

APPENDIX I.

ANNUAL REPORT OF LIEUTENANT-COLONEL Q. A. GILLMORE, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1879.

UNITED STATES ENGINEER OFFICE,  
*New York, July 15, 1879.*

GENERAL: I have the honor to transmit herewith my annual reports upon the works of river and harbor improvement under my charge for the fiscal year ending June 30, 1879.

Very respectfully, your obedient servant,

Q. A. GILLMORE,

*Lieut. Col. of Engineers, Bvt. Maj. Gen., U. S. A.*

Brig. Gen. H. G. WRIGHT,

*Chief of Engineers, U. S. A.*

I 1.

IMPROVEMENT OF HARBOR OF CHARLESTON, SOUTH CAROLINA.

The work done during the past fiscal year was the beginning of a new project.

There had previously been expended between the years 1871 and 1878 the sum of \$93,700 in removing the wrecks of 14 iron-clad and wooden vessels sunk during the war, and in removing a portion of the Bowman jetty in Beach Channel.

OPERATIONS DURING THE LAST FISCAL YEAR.

During the fiscal year just closed the works for the permanent improvement of the channel of entrance into Charleston Harbor were begun upon the plan submitted March 9, 1875. As preliminary thereto additional borings were made by my assistant, Capt. James C. Post, Corps of Engineers, under instructions dated July 17, 1878, upon the crest of the bar and its seaward slope, with a view, mainly, of determining the general character of the materials of which the bar is composed, with respect to hardness, tenacity, and cohesion, as bearing directly upon the question of the methods and agencies within control by which the greater depths needed in the new channel between the jetties could be established at moderate cost, whether in large measure by the scour due to accelerated velocities or by dredging, raking, and other mechanical means.

Additional observations were made by Civil Assistant George Daubeney, under instructions dated July 3, 1878, to ascertain the velocities of the ebb-current upon the crest and outer slope of the bar, along the line of the North Channel between the proposed sites of the jetties.

It having been determined to begin the works by laying so much of the

apron foundation of the North or Sullivan's Island jetty as the appropriation of \$200,000 made June 18, 1878, would cover, a careful survey for location was made under the direct supervision of Captain Post, in compliance with instructions bearing date August 13, 1878, of a strip or belt of the bar about 800 yards wide and 5,000 yards long, extending from Sullivan's Island in a southeasterly direction so located as to embrace the whole of the north jetty, even should it be deemed expedient in view of the additional information recently obtained to add largely to its length, and make very considerable changes in its location.

The plan of improvement of which a general description will be found in Appendix H, Part I, of annual report of the Chief of Engineers for 1878, comprises the construction of two low jetties of riprap stone resting on mattresses of logs and brush, one springing from Morris Island and the other from Sullivan's Island, converging toward each other in curved lines, convex on the inner or channel side, in such manner that their outer ends, or the straight tangents thereto, beyond the crest of the bar, shall be parallel to each other and  $\frac{1}{2}$  to  $\frac{3}{8}$  of a mile apart.

The following extract from the specifications which formed part of the contract under which the work of the last fiscal year was executed describes in general terms the apron of the north jetty, according to the original plan:

A design for the apron has been prepared in this office, which is deemed suitable for the purpose. It consists essentially of a platform of round logs from 11 to 12 inches in diameter, placed and held close together side by side at right angles to the axis of the jetty. The logs are to be as straight as can be procured, and those of about the same size must be selected to go together. This log platform is to be overlaid by a compact layer of stout brush to a depth of 12 to 14 inches, projecting from 10 to 12 feet beyond the ends of the logs on either side, the projecting portion being closely confined and bound together so as to form a kind of mattress. As much brush should be used as the logs will bear up and float. Upon this wooden substructure, which will be at least 2 feet thick, good soundstone of random sizes and of compact form, but none weighing less than 30 pounds, will be placed as compactly as possible. The depth of this bed of riprap stone will be  $2\frac{1}{2}$  feet for all that portion of the work that constituted a part of the stone superstructure and lies within the side slopes of the jetty, while a depth of only 1 to  $1\frac{1}{2}$  feet will be required upon that portion on either side which projects as a mattress beyond the foot of the side slopes.

The total length of the north jetty according to the original plan is about 8,840 feet. This may be increased hereafter.

The width of the log platform at any point will be regarded as the bottom width of the jetty at that point. As the apron progresses the pre-arranged widths may require a slight increase in consequence of scour in advance of the work. The greatest bottom width of platform will be about 92 feet, and the least will not be less than 33 feet. The average bottom width may be a little greater or less than 52 feet, but for the purposes of bidders will be taken at 52 feet.

On the 7th of November the contractors, Messrs. Bangs & Dolby, of Fayetteville, N. Y., requested a modification of the specifications, with respect to the method of making the mattresses, constituting the bottom portion of the apron. They proposed to make the log platform 10 feet wider than the contract required, to omit the joints in the logs, and restrict the projection of the brush beyond the ends of the logs to 4 feet.

In forwarding this proposition for the action of the Chief of Engineers, it was stipulated, with the contractors' written consent, that the projecting brush was to be close and massive, although not formed into a mattress as in the original plan, that the quantity of riprap stone used in the apron was to be the same as specified in the contract, and that the cost of the work to the United States was not to be increased; also, that none of the riprap stone was to be placed upon the projecting brush, all of it being distributed above and over the area occupied by the log platform.

These proposed changes in the details of the plan were approved by the Chief of Engineers, under date November 13, 1878.

On sheet 2, accompanying this report, a cross-section of the apron, according to the original design, is shown in Figure 1, and of the design as amended, in Figure 2.

The comparatively low bottom velocities of the ebb-current observed on the seaward slope of the bar seemed to point to the necessity of giving the jetties greater length than that contemplated in the original project. It was thought best also to adopt a longer radius for the curved portions of the north jetty, and to carry the point of tangency between it and the straight portion farther to seaward.

It was determined to retain the original point of departure from the line of ordinary high-water on Sullivan's Island, and to carry out the jetty for a length of 8,840 feet, on an arc of a circle described with a radius of  $2\frac{1}{2}$  miles, so located that a straight tangent at the sea-end of the arc would have a direction about east 32 degrees south. This line is shown at D E on sheet 1 of the accompanying drawings.

Sheet 2 shows a longitudinal vertical section of the apron and a plan of the same developed on a straight line prepared for convenient reference in ascertaining the proper widths of the mattresses at various points. The scales for lengths, heights, and widths are not the same, and are therefore given on the drawing.

It will be observed by reference to the chart, sheet 1, that the depths on Drunken Dick Shoal vary from 1 foot to 6 feet at mean low-water.

The contractors, anticipating great difficulty in laying their work upon this shoal, which is covered with breakers a great portion of the time, requested, under date April 21, 1879, such a change in the location of the line of the jetty as would in effect divert it to the westward, thereby escaping a portion of the shoalest water, and diminishing the quantity of work to be put down in the breakers.

The work from the beginning had been laid upon straight ranges, or chords of 400 feet in length, and not upon the circular arc of  $2\frac{1}{2}$  miles radius. By the change desired the line of the work, after completing the eighth chord, 3,200 feet from ordinary high-water mark on the shore, would continue on the straight prolongation of that chord for a distance of about 3,000 feet, or until Drunken Dick Shoal was crossed. This change of direction was approved for a length of 2,000 feet beyond the eighth chord, leaving it to be determined, when that limit shall have been reached, whether the work shall be continued on the straight line, or on an arc of  $2\frac{1}{2}$  miles radius parallel to the original arc, or otherwise.

The line on which the work has thus far been laid is shown at D F, sheet 1.

The portions of the apron laid during the fiscal year, amounting to 4,096 linear feet, measured along the axis of the work from the line of high-water on Sullivan's Island, is indicated by heavy parallel hatching lines. Upon 682 linear feet of this apron, laid in June, there was still required 1,617 cubic yards of stone at the close of the fiscal year.

The width of the log platform which forms the base of the structure varies from 43 feet to 66 feet. These widths include the 10 feet added in modifying the design as already noted, and, therefore, exceed by that much the widths on which payments have been made.

The riprap stone is required by the contract to be sound stone of random sizes, but none weighing less than 30 pounds. The maximum sizes were not specified, either by weight or dimensions, and the contractors assumed and insisted on the right to exclude heavy stones. The largest pieces are such as one man can pick up and throw overboard

from the scows used in conveying the stone to the jetty, while the smaller sizes run somewhat under the prescribed limit of 30 pounds. As these latter, however, in great measure go to fill up the interstices between the large pieces, thus increasing the weight of the mass without materially adding to its bulk or cost, no objection has been made to their use to a moderate extent.

The frequent inspections that have been made do not show that any of the stone has yet been carried off the apron by the force of the waves, and perhaps no apprehension need be entertained of serious disturbance from this cause to any of the work already laid, unless it be on that portion put down in June, 1879, on the inner slope of Drunken Dick Shoal, where the depth at mean low-tide does not exceed 8 to 8½ feet. It seems hardly safe to assume, however, that stone of such small sizes will continuously withstand the force of the waves on the crest and exterior slope of the bar. Not that there is likely to be any sudden movement of large masses, but that the waves produced by the prevailing heavy storms, those from the northeast, will carry the stones gradually, a few only, and for short distances at any one time, from the inner slope of the jetty to its crest, and thence over to the western slope. Large stones will have to be used for the upper portions of the work, and some device may have to be resorted to for holding them in place.

The design of the apron is such that the log platform which forms its base would be exposed to the ravages of the teredo unless covered with sand or other material placed upon the ends of the logs, or accumulated there by the action of the currents, or by the settlement of the structure.

An examination made on the 24th of June shows that for a length of about 1,450 feet from the high-water mark on Sullivan's Island, comprising all the work laid before the 4th of February, the apron is so well embedded in the sand as to afford a complete protection to the wood.

Most of the work laid in February, and all laid subsequent thereto, is more or less exposed, and directions were given near the end of June, to cover the exposed wood with riprap stone.

No settlement of the work has been detected on any part of the line.

#### OPERATIONS CONTEMPLATED DURING THE PRESENT FISCAL YEAR.

During the current fiscal year, the apron of the north jetty will be carried out to the length of 9,250 feet, provided for by the contract with Messrs. Bangs & Dolby. The contract has been extended 4 months. This fixes the time for its completion at December 1, 1879.

With the \$200,000 appropriated by act approved March 3, 1879, it is proposed to extend the apron of the north jetty, to add something to its height where it crosses Beach Channel, and also at the sea end, as may be hereafter determined upon, and to begin the construction of the south jetty. It is proposed to do this new work by contract, after inviting proposals in the usual way.

The construction of the south jetty will, in some measure, impede the flow through Pumpkin Hill Channel, which at present offers the best passage over the bar, and may render it necessary to deepen the Swash Channel between the jetties for the use of large vessels. In such case the dredging can be done advantageously by the United States dredging steamer Henry Burden.

The following drawings and papers accompany this report:

1. Sheet 1, showing the site of the jetty and the results of survey, borings, and current observations made during the year
2. Sheet 2, showing a longitudinal vertical section of apron, a plan giving its varying widths, &c.

3. Report of Capt. James C. Post, Corps of Engineers, showing progress made during the fiscal year, accompanied by one sketch and tabulated analysis of marls, &c. This work is located in the collection-district of Charleston. The nearest port of entry is Charleston.

A table of commercial statistics, furnished by the collector of the port, is appended, giving the amount of revenue which was collected during the last fiscal year, and other information tending to show the amount of commerce or navigation which would be benefited by the completion of the work.

The original estimate of cost of the work as now being carried on is \$1,800,000. Since the adoption of the project, appropriations have been made as follows:

By act of Congress approved June 18, 1878 .....	\$200,000
By act of Congress approved March 3, 1879 .....	200,000
Total .....	400,000

Of this amount there has been expended up to the close of the last fiscal year (including outstanding liabilities), \$68,526.88.

#### Money statement.

July 1, 1878, amount available .....	\$200,976 35
Amount appropriated by act approved March 3, 1879 .....	200,000 00
Total .....	\$400,976 35
July 1, 1879, amount expended during fiscal year .....	56,395 75
July 1, 1879, outstanding liabilities .....	12,131 13
Total .....	68,526 88

July 1, 1879, amount available .....	332,449 47
Amount (estimated) required for completion of existing project .....	1,400,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1881 .....	500,000 00

Abstract of proposals for constructing apron of north jetty in Charleston Harbor, South Carolina, opened August 29, 1878.

Number.	Names of bidders.	Price per linear foot, guaranteeing stability of structure, for 9 months from date of completion.	Price per linear foot, without guarantee during construction or after completion.
1	Eli T. Bangs and Moses Dolby, Manlius, N. Y. ....	\$21 00	\$18 00
2	Mark T. Seymour, New York City .....	25 00	21 24
3	David V. Howell, New York City .....	24 47	18 88
4	Roderick G. Ross, Wilmington, N. C. ....	21 45	19 95
5	Willis Ney, Fulton, N. Y. ....	27 00	23 20
6	Walter Doty, Fort Edwards, N. Y. ....	29 47	25 63
7	Brott & Norris, Washington, D. C. ....	25 00	21 00
8	Hugh Ferguson and Joseph A. Yates, Charleston, S. C. ....	55 00	43 00
9	Francis A. Page, New York City .....		19 86
10	Archibald McArthur, Chicago, Ill. ....		33 00
11	Ross & Sanford, Newark, N. J. ....		37 59
12	James N. Ingerson and W. H. Molfthrop, New London, Conn. ....		26 40
13	John Brady and Thomas Doran, Brooklyn, N. Y. ....		39 95
14	Franklin B. Colton, Philadelphia, Pa. ....	23 47	20 47
15	Henry S. Kearney, New York City .....		49 00
16	C. M. Hemerway and Rowell Hayes, Painesville, Ohio. ....		35 00

Abstract of contract for constructing apron of north jetty in Charleston Harbor, South Carolina.

Contractor.	Residence.	Date of contract.	Nature of work.	To be completed—
Bangs & Dolby...	Manlius, N. Y.	Sept. 4, 1878	Constructing apron of north jetty in Charleston Harbor, South Carolina.	Aug. 1, 1879.

COMMERCIAL STATISTICS.

Entrances and clearances of vessels at the custom-house port of Charleston, South Carolina, from 1874 to 1877, inclusive.

VESSELS ENTERED.

Year.	Coastwise.			American vessels from foreign ports.			Foreign vessels from foreign ports.			Total.		
	Number of vessels.*	Tonnage.	Crew.	Number of vessels.	Tonnage.	Crew.	Number of vessels.	Tonnage.	Crew.	Number of vessels.	Tonnage.	Crew.
1874..	510	372,378	11,467	45	11,484	355	174	77,940	2,198	729	461,802	14,020
1875..	504	382,018	11,649	38	13,144	326	198	88,879	2,404	740	484,041	14,379
1876..	471	340,439	10,113	44	11,898	335	224	101,272	2,768	739	453,609	13,216
1877..	400	324,919	9,885	32	13,972	308	236	105,480	2,851	668	444,371	13,044
1878..	399	322,527	9,623	44	19,935	455	329	163,368	3,967	772	505,830	14,045

VESSELS CLEARED.

1874..	409	318,619	10,148	52	18,236	473	192	84,205	2,335	653	421,660	12,956
1875..	461	328,266	10,830	57	24,679	555	211	94,595	2,527	729	447,540	13,912
1876..	431	278,744	9,095	60	23,598	546	230	103,276	2,812	721	505,618	12,453
1877..	335	234,429	7,719	35	22,767	423	250	108,446	2,910	620	365,602	11,052
1878..	266	172,988	5,801	45	24,397	479	298	149,975	3,591	509	347,360	14,045

Year.	Value of exports.	Value of imports.	Import duties collected.
1874.....	\$17,900,146	\$803,573	\$164,107
1875.....	19,655,966	680,343	80,656
1876.....	18,088,152	455,562	89,168
1877.....	16,917,492	161,237	46,848
1878.....	21,167,575	184,127	36,990

\* The above only exhibits the number of vessels in the coastwise trade that are required by law to enter and clear at the custom-house. A large number of vessels arrive and depart which are not required to so enter and clear.

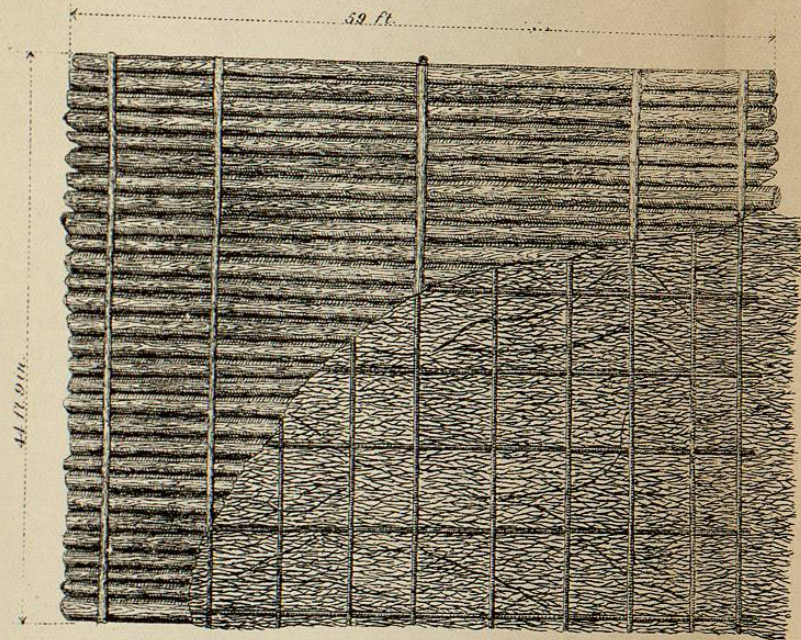
REPORT OF CAPT. JAMES C. POST, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,  
Charleston, S. C., July 1, 1879.

COLONEL: I have to submit the following report of the progress of the work of improvement of Charleston Harbor for the fiscal year ending June 30, 1879.

It having been determined on account of the unfavorable weather encountered, to repeat the current observations made on the bar in the month of April, 1878, for ascertaining the comparative velocities of the surface and bottom currents, Mr. George

Sketch of Mattress used in North Jetty  
Charleston Harbor S.C.  
sent to Bvt. Maj. Gen. Q. A. Gillmore  
Lieut. Col. Corps of Engineers  
with annual report of Capt. J. C. Post Corps of Engineers  
dated July 1<sup>st</sup> 1879.



Plan of Mat 92.



Section of Mat 92.



Brush on this mat is estimated under weight of stone to 8

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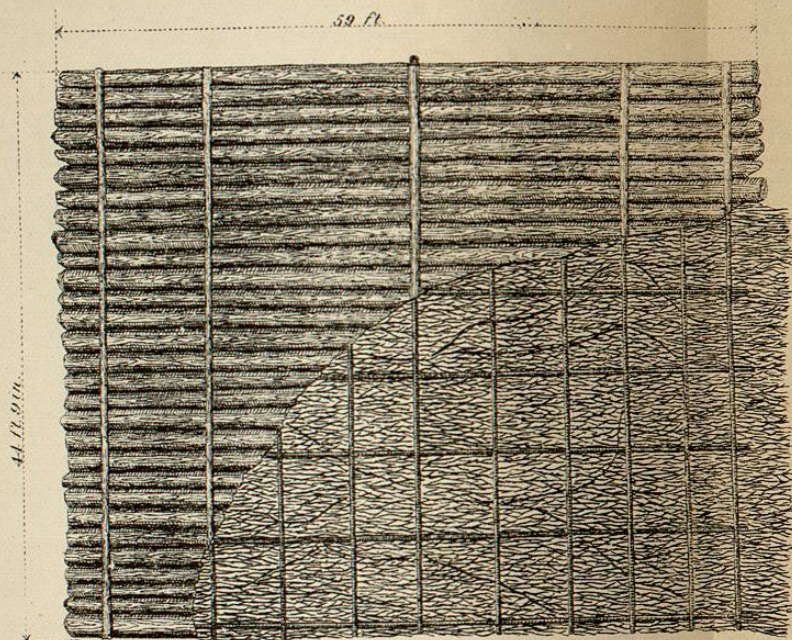
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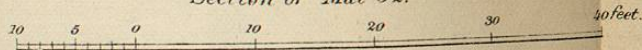
*Plan of Mat 92.*



*Method of attaching mat.*



*Section of Mat 92.*



*Brush on this mat is estimated to compress  
 under weight of stone to 8 1/2 in thickness.*

Daubeney, assistant engineer, was early in July directed for this purpose to proceed to Charleston from Savannah, where he was at that time employed. These he finally succeeded in making after being delayed several weeks by high winds and sickness. His report with a diagram illustrating graphically the ascertained velocities of the different portions of the tide at each station was forwarded you September 12. The measurements were taken with great care during a whole tide at each position from a small boat, and were obtained by using double floats for the bottom, and a surface float for the surface velocities. The floats were attached to a small log-line, which, after the boat was anchored and the floats placed in the water, was allowed to run free for 12 seconds indicated by a sand-glass. From the distances traveled by the float in this time, and indicated by the length of the line run out, their rate of movement was determined.

After further consideration of the plan of the improvement of the harbor by jetties, it having been considered more practicable to attempt the deepening of the Swash Channel instead of the North Channel, as in the original plan, on account of its direction and greater depth, borings were made in this channel to ascertain if any unusual obstacles existed which would add to the difficulties of increasing its depth by a scour due to the concentrated flow of water produced by the jetties. These borings were distributed along the axes of the channel, a little to the north and south of it. Seven borings were made, and in all of these no material of any considerable hardness was found at a less depth than 27 feet below low-water. In 5 of these borings a bed of white marl was reached at depths below water of 33 $\frac{1}{2}$  feet, 29 feet, 27 feet, 23 feet, and 27 $\frac{1}{2}$  feet, respectively. All of the strata overlying these depths were composed of shells and sand, and occasionally thin layers of clay and soft mud.

A detailed report of these borings was forwarded September 12, 1878.

Through the kindness of Dr. C. W. Shephard, jr., of the Charleston Medical College, to whom I am deeply indebted, the specimens of marl obtained from these borings as well as some of the specimens obtained while making the borings in February, 1878, were analyzed by Mr. William Robertson, of Charleston. The results of these analyses have been tabulated, and accompany this report. These marls are similar in formation to those that are found underlying the Charleston basin, except that they contain a larger percentage of sand and organic matter. They lie at different depths, though at a considerable distance below the surface, throughout this section as has been shown by the strata passed through in boring the various artesian wells. Those marls that are obtained at or near the surface contain a much larger percentage of phosphate. Considerable difficulty was experienced in analyzing the second and third specimens, owing to their heterogeneous character. In the fifth specimen there was present a comparatively large amount of magnesia and earthy oxides. The sixth specimen resembles the green phosphatic sand occurring with and beneath the phosphatic rock in Stono River.

By reference to my reports of February 25 and September 12, 1878, the positions of the various strata from which these specimens were taken will be seen.

For the purpose of locating the north jetty or the one springing from Sullivan's Island, a survey of its proposed site was made in September. This survey covered an area about  $\frac{1}{2}$  mile wide and 2 miles long, so as to give considerable latitude in the selection of a proper site. In this work I was ably assisted by Mr. E. A. Gieseler, assistant engineer.

The site having been selected, a contract was made with Messrs. Bangs & Dolby for the construction of the apron of the north jetty. This apron consists of a wooden foundation of logs and brush, and sufficient rubble-stone to cover it with a thickness of 2 $\frac{1}{2}$  feet, the covering of stone having slopes on its sides of 1 upon 2. The wooden foundation is composed of logs, laid side by side, bound together, and covered with a layer of brush. It averages from 19 to 22 inches in thickness, the logs being from 11 to 14 inches in diameter, and the layer of brush from 6 to 8 inches in thickness when compressed. The wooden foundation is laid in sections called mats; these vary in size, and are from 40 to 45 feet in length; their width and the length of the logs which compose them is determined by the width of the apron decided upon for the various depths. I inclose herewith a plan and section of a mat to show their method of construction. The mat taken for the example is No. 92, and is 59 feet wide and 44 feet 9 inches long. It is composed of 29 logs which average 14 inches as the middle diameter. Generally in making the mats, several logs hewn on the upper and lower sides are used in each of them to increase the flotation of the raft and enable a sufficient quantity of brush to be placed upon it. Some of the mats contain as many as 8 of these hewn sticks, and others less; these are distributed on the ends and middle of the raft.

The mat of which the drawing is made contains 3 of these sticks, 1 at each end, and 1 in the middle. The log-binders, 5 in number, are from 6 to 8 inches at the larger end, flatted on the lower side, and fastened to the logs by 12-inch spikes, and are placed as shown in the drawing, the end binders 2 feet from the ends of the logs, the second binders from the ends of the logs  $\frac{1}{3}$  of the distance from the end binders to the middle of the raft, and the fifth binder along the middle of the logs. The