

APPENDIX JJ.

ANNUAL REPORT OF LIEUTENANT-COLONEL C. SEAFORTH
STEWART, CORPS OF ENGINEERS, FOR THE FISCAL YEAR
ENDING JUNE 30, 1879.

UNITED STATES ENGINEER OFFICE,
San Francisco, Cal., July 1, 1879.

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

Very respectfully, your obedient servant,

C. SEAFORTH STEWART,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

JJ I.

IMPROVEMENT OF THE HARBOR AT SAN DIEGO, CALIFORNIA.

The San Diego River formerly emptied into False Bay. Many years
since, its course, during a great freshet, was changed into San Diego
Harbor. In rainy winters large quantities of soil and sand have at times
been carried by this torrent into the harbor, and it has been feared the
result might finally be to diminish its capacity and increase the bar at
its entrance.

Hence, by act of Congress approved March 3, 1875, the sum of \$80,000
was appropriated for the purpose of turning the river back into False
Bay.

As soon thereafter as practicable, Lieut. John H. Weeden, Corps of
Engineers, was directed to make a survey of so much of the ground be-
tween the harbor and bay and Presidio Hill and Point Loma as might
be necessary. He with his party began the field-work on May 26, 1875,
finishing on the 9th of June. The works adopted for this improvement
consisted essentially of a curved artificial channel-way across the plain,
from high ground at the Presidio Hill to a slough from False Bay close
to the end of Point Loma peninsula, the convexity being turned to the
northward, or towards False Bay. On the south side of the new water-
way, between it and San Diego Harbor, a berm of 100 feet was left, and
beyond this an embankment, with a dry cobble-stone facing, from 2 to
3 feet thick, was built to prevent the waters of floods from working into
San Diego Harbor. The levee and berm being concentric with the arti-
ficial channel-way, extend from Presidio Hill to high ground of Point
Loma.

The site for the works could not be procured by purchase. Therefore,
under the laws of the State of California, early in 1876 the necessary
suit was instituted in the 18th district court, and the required land con-

tween the harbor of Wilmington and that of San Francisco. It is at the north end of the bight lying between Point San Luis and Point Sal, the latter being to the southward and eastward from the former, and distant 18 miles. High hills shelter it from winds from west round by north to the east; from that to south-southeast it is more or less exposed, and from south-southeast to southwest is open to wind and sea.

For the greater part of the year the harbor is a good one. During the winter season, for some three or four months, the wind is more or less frequently from the southward. Then heavy storms from that quarter may occur, preceded, accompanied, or followed by a heavy swell from southward and westward, which causes trouble along this coast. It is said that during heavy southeasters, owing to the formation of the high hills at the northwest end of the harbor, the wind is deflected to the westward and rarely blows home. At the same time, on account of the curvature of the beach, the sea coming in makes an eddy, which tends to ease the strain there otherwise would be on the cables of vessels at anchor there.

As may be seen on the tracing sent herewith, the reef extending for nearly a half mile to southward and eastward from Point San Luis forms more or less of a breakwater against the swell from the southward and westward. By this means, during the worst gales, this swell is completely broken into foam, but, when the sea is not so heavy, some of it coming in through gaps in the ledge may be felt within. It was told me on the spot that this reef made the anchorage to the westward of the line AB, drawn from its end to the mouth of San Luis Obispo Creek, secure at all times, the seas from the southwest being cut off and those from the southeast being short and not heavy, the holding-ground also being good.

If this be so, there is already in this harbor, between the 3 and 5 fathom curves of the bottom, a good anchorage of an area of more than 250 acres, besides any there may be exterior to those curves. This should be ample for all present needs as well as for those of a long time to come.

The practicability of building a breakwater here depends on the amount of money that may be had for that purpose. If a harbor of refuge is wished large enough to satisfy the needs of commerce in the distant future, the work should be placed in water of from 8 to 9 fathoms deep. The cost will in addition depend on the kind of material used, the plan, section, and length of structure.

As to material, from the present high price of Portland cement and labor on this coast, and from other difficulties in the way of making blocks of beton of large size at a moderate cost, stone would probably have to be used as cheaper.

The mountains of the Coast range contain much rock, usually, so far as has been seen, a variety of sandstone, limestone, or conglomerate; with, in the vicinity of San Luis Obispo, some syenite. The high hills at the northern end of this bay, from outcroppings, appear to be chiefly of sandstone and serpentine with other minerals, some of them very hard. There having been no demand here for stone, in large quantities, for building purposes, no quarries have been fairly opened so as to show whether blocks of suitable quality, size, and shape for resisting the action of heavy seas can be had, in quantity, at moderate cost. From the general appearance of the rocks it might be difficult to get out such. Therefore, any estimate of the cost of stone per ton in place can only be approximate. It is likely to be greater here than in similar works at the East, labor being higher, the seas heavier, and requiring in the

structure more of the large blocks, which are the most costly to quarry and handle. With such information as is at hand, it is likely that, on an average, at least \$3 per ton would have to be paid for the mass of stone in place.

The general plan and sections of one design for a breakwater are shown on the tracing.

Along the line CA, the gaps in the reef, which are from 3 to 4 fathoms deep, are to be filled in with stone, and together with the low portions of the ledge raised to a level 6 feet below that of the plane of mean low-water. This mass will probably wholly break up the southwest swell. From the end of the reef, at A, the line of work is run east for a length of 500 yards to D to cover a larger area from the same swell. At a distance of 250 yards north from D, another line from E to F is run to the northward and eastward for 1,350 yards, to cut off heavy seas from the southward. This will also protect the space to its northward and westward from any southeasterly seas. These protecting masses are to be of stone of various sizes dropped in place. In arranging the form of cross-section, it is assumed that to a point 18 feet below lowest low-water of spring-tides, a slope $\frac{1}{2}$ faced with blocks of from 1 to 2 tons in weight will not be disturbed. From that depth to the level of highest water of spring-tides a slope of $\frac{1}{3}$ is given which is to be faced with stones of 8 to 10 tons and upward. The thickness at its crest is 25 feet. For an additional height of 10 feet and width at top of 20 feet, the structure is capped by large blocks. The inner slope of the main mass is $\frac{1}{4}$. To diminish or prevent the injurious action of currents upon the bed, at the ends of the breakwater, an apron of small stones extends beyond them for a hundred yards.

In estimating the quantities of material, three-fourths of the volume given by calculation are taken and each cubic yard is supposed to weigh 2 tons, and each ton in place, exclusive of apron, to cost \$3. With this understanding there will be required to fill gaps—

Along line AC....	29,172,722 tons of 2,000 pounds each, at \$3.....	\$87,518 17
For line AD.....	579,076,794 tons, at \$3.....	\$1,737,230 38
For apron at end..	12,962,599 tons, at \$1.50.....	19,443 90
		1,756,674 28
For line EF.....	1,795,924,672 tons, at \$3.....	5,387,774 02
For apron at ends.	25,007,013 tons, at \$1.50.....	37,510 52
		5,425,284 54
Total.....	2,442,143,800 tons, costing.....	7,269,476 99

Upon an average there is required along the line AC, 83.83 tons per running yard, at a cost of \$251.49; along AD, 1,184.08 tons, at a cost of \$3,513.35, and along EF, 1,348.84 tons, costing \$4,018.73.

From an examination of the records of vessels wrecked during the past four years and five months, on the coast of California south of San Francisco and north of San Diego, a shore-line of about 600 statute miles, it is found 12 vessels in all were stranded. One of these got off with trifling damage; eleven were total wrecks, with a loss of twelve lives and 4,907.83 tons, at an estimated value for vessels and cargoes of \$477,725. Out of this number, five schooners, giving a loss of 419.04 tons and \$40,025, went ashore during calms, or when there was very little wind—two having drifted into breakers, with a loss from one of two lives; the remaining three broke from their moorings owing to a heavy swell.

Three brigs, of 597.41 tons in all, parted their moorings or dragged ashore during heavy westerly gales accompanied by a heavy sea, with a loss of one life and \$21,700. One bark struck at night during a heavy

gale and sea breaking, tonnage 833.31 tons; estimated loss, \$13,500. One ship of 1,864 tons was run ashore at night in a dense fog, owing to miscalculation of her position, with a loss of \$145,000 and nine lives. A steamer of 724.63 tons was stranded during a thick fog, the compasses bearing the blame as "faulty"; estimated loss, \$180,000. Another steamer of 469.44 tons was at a wharf; a heavy sea came in, and in casting off her lines, through carelessness her stern-line fouled the propeller, and though able to reach the moorings, she dragged on to the beach and was a loss of \$77,500.

Of these disasters, all but one took place previous to December 4, 1876; two of them in 1875, and nine in 1876. Since December 4 of the latter year, including two winters, of which the past one has been noted for the severity and number of its southerly gales and for its heavy seas, no vessel has been wrecked from stress of weather on the coast of California south of San Francisco. On the 24th of March, 1877, a schooner of 43.93 tons did get ashore, and was wrecked, at a loss of \$4,000, but it was because there was no wind and the current drifted her into breakers.

A person who has for years kept an account of disasters of all kinds which happen to vessels, tells me losses are not now near so numerous as in former years. This is natural, for each year the masters of coasters are becoming acquainted more thoroughly with the peculiarities of fogs, winds, currents, and the swell at various points of the coast as well as with the other dangers to navigation, and can better avoid them.

From the foregoing record, it seems the time has not yet come when the necessities of navigation can fairly compel the construction of a harbor of refuge along this coast.

A breakwater at the harbor of San Luis could not have saved a life of those lost, nor have prevented the destruction of one of the vessels referred to. Such a construction here would probably tend to hasten the shoaling of the inclosed area, and in connection with some shoal spots of limited extent in the approaches, would, during the thick fogs which prevail in the summer months, render entrance and exit from the harbor more difficult.

This harbor is the chief port for the exports and imports of the town of San Luis Obispo and portions of the surrounding country. A narrow-gauge railway now connects the town with the landing, and it is intended to extend a branch to the Santa Maria Valley, to aid in the movement of its produce and return merchandise.

From statistics kindly given me by Messrs. Goodall, Perkins & Co., general agents of the Pacific Coast Steamship Company, it appears that for the year ending October 31, 1878, there were received at the Port Harford landing as follows:

IMPORTS.	
General merchandise, in tons of 2,000 pounds	2,814.26
General merchandise, in tons, measurement	4,903.00
Total tons	7,717.26
Lumber, feet, board-measure	3,133,266
Lime, barrels	718
EXPORTS.	
Hides, tons of 2,000 pounds	60.73
Pelts, tons of 2,000 pounds	22.35
Tallow, tons of 2,000 pounds	6.99
Asphaltum, tons of 2,000 pounds	28.25

Iron ore, tons of 2,000 pounds	2,438.75
Grain, tons of 2,000 pounds	3,301.95
Wool, tons of 2,000 pounds	601.59
Butter, tons of 2,000 pounds	86.64
Cheese, tons of 2,000 pounds	167.49
General merchandise, tons of 2,000 pounds	1,455.55
Total tons	8,170.29

Stock (head)

1,932

San Luis Obispo is in the collection-district of San Francisco. San Francisco is the nearest port of entry.

The amount of revenue collected at that port during the past fiscal year is given as \$6,336,314.07.

The nearest light-house is at Piedras Blancos. The nearest fort is at Fort Point, San Francisco.

As the result of my examination of the locality and of such records and statistics as have been procured, I do not think the construction of a breakwater for the harbor of San Luis Obispo an improvement proper to be made at present.

Respectfully submitted.

C. SEAFORTH STEWART,
Lieutenant-Colonel of Engineers.

II.—EXAMINATION OF HARBOR OF SANTA BARBARA, CALIFORNIA.

The roadstead of Santa Barbara following the general direction of the coast, is some 100 miles to the southeast of the harbor of San Luis Obispo, 25 to the northward and westward of San Buenaventura, and nearly 100 in the same direction from that of Wilmington. It is exposed, more or less, to wind and sea from south of east round by the south to nearly west. In general, there is no difficulty in landing at this place, where there is a good wharf, reaching to deep water, alongside of which vessels are made fast.

During the winter season now and then severe southerly storms, usually of short duration, do occur, which may make it impossible to land. This, however, it is said, rarely happens.

The islands, parallel to the coast and some 23 miles to the southward, aid in sheltering the roadstead somewhat from heavy swells from the southward and southwest, and during southerly gales vessels can seek shelter under the lee of the natural breakwater thus formed. Owing to the fine climate and agreeable surroundings Santa Barbara is already quite a place of resort for those not in robust health or who desire a pleasant residence. In addition, the hot sulphur baths in the vicinity, sea-bathing, and other advantages will probably combine to make it a favorite watering-place.

The population may be about 5,000.

The mountains to the northward, running east and west, isolate it, rendering access, except by water, somewhat tedious, and limit the area of whose products it may be said to be the outlet; so that there is but little back country available to make it of much importance as a commercial port. The coast-steamers which touch here every two or three days with a few sailing-vessels easily supply all wants so far as imports and exports are concerned. It has been reported that sailing-vessels and steamers to the number of 2,760, exclusive of regular passenger and freight vessels touching here, have passed through the Santa Barbara channel, in both directions, during the past three years. If so, records

of disasters kept for the last four years and almost a half give no account of any vessel having gone ashore on the coast from stress of weather nearer Santa Barbara than the harbor of San Buenaventura, distant 25 miles on the one side, and Point Sal Landing, upward of 80, on the other. It is nearly two years since any vessel has been lost south of San Francisco on the coast. This would seem to show that the necessities of general navigation do not require at this point any special construction for its protection, so far as stress of weather is considered. In fact, 75 per cent. of the lives, 68 per cent. of the money value, and 52 per cent. of tonnage lost during the past four years and five months by the stranding of vessels between San Francisco and San Diego has been due to fogs, joined perhaps to insufficient caution on the part of navigators. Having been directed to examine as to the practicability of building a breakwater at Santa Barbara, the result of the examination made is the conclusion one may be built if it is deemed worth while to make a large expenditure. The mountains in the vicinity contain sandstone and probably other rocks which may be durable enough and may perhaps be had of proper sizes. To find out with certainty, quarries would have to be opened at various points.

On the tracing forwarded herewith are given a plan and section of a breakwater. It has been placed in as shoal water and is of as little extent, 1,320 yards, as is thought would answer for a harbor of refuge of the smallest size. The same cross-section as given in the case of San Luis Obispo will probably do here. The bed beyond each end of the work to be protected by an apron of small stones to a distance of 100 yards. The quantity of material is taken at three-fourths of the calculated volume, and one cubic yard as weighing 2 tons. As there might be greater expense here in moving the material than at San Luis Obispo, the cost per ton of mass, in place, is called \$3.25. There will then be required—

The body of the work..	1,087,019.08 tons, at \$3.25.....	\$3,532,812 01
Apron at ends	25,613.42 tons, at \$1.50.....	38,420 13
Total.....	1,112,632.50 tons, costing	3,571,232 14

This gives about 842.9 tons per running yard, at \$2,705.48.

Statistics of imports and exports have failed, as yet, to reach me. It is thought, however, the amounts cannot be very large.

Santa Barbara is in the collection-district of San Diego, which is the nearest port of entry.

The amount of revenue collected there (San Diego) during the past fiscal year is given as \$5,102.35.

Santa Barbara light is the nearest light-house.

The nearest fort is that begun some years ago at San Diego.

As the result of examination and investigation made, it does not appear to me that a breakwater is required at Santa Barbara for the needs of general navigation.

Respectfully submitted.

C. SEAFORTH STEWART,
Lieutenant-Colonel of Engineers.

III.—EXAMINATION OF HARBOR OF SAN BUENAVENTURA, CALIFORNIA.

The town of San Buenaventura lies at the foot of a spur of the coast range between the San Buenaventura and Santa Clara Rivers, on the north side of the outlet to the Santa Clara Valley. It is about 25 miles

to the southward and eastward of Santa Barbara and some 75 to the northward and westward of the harbor of Wilmington. The climate is pleasant. The population is estimated at about 2,000.

The harbor is an open roadstead, formed by a slight indent of the coast-line, and is exposed to wind and sea from the southward of east by the south to the northward of west. The bottom is of sand, and understood to be not particularly good holding-ground. The seas in southerly and westerly blows are said to be heavy. There is a wharf, at which some of the coast-steamers and sailing-vessels touch. From this a portion of the produce of the Santa Clara Valley is shipped, but the great bulk of the grain is sent from Hueneme, about 10 miles farther to the southward and eastward, from which it is expected 14,000 tons will be exported this season. As yet, San Buenaventura is not a port of great commercial importance.

Upon examination, nothing was seen to make the building of a breakwater more impracticable here than elsewhere, nor to recommend this, in particular, as the site for such a work.

It does not appear that any stone-quarries have been opened near the town, and, on inquiry, I heard of none. In the mountains, between this place and Santa Barbara, are large quantities of sandstone. Much of it near the surface is seamy and shattered, and unfit for use. Perhaps if quarries were opened on a large scale, a better quality might be found which could be got out in large blocks. The prospects are that the material would have to be hauled quite a distance, or procured from some of the adjacent islands, or other points along the coast, thus increasing its cost.

A plan and section of a breakwater are shown on the tracing of this harbor. The least dimensions that would probably answer are given. Two positions for the westerly branch are indicated; the more northerly, or broken line, would afford a better shelter from westerly seas, but might interfere in a greater degree with along-shore currents. An apron of small stones is to be laid for a hundred yards beyond the ends of the work, to prevent the formation there of deep holes and the deposition elsewhere of the material that otherwise would be moved. The cross-section from the bottom to lowest water of spring-tides is similar to that proposed for the one at San Luis Obispo, but as this is a more exposed situation, the slope between that level and highest water is made $\frac{1}{4}$, and thence to the top $\frac{1}{2}$, the thickness there being increased by 5 feet. The stones are to be put in place by some of the methods used in such constructions. The amount of stone is estimated by taking three-fourths of the volume of the solid given by calculation. Each cubic yard is supposed to weigh two tons. It is believed the cost per ton in place here will not be less than \$3.25. Then

The line AB will require.....	1,767,046.41 tons, at \$3.25=	\$5,742,900 83
Apron at ends will require.....	37,898.72 tons, at \$1.50=	58,348 08
Total	1,805,945.13 tons, costing....	5,801,248 91

This gives an average of about 1,368.14 per running yard, at a cost of \$4,394.88 $\frac{1}{2}$.

During the year 1876, three vessels were lost at San Buenaventura. On the 25th February of that year, the steamer Kalorama, of 469.44 tons, was at the wharf. A heavy sea came in, the lines were let go, and the stern line fouled the propeller. The vessel got to the moorings, dragged ashore, and was finally wholly wrecked, with a loss of \$77,500. Had she been able to work the propeller this would not have happened. Very often along the coast of California, with no wind and a smooth sea, the

heaviest waves will come in, due to a far-off storm, or sometimes to distant earthquakes, and do much damage. On the 29th of March following, the brig *Crimea*, of 223 tons, was beached during a heavy westerly gale and sea—loss, \$9,200. The 1st of the succeeding December, the brig *Lucy Ann*, of 199.61 tons, in a northwest gale and heavy sea, parted her moorings and was wrecked, with a loss of \$6,500 and one life. For the last two years, though the last winter was noted along the coast for the number, length, and severity of its storms and seas, no vessels have been lost between San Francisco and San Diego.

The following statistics of trade for San Buenaventura during the years 1876-1877 are given by Messrs. Goodall, Perkins & Co., of the Pacific Steamship Company:

	1876.	1877.
EXPORTS.		
Barley..... tons of 2,000 pounds..	1,060.40	1,700.85
Wheat..... do.....	279.48	63.42
Rye..... do.....		4.10
Corn..... do.....	1,291.88	596.70
Bird-seed..... do.....		21.63
Beans..... do.....	215.12	220.16
Flaxseed..... do.....	185.45	189.02
Potatoes..... do.....	35.37	
Ground feed..... do.....	43.02	74.50
Flour..... do.....	31.45	52.87
Wool..... do.....	406.88	461.13
Pelts..... do.....	25.37	25.90
Honey (extracted)..... do.....	20.00	76.56
Honey (combs)..... do.....		50.49
Rock soap..... do.....		58.90
Sundries..... do.....	231.00	205.00
Total tons.....	3,825.42	4,341.23
Eggs..... number..	336,000	288,000
Crude petroleum..... gallons..	93,600	139,500
Refined petroleum..... do.....		34,900
Hogs..... number..	4,840	7,086
Sheep..... do.....	300	886
Lambs..... do.....	400	610
Dry hides..... do.....	1,801	1,734
Tallow..... barrels..		32
INWARD FREIGHTS.		
General merchandise..... tons..	4,564	4,713
Lumber..... feet..	2,917,208	2,891,605

San Buenaventura is in the collection-district of San Diego, which is the nearest port of entry. The amount of revenue collected at San Diego during past fiscal year is given as \$5,102.35. The nearest light-house is Hueneme light.

The nearest fort is that begun at San Diego.

From the examination made and from such other information as has been obtained, it does not appear that the wants of general navigation require, as yet, the construction of a breakwater at San Buenaventura. Respectfully submitted.

C. SEAFORTH STEWART,
Lieutenant-Colonel of Engineers.

IJ 4.

EXAMINATION AND SURVEY OF THE COLORADO OF THE WEST FROM FORT YUMA TO EL DORADO CANON.

SAN FRANCISCO, CAL.,

April 22, 1879.

SIR: Instructions from your office, dated Washington, D. C., July 8, 1878, charged me with the examination or survey, or both, of the Colorado of the West, from Yuma to El Dorado, provided for by act of Congress approved June 18, 1878.

Such a personal examination of that river as was practicable was made between the 12th and 28th days of August. It was supposed this would be the last trip of any steamer to El Dorado for the season. The stage of water in the river was higher than was expected, so the information wished as to its condition in the low stage could not be obtained then. Enough was seen to show that an examination and such instrumental surveys of portions of the river, at its lowest stage, as the funds available should allow must be made to get any reliable data on which to base any plan of improvement for the fixed obstacles to its navigation.

There was but little freight taken up or brought down the river on this trip throughout the 344 or more miles of its length traversed, and but 4 or 5 passengers.

The country, at that time, excepting the low river bottoms, covered with young willows and cottonwood, presented a most barren and desolate appearance. It was as hot, uninviting, God-forsaken looking a region as one would care to see. With some exaggeration it might be said the river was going where it listed through the light loose soil or the valleys, which material seemed to offer hardly more resistance to its course than would drifts of newly fallen snow.

After my return, when Lieutenant Payson, Corps of Engineers, became available for the duty, he was directed on the 2d of December to proceed by rail some 700 miles to Yuma and thence by steamer 285 to Camp Mojave, so that, if practicable, he might examine the upper part of the river for 57 miles above that post at the lowest stage, which usually occurs between the middle of December and that of January.

He with his party left San Francisco on December 4, and reached his first camping-ground near Hardyville, 12 miles by water above Camp Mojave, on the 18th.

Having made the ascent of the river to or beyond El Dorado in skiffs, the party descended in them some 344 miles to Yuma, examining all important obstructions, and arriving there January 15, 1879.

Since his return to this city, Mr. Payson has been occupied in having the results of his examination and surveys, together with plans of suggested improvements mapped; also in procuring statistics and in making his report and its appendix transmitted herewith; to which you are respectfully referred for the plans and details of his operations, and for the descriptions, characteristics, statistics, &c., relating to the river.

The improvements suggested above Camp Mojave are estimated to cost \$85,000. These estimates seem to me too low, considering the out-of-the-world region in which the work is to be done. At present, practically, this expenditure would be mainly for the benefit of the small quartz-mill at El Dorado, which is apparently in a feeble condition. The firewood for this mill is obtained from Cottonwood Island, some 26