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Diag. Cht. No. 6002-1

U. S. Coast and Geodetic Survey
MAR 7 1895
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U. S. COAST AND GEODETIC SURVEY.

T. C. Mendenhall, Superintendent.

State: Washington.

DESCRIPTIVE REPORT.

Hydrographic Sheets Nos 2201, 2202 & 2203.

LOCALITY:

Coast of Washington

1894.

CHIEF OF PARTY:

Lieut. F. H. Crosby, U. S. N.

2201-2202-2203

2202

OFFICE OF COAST SURVEY
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Department of Commerce and Labor
COAST AND GEODETIC SURVEY

T C Mendenhall
Superintendent.

State: Washington

DESCRIPTIVE REPORT.

Hyd S Sheet No. 2202

LOCALITY:

Coast of Washington
See SHA 2201

1894
~~190~~

CHIEF OF PARTY:

T H Crosby

2202

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Department of Commerce and Labor
COAST AND GEODETIC SURVEY

T C Mendenhall
Superintendent.

State: Washington

DESCRIPTIVE REPORT.

Hyd C *Sheet No.* 2203

LOCALITY:

Coast of Washington
See SHA 2201

1894
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CHIEF OF PARTY:

J H Crosby

2203

MAR. 4 1895. 019760

Descriptive Report
of the Hydrographic Work
performed by the U.S.C.&G.S.
Str McArthur, off the Coast
of Washington.
Season of 1897,
Lt. F. N. Crosby, U.S.N.
Chief of Party.

3 Inc.

Write me at: San Francisco, Cal.

Telegraph me at: do

My Express Office is: do

U. S. Coast and Geodetic Survey, H M Mc Arthur

San Francisco, Cal.,

Feb. 20th, 1895.

2-647

General W. W. Duffield,

Superintendent, U. S. C. & G. Survey,

Sir:

In accordance with Par. 204 "General Instructions for Hydrographic Parties," I have the honor to submit the following Descriptive Report of the Hydrographic work of this vessel during the season of 1894.

The work was carried on pursuant to instructions issued March 9th. by the Superintendent, supplemented on the same date by detailed instructions by the Hydrographic Inspector.

After due preparation, which included swinging ship for the Compass error, San Francisco Bay was left on April 1st in the forenoon en route to the Striking

ground off the coast of Washington. Without incident, anchorage was made at 8.40 p. m. on the evening of April 7th near the Whistling Buoy off the bar at the entrance to Gray's Harbor. At 11 a.m. of the 8th, an anchorage was made off the wharf at Westport, Wash., and, on April 9th the vessel was moved off the wharf at Acosta. Hereafter and the anchorage at Acosta, and, later Destruction Id., were utilized as points from which the work was carried on.

Because of unfavorable weather, and the nature of the work, the vessel only left Acosta at 11.50, a. m. on the 19th April, anchoring the same evening at 7.25 in a dense fog under the lee of Destruction Id. The following day a Marden box gauge of the ordinary type, using a copper float, numbers increasing upward, was erected in the small arm in the S.E. face of the Island. No other work could be done because of thick weather.

On the 21st, the Signal Building was begun; and, on the same morning, the vessel returned to Coos Bay, returning again to Destruction Id., at 11.45 p. m. of the 23d.

On April 24th the Sounding Work was begun with tidal observations, and thereafter continued, whenever the weather permitted, as the vessel was not materially absent, for other reasons, from the working ground.

At various places and times, tide gauges were set up and compared, but it was found that the one before mentioned was the one, the records of which, should be used in the reduction of the work actually accomplished.

Continuous observations were made for a period upon a gauge set up at Point Adams, the point marking the Southern entrance to Grays Harbor, in the belief that the Face rocks would permit the work to be carried further South than

found to be the case.

The locality of the Hydrographic work accomplished was off the Western Coast of Washington, and extended from a point ½ mile North of the Quillehute River to a point South, 1¾ miles South of Duck Island, and, off shore to a distance varying from 20 to 25 miles.

The carrying and passenger traffic in this belt, inward and outward from Cape Flattery, comprises nearly all, with the exception of the deep sea sailing traffic, which takes, as a rule, a greater offing.

The trade in the belt is confined to the charter of a small vessel to supply the needs of the settlers, the landings being made at the Quillehute.

The description of the shores and rocks contained in the Pacific Coast Pilot, 1879, of this region is admirable, and but little can be added through the experience

of the Summer.

About one mile W. N. W. of the mouth of the Hobrinn, the bluff along the Shore presents a Triangle formed of yellow clay which was frequently used as a signal in sounding, and is visible from seaward when other marks fail, at a distance of 20 miles.

Between James Id. and Dishmakin Id., for an average distance from Shore of about 1½ miles there are many rocks and reefs most of which are above water.

The exceptions are few and is stated.

The shore line South of the Hobrinn differs in character from that to the North in presenting a low appearance, the bluffs being of clay & sand in lieu of rocks.

Between the Quest rinn and Cuck Id, there extends a yellow clay bluff, several miles in extent, and about 100' high, which also forms an excellent landmark

South of Duck Id., the stone is again made up of rocky bluffs.

S. W. of South rock, for about ½ mile there is a number of rocks not awash, also, a number of rocks, awash and sunken, E. S. E. of the same rock for a distance of 1 ¼ miles. There is a group of rocks 3/4 miles W. × N. of South rocks. The locality, in fact, about Hoh Head being shoal with dangers, the same remark applying to the neighborhood about Abbey Id., and South Bk.

The Quillebute River can be entered only at high water, under the most favorable conditions by the smallest of vessels. The breaker line extends well off shore, about ½ mile, even in fine weather.

The mouth of the Ket-Chee-Whitt River appears to be incorrectly placed upon the chart.

It appears to be about ¼ mile

L. S. S. ½ E of its location upon the chart.

It is not believed that the stream has changed its course for the reason that, for one ½ mile to the northward of the present position of the mouth, the shore line is a solid rocky bluff.

The Ket-chen-whitt is known locally as Jackson Creek, being named for an Indian. This statement is made by the settlers at Ladysmith. It can be entered by boats in pleasant weather, and, upon one occasion, fresh water was procured in the river by one of the whale boats of this vessel.

The mouth of the Kok River shows signs that it shifts a little. At low water it is perhaps 40 yds. in width; at high water about 150 yds. It was entered by the whale boat at half tide. The current is very swift.

The Questo river, the largest south of Vancouver Id, on the sheets, has a bar

off its mouth, a bar about ½ mile, which breaks continuously. To enter with boats it is necessary to proceed about ½ mile below the mouth, pulling up inside the line of breakers, then turning sharply. When abreast the entrance, which is about 30 yds wide at low water.

The Rapt river is easy to enter as its mouth is sheltered behind Crab Id., and the adjacent rock to the N.

The various islands upon the coast form excellent land marks, the best, of course, being Destruction Id. with its light; the yellow clay before mentioned being also a noticeable feature from seaward.

Destruction Id. has the only light in the section. It is Flashing White; 10 sec. interval; elevated 80 ft above the sea; visible 18 miles. There is a siren near the light.

There are no regulations governing the navigation of the waters under consideration.

Channel, pilot, nor harbor, and
no Custom House.

The general character of the bottom
is sandy, except in the vicinity of
Islando and rocks.

The only customary anchorage, (rarely
used) is off the S. E. face of Dromedium
Id. The shelter is excellent from winds
and sea from N.W., in the good season.

There is no shelter on the whole
section for vessels from other directions,

The best anchorage is in 12 fms.,
sandy bottom, with the Lt. No. bearing
between W. and W. N.W. The bottom
becomes rocky in less water. The
L.H. No. 1 Establishment maintains two
mooring buoys near the best anchorage.

Between the sandy and rocky bottoms,
there is a strip of muddy bottom.

Vessels should get away upon the
first sign of indication of Southerly
weather.

Fogs are very frequent, especially during July, August and September. In August and September, the numerous forest fires produce a smoke which is dense and more lasting than the fog. Rain is necessary to dispel the smoke.

The prevailing Summer winds appear to be from the N.E. and N.

The heaviest weather is looked for from the S.E. to S.W.

There are no life saving stations built in the limits of the San Juan claims, and No Quarantine.

Good water can be obtained with difficulty. It may be obtained where boats can enter the inner. There are springs on Discovery Isl. This would procure water there in part, by digging cisterns and the use of pipe.

There are settlements at Saturna and further up the Gulf Islands. Saturna

has a few hundred Indians and Several whites.

Communication is inland to Clallam Bay - on the Straits of Juca, and by an occasional excursion. The Shore is used as a camping ground by fishing and hunting parties.

The sea-otter hunters still occupy points along the shore, which is used as a highway between the settlement and the Ozzekut - or Grays Harbor, below the Quaets.

Kelp is not abundant, no fields being noticed. The largest quantity observed was near Destruction Id., and the Giant's Graveyard.

Three quantities are observed near the isthmus reks and reefs.

No changes from the chart nomenclature are noted, & safe & that before mentioned, in the case of the Kek-Chee-Whitt.

The pronunciation of the name to-lipse by the settlers is Tō-klipse, through ignorance

prevails as to the hydrography.

The heavy swell of the Pacific, the characteristic bars, and the rocks, conspire to make this coast one of peculiar unfriendliness for boats.

The boat landings observed during the season, in accordance with instructions, are few. In moderate N.W. weather boats can land inside James Id.

The west side of James Id. furnishes the only boat landing in the section during the prevalence of Southerly weather.

There are good boat landings in N.W. weather in the two coves East of Trak-White-Head, the best being in the small western cove. Another landing, to be used with caution, owing to the rocks, is found 1½ miles S.E. x E. of the Head.

No landing in the mouth of the Kah-Chew-White has been noticed.

Just South of Hah Head are two bights

in which boats might land with the danger of being stove on the rocks.

The south east side of Destruction Id. offers a good landing except in Southerly weather. The landing should be made in the cove under the derrick used for supplying the St. Ho. with stores.

The northern side of the Id. is dangerous on account of the breakers, and the quantity of rocks. The St. Ho. Tenders however, occasionally land stores on that side in Southerly weather.

The mouth of the Bottle Cove completes the list of available boat landings.

The landing can be made in good weather, with little swell and near high water, (sometimes at low water), by passing to the north and inside of the Pinical rock, just north of each Id.

It happens occasionally in the summer, during a spell of fine weather, that boats can land at many points along the shore.

The paper which I enclosed with the General Report, showing the conditions of the work as affected by the weather, is believed to represent the average conditions, notwithstanding, that after October 1st the weather was unusually severe, and that the number of disasters to shipping was unprecedented.

Early in September, I was informed that Cutler no more hydrographic work could be accomplished, but I was anxious to see for myself. If the conditions in this season has been only average, I can frankly say that I do not think hydrographic work can profitably be carried on after Sept. 1st, on the coast in question.

Transmitted with the Records is a chart which was used on board in lieu of the latest edition of the U. S. Chart, which was not available. The drawing was made from one in the possession of Bolton W. de Courcy, C. E. of Castine. It was

used in crossing the bar of Grays Harbor and in moving about the Harbor itself. The buoys are subject to frequent changes, and their position on the chart is only approximate up to Nov. 7th, 1894.

The survey did not include Grays Harbor, but as the vessel was frequently in the Harbor, and went several times to Aberdeen for soundings and coal, it is deemed perhaps of use to note the hydrographic and other features that came under the notice of the party.

At high water, the Harbor proper as distinguished from the mouth of the Chehalis river has a greatest width of about 15 miles. The Chehalis river and its tributaries, with other minor streams, discharge into the harbor, and two well defined channels have developed, one on either side. These channels are not entirely permanent, from natural causes, and some improvements at the mouth and harbor itself tended to divert

their course. On these accounts the buoys cannot be relied upon by strangers, the courses between being formed by the circumstances of the moment. At low water a large extent of sand mud is uncovered.

At present a branch of the Northern Pacific Railway crosses the Chehalis river between Cosmopolis and Aberdeen, and extends to Centralia. Another branch is in course of construction which will soon bring Aberdeen into direct railway connection, instead of requiring the Aberdeen traffic to cross the river to the town of South Aberdeen. The towns on the Chehalis remain in a moderately thriving condition though severely affected by the post general business depression, and are still suffering from the false appreciation of values brought about by booms.

Of course lumber and its finished products forms the main industry, though

supplemented by the fishery and canning interests.

Vessels drawing from 14' to 17' pass fortnightly as far as Cosmopolis.

Hoquiam, at the head of the harbor, remains in a moderately thriving condition. Wooden sailing vessels of considerable size have been built and launched at this point.

At Aberdeen and Hoquiam machine work of considerable extent will be undertaken.

At Aberdeen, the Dominican Catholics maintain a remarkably fine hospital.

Ship stores are either kept on hand at Hoquiam and Aberdeen, or, they can be readily obtained from Portland or the Sound ports.

The town of "Gray's Harbor City" has grown up and been abandoned since the date of the last published information. This included the abandonment of a fine wharf, 1⅛ miles long, leading

out to the mouth channel.

Ocosta in spite of its advantages of being near the entrance to the harbor, as the terminus of the railway, and of the determined effort of its projectors appears to be on the down road track. Industries are closing rapidly and the people are leaving. A company is experimenting with a gold plant intended to extract pay from the beach sand near Westport.

Hoquiam, Aberdeen and Cosmopolis possess established industries, and the great advantage of a reasonably deep water front, obviating the need of lengthy, expensive wharves.

The absence of the teredo in the Harbor is noteworthy.

There are no Custom Houses and no regulations of navigation. Communication between points is had by small steamers of light draft.

Quite an extensive commerce is maintained

in sailing vessels in lumber. Two tug boats chartered, & owned, by lumber companies answer for towing service, and are usually available for strangers whenever the bar can be crossed.

There is no published list of pilotage.

Small and insignificant Marine railways are to be found in Aberdeen and Hoquiam.

Two hundred entrances and clearances is said to be the present annual average of shipping.

The customary anchorage for vessels waiting the bar inside, is off the wharf at Westport and to the Northward; an anchor can be dropped any where however, the anchorage mentioned being the best in the prevalence of southerly weather.

Some time since the shoal at Cow Point, above Hoquiam, was removed but the place remains one of the shallowest in the channel, and it

is said that its removal has had an injurious effect upon the hard sand shoal spots below Hog Island.

Off Cow Point, the bottom is soft mud, and deep channels when the lead shows less water than the draft. There is danger in this for steamers, for there is an occasional drifting tree lodged in the mud.

At nearly all other points the bottom is hard shifting sand and not first class holding ground.

During the past season, Engineers of the U.S. Army have been engaged in a series of observations with the view of reporting upon the practicability of improving the entrance. There is a strong local clamor for this measure. The general impression is, as seems to be, that the bar becomes more water than better. Upon the few occasions it became my duty to cross it, Sounding

the run, on courses and bearings from buoys, (no other signals being available).
The results, or a portion of them, are plotted on the chart transmitted with this. (The results while only approx. show considerable change in the bar.) The lines seem to be equally good for the passage of the bar.
One good feature is, that vessels may stand up boldly for the entrance and obtain a good idea of the conditions for entering; experience, however, is necessary in judging the conditions from seaward when there is doubt.
The current as a rule seems to set across the bar to the southward with the greatest strength, and this set should be guarded against. If entering on a flood tide, with swell from the west, care will be necessary to keep up well to the northward so that the seas may be taken astern. The tug boats have a different way for entering with different conditions of the water. In towing a deep vessel

they sometimes prefer to tow in, broadside to the sea. It is also considered an easier undertaking to enter with the sea, (as landing through a surf), than to go out against the sea. The danger for deep craft in entering would be in touching bottom and broaching.

The condition of the water on the bar is subject to sudden and rapid changes, and with a heavy swell from seaward with little or no wind, the bar may be impracticable for any vessel.

Strangers should not attempt it unless it appears moderately smooth, in which case the chart is a safe guide. The most serious time this vessel had, was, with a gentle breeze and confused moderately small. The breakers at that time being found inside the bar and in comparatively deep water. The tug boats occasionally, under

favorable circumstances, run in the broken water to the west and south of the channel shown upon the chart.

In the west most angle of the Harbor is the settlement and the Wharf of the Oysehut, which is the starting and departing point for the Coast land trade before mentioned.

Inside the Entrance the only safe guides in navigating are the constant use of the lead and local knowledge.

Gray's Harbor as one of the few breaks in the Coast line, and the most western of these, seems to possess a peculiar importance, although the claims put forward by those interested in one or the other of the the various estuaries are somewhat contradictory. A vessel unable to enter the Columbia, must, in my opinion be unable to enter the others.

The disasters, as a rule, when not

due to carelessness, appear to be due to the dangerous currents setting on and along shore, when vessels, through lack of wind, or other reasons, are out of control.

One vessel in my knowledge, making a false landfall to the northward of Grays Harbor bar, becoming disabled, drifted across the bar, through the broken water, and knocked headboards on the beach of the South Jetty.

I enclose a statement furnished me by the Chamber of Commerce at Aberdeen. Exact statistics are not available, but it would seem that a safe harbor where most needed, i.e. in foul weather, does not exist upon the coast in question. It appears that some of the wrecks that take place are of vessels, bound for the Columbia, which have drifted south.

I regret that I can furnish little or nothing concerning the currents.

The projections show a significant trend to the southward in the line normal to the coast.

It is certain that dangerous currents do set along and on the shore, and that no precaution should be neglected by people navigating these waters.

The distances apart at which were found the bodies of the unfortunate Whale boat crew and the Chief of Party is also significant.

On the run from Grays Harbor to San Francisco, this vessel was dead reckoning in the neighborhood of 40 miles, the P. L. being an excellent one. Owing to the dense fog which prevailed all the way it is impossible to state the exact set and drift.

I neglected to state that coal can be obtained alongside the wharves at Aberdeen and Acosta, delivered, in the first instance, directly from cars, and, in the second, by drays.

Water can be taken from a pipe at the Wharf in Aberdeen, but must be brought from a distance in Casks in Ocosta.

On the Morning of the 18th, August, one of the Whale boats of the Vessel, in attempting to land near J. Creek, in order to complete the building of a signal, successfully began the previous evening, was upset in the Surf with the distressing result hereto fore fully reported to the Office.

Three lost were Lt. F. N. Custer, U.S.N. Chief of Party; Q. M. Sgt. John Freyer, Seamen, William Nehm; Alexander Smith; and Jens Gudmundsen. All of the bodies with the exception of Sea. Alexander Smith, were recovered by the Indians and Settlers, and decently interred by the Force of this Vessel, Each Grave was covered with Stones, Headboards being erected bearing the Names, dates and Cause of death.

The location of each gun, with full details is upon the files of the Office

The thanks of the office for the generous behavior of the people along the Potomac and Rhine, are conveyed to them as our last parting.

Since assuming command, under orders from the office on Sept 3d my work has been made easy by the hearty cooperation of all on board.

In the preparation of the data and this Report I have been largely dependendent upon Mr Salter, Gno. N.S.N., the Executive Officer under Lt. Austry.

Had Lieut Austry lived to make his own report I feel that the Office must have acquired valuable information, beyond my power to give.

Very respectfully
James H. Sears
Lt. N.S.N., Comdg.

CHAS. R. BELL, Pres't.
R. T. DABNEY, Vice Pres't.
W. B. MACK, Sec'y.

Chamber of Commerce

Aberdeen, Wash., ... 1894

Wrecks.

During the last few years a number of vessels have been wrecked, along the coast North and South of Gray's Harbor.

The Brittish Ship Abercorn all hands lost.

The Brittish Ship Fernlale, only three saved

The Brittish Ship Sir Jamsetjie Family all hands lost.

The Brittish Ship Unknown , wrecked South of Gray's Harbor, only a small boy saved from entire ship crew, who bore the touching message from the Captain . "Tell my wife my last thoughts were of her"

The Chilian Bark Lilly Grace ,all hands lost.

The Brittish Barque Fort Gordon, all hands lost.

The Brittish Ship Airburth was driven into the breakers North of the Harbor several years ago , but was rescued by Harbor Tug just as she began to strike, in five minutes more the vessel would have been a total wreck. All of the above vessels and a dozen of others, whose bones line the shores , were bound principally to the Columbia River, and were driven in here by stress of weather and on account of lack of water over the Bar dare not attempt to cross.

With deeper water over the Gray's Harbor Bar all of the above vessels could have entered with safety.

CHAS. R. BELL, Pres't.
R. T. DABNEY, Vice Pres't.

W. B. MACK, Sec'y.

Chamber of Commerce

Aberdeen, Wash., ... *1894*

Statements of exports and imports ,for the yeax ehding June 30th. 1894.

Lumber feet(board measure)	86.500000.	value	$865.000.00	vessel shipm'$	
" " " "	11.400.0000	"	205.200.00	rail	"
Shingles 118 million		"	165.200.00	"	"
Salmon (fresh) 250 tons		"	16.000.00	"	"
" canned 727 "		"	71.400.00		
" salted in bbls. 30 tons		"	1.100.00		
Hides 35 "		"	2.800.00		
Basket material and manufactured stock		"	22.000.00		
Potatoes,hay and oats,250 tons		"	4.500.00		
Total			$1.353.200.00		

Imports.

Machinery Pig iron,Gen. Mdse.hay feed etcet.

68.300 tons value $2.973.500.00.

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First proof, subject to correction. This copy is mailed to you with the hope that you will take part in its discussion, either in writing or orally.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
INSTITUTED 1852.

TRANSACTIONS.

NOTE.—This Society is not responsible, as a body, for the facts and opinions advanced in any of its publications.

IMPROVEMENT OF GRAY'S HARBOR, WASH.

By BOLTON W. DE COURCY, M. Am. Soc. C. E.

TO BE READ ~~OCTOBER 3D,~~ 1894.
Sept. 19th.

An examination of the harbors of the United States on the Pacific coast will demonstrate that, in order to make them available for craft drawing over 15 ft., improvements must be made by the general Government. Harbors of refuge are much needed, inasmuch as the prevailing storms in winter cause the shore to be a lee, which circumstance, with the course of the great Japan current, causes loss of vessels and life.

The general Government has had an investigation made, and estimates for a harbor of refuge at Port Orford in Oregon, but nothing further has been done as far as the writer is aware. Appropriations have been made and improvements are being carried out for harbors, or rather, harbor entrances, at Yaquina Bay, the Coquille River entrance, the Siuslaw and Coos Bay, all in Oregon and south of the Columbia River, but no attention has been hitherto paid to any place north of that river.

There are two fair entrances north of the Columbia River, both of which gives the best natural entrance on the coast, north of San Francisco; these are Shoalwater Bay or Willapah Harbor and Gray's Harbor. It is the purpose of this paper to direct attention to the latter alone.

The United States Coast and Geodetic Survey, in the fall of 1891, made a survey of the bar at the entrance to Gray's Harbor, which shows in the line of deepest water a minimum depth of 16 ft.

The crest of the bar at that depth is less than ½ mile in width, and the distance between the outer and inner 18-ft. curves is about ½ mile; the bar is 3 miles from the gorge of the entrance formed by the two points, Point Brown or Damon's on the north and Chehalis or Peterson's on the south; the distance between these points at low water is about ¾ mile; at high water, 2 miles; at low water the minimum depth at this gorge is 48 ft.; the maximum, 81 ft. These points are the resultants of several natural forces, which are the Japanese current, the prevailing northwestern or southwestern storm winds and the fluvial discharge.

The channel of deepest water over the bar has a tendency to vibrate over a certain distance, but a close examination of the entire crest will show that, although the discharge from the harbor expands and covers a distance of over 3 miles in width, the difference in depth from the line of deepest water is only a few feet less, which assures that, if the water be properly concentrated by jetties, a depth sufficient for any sea-going craft can be obtained.

The Pacific Ocean breaks at the 10-fathom curve, and this curve is closest to the shore opposite to the entrance to Gray's Harbor; therefore, the combers will have less extent, and last January demonstrated the fact that vessels can safely enter at all times, and the depth of water is the only limiting force.

The harbor is somewhat of a heart shape, with the top toward the west, north and south. It is in its greatest width about 12 miles, and east and west about 15; at low water, several channels are developed, with an extent of sand and mud banks separating them.

Besides the Chehalis River, the main stream, there are the Humptulips, the Hoquiam, the Wiskah, the Newskah, the John's and the Elk Rivers, beside numerous creeks discharging into the harbor, the water-shed covering about 3 500 square miles with a rainfall of 90 ins.

There are two well-defined channels extending from the mouth of the Chehalis River to the gorge; these are connected by two cross channels.

The main channels are locally distinguished by the names north, south and middle.

At the east end of the harbor is situated the town of Hoquiam, where are large lumbering interests and immediately adjoining, but on the Chehalis River before it enters the harbor, is the city of Aberdeen, also with a number of large saw and shingle mills, and adjoining this city is the town of Cosmopolis, with the fine lumbering establishment of the Gray's Harbor Commercial Company and several shingle plants.

The annual output of these establishments amounts to, when running at their full capacity, 171 000 000 ft. B. M., and 213 000 000 shingles.*

There are also canneries and other establishments.

The only other town of any consequence on the harbor is Ocosta, situated on South Bay. It has two saw-mills, a tub and pail factory, a brewery, ice plant, flour mill, sash and blind and several shingle factories. It is also one of the termini of the Northern Pacific Railroad, and the nearest one to the ocean being only 3 miles from the entrance between the points.

Several years ago, a survey of the Chehalis River and Gray's Harbor, with a view to its improvement, was ordered by Congress. This was made and a project approved, for laying out an appropriation of $50 000, which sum was expended in the removal of the shoal at Cow Point, between Aberdeen and Hoquiam. Twenty-two ins. in depth was gained over a limited area by this outlay, but at the expense of the lower shoal near the long wharf.

The best authorities hold that improvements to streams should be begun at the lower part, as it is sure then that the benefit is felt of all finished work as you proceed, and this is proved in this case, for the silt and sand from Cow Point shoal was deposited in the expanded channel and added to the shoal caused by the meeting of the waters of the Chehalis and Hoquiam rivers with those of the middle channel.

The work of improvement consists of a system of pile jetties, commencing at the south bank of the Chehalis, and extending by angular

* Report of the Chief of Engineers, U. S. Army.

courses across the south channel, leaving a space of 1 000 ft., mattressed so as to give a depth of 8 ft., with a jetty dam of the same construction across the middle channel.

If the lower shoal had been taken care of at first, the writer believes the results would have been much more satisfactory. He also thinks that where water is to be trained, it is of much benefit to use curves, as water will follow such an alignment, but is sure to cause an eddy where angles are used.

With proper calculations and a curved trace, enough water could have been deflected from the river by a jetty unconnected with the south bank to perform all the scour needed, and this curved trace, with the concave face to the north, would have had a tendency to make the deep channel along the jetty, and not as it does at present, deflect the current toward the embouchure of the Hoquiam River, thus tending to form a bar below it.

These jetties are formed of piling driven 6 ft. apart in two rows, with mattresses of brush sunk and filled in with fascines weighted with stone and sand bags.

The writer is confident that this construction is unnecessarily expensive, as, there being no teredo, a system of piles and sheet piling would answer every purpose, and it would certainly happen that the jetties would fill up with sand in the inside.

From the mouth of the John's River at Markham, north to Ned's Rock, there is a neutral line east of which is a deposit, principally silt. West of this line sand preponderates; this line would seem to be the limit in the main for the silt of the river, and the sand brought in by the flood tide.

Below the mouth of the Wiskah at Aberdeen, the Chehalis River has a width of 1 100 ft. Its mean hydraulic depth is 15.76 ft. at low water. Just below, however, near Cow Point, the river expands to 2 300 ft., with a mean hydraulic depth of 10.18 ft. also at low water. The most natural course for improvement in direction is the south channel. This gives the shortest distance to the ocean, is nearly direct and curved so as to give the nearest channel to the shore, requiring wharfs of moderate length to get to deep water; but the commercial interests of Hoquiam as regarded by those controlling them demand the improvement of the north.

The training of the channel should be done with care. It cannot be

done except at the expense of the tidal area; but if given a proper alignment and direction, as well as a right proportion in width, the volume of water is ample to preserve the requisite depth.

The width should be enlarged as it approaches the neutral line, and in the opinion of the writer should not be carried any further.

The river mouths ought to be trained so as to flow into the main channel parallel to the main stream. The Hoquiam, before the improvement, had such an embouchure, and the two rivers maintained separate channels, the Hoquiam to the north of the lower shoal and the Chehalis to the south of it. The Chehalis, now diverted by the improvement, is filling up. This is proved by the grounding of the United States Coast and Geodetic Survey steamer *McArthur*, and a few days after of the steamer *Point Loma*. Lieutenant Crosby, who is in command, states that the tide was, if anything, over the half when he grounded, and the charts show that there was formerly plenty of water at that state of the tide to float a vessel with greater draft than the *McArthur*.

While the training of the river through the harbor is commercially of the greatest importance, the writer considers the matter of a harbor of refuge of still more consequence. During the last few seasons several large steel vessels, waiting for an opportunity to enter the Columbia River, have been wrecked, with great loss of life, north of the entrance to Gray's Harbor. The last two were the *Abercorn*, laden with railroad iron, and the *Ferndale*, with Scotch coal.

North and south bays give a large area of anchorage and good shelter from all storm winds, and the depth of water at the gorge would give assurance of as deep water on the crest of the bar if proportioned in the same manner. The rise of tide on the bar, according to the notes of the United States Coast and Geodetic Survey, is for the mean of the greater high waters, 9.38 ft., and for mean of the lesser, 7.71 ft. This gives 25.38 ft. and 23.71 ft. as the greater and lesser depths at high water on the bar.

In the harbor this height is increased, as is usual under such circumstances; extreme rise of tide at Aberdeen approaches 13 ft.

It is a difficult matter to procure good stone on the harbor, and the writer is certain that a construction as described for the training of the river, properly modified, would be successful, as the volume of fresh water coming to the bar is so great that frequently quite fresh water

can be dipped up and it is never more than brackish in the main channel, so the destructive teredo is no where to be found, and fascine filling, loaded with sand, would be likely to answer all purposes.

The depth of water at the gorge at low water would also indicate that half-tide jetties would supply all the concentration of force necessary to give a depth sufficient for vessels of the greatest draft, and thus the tidal area would be made available to the fullest extent by the free admission of the flood tide.

The neutral line mentioned, where the sand meets the silt of the river, indicates a deposit of sand brought in by the flood tide, but there is also another cause for this deposit, viz., the prevailing storm winds from the northwest and southwest. This traveling of the sand can be both seen and felt, but can be easily remedied by the cultivation of the *Arundo Arenarea.*

While accretion and abrasion has been going on about the north point, the alterations in the south are scarcely perceptible; in fact, the shore has not materially changed in 11 years.

To conclude, the rules to govern in the main and to be carefully considered are: To give the river a uniform depth by regulating the alignment, flow and width, using formulas found to give satisfactory results by the experience of others, and recognizing the fact that to obtain this the current must be as equable as possible and the channel as straight in direction.

The ebb tide is the most efficient agent to deepen the channel over the bar; therefore, it follows that the admission of the flood must be as unrestricted as possible. Converging jetties, as so successfully used at Dublin and other places, must be used.

Dredging may be advantageous in some places, as thus the silt may be got rid of without a deposit again in some other part of the channel, and, by pumping, the land reclaimed may be sooner rendered available and of considerable value.

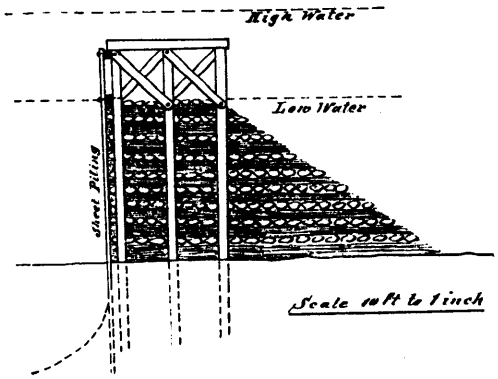
The extreme narrowness of the crest of this bar is occasioned probably by the Japan current causing erosion on the ocean side, and if the jetties be carried to a little beyond, there will be no farther extension of the bar seaward. This current is so pronounced here that vessels entering have to take into consideration a considerable drift to the south.

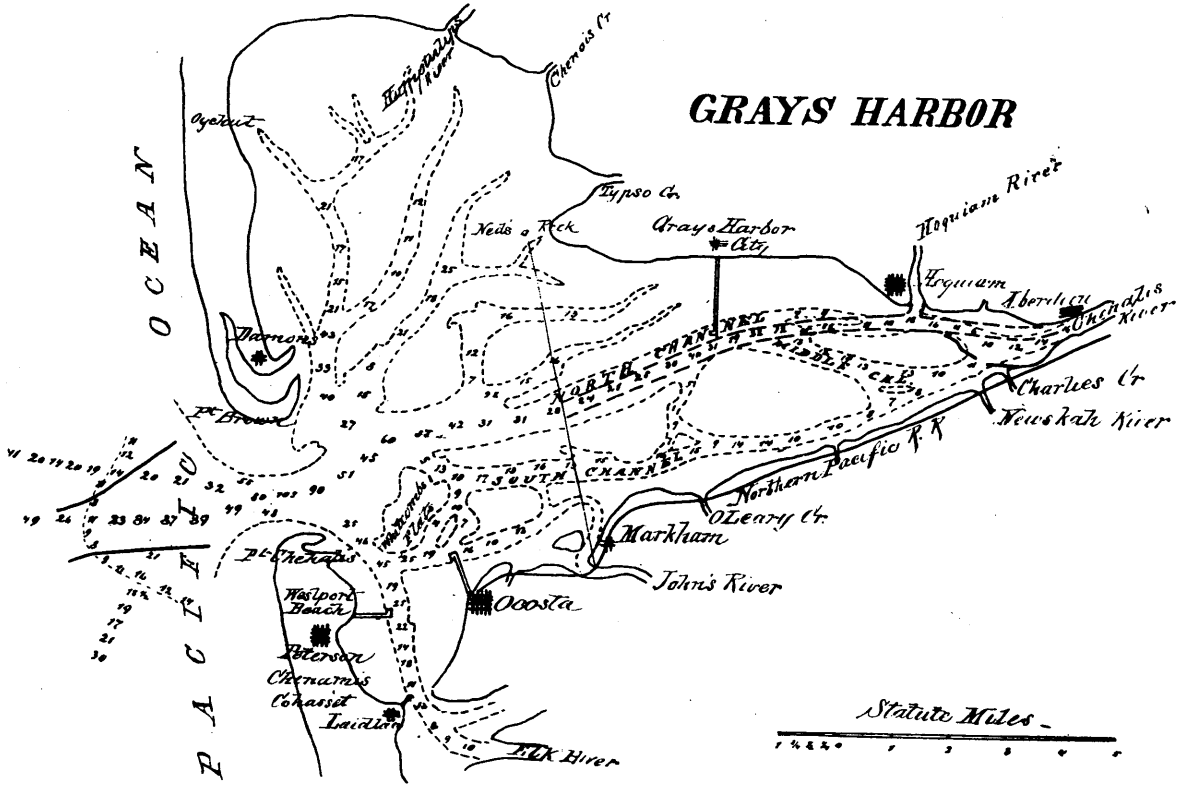
Vessels drawing 17 ft. of water frequently pass out, and the re-

sources of the country in timber and other productions are being developed so fast that, besides the demand as a harbor of refuge, that for improvement for the benefit of commerce is coming on amain and cannot be long neglected.

The ocean greyhounds as used on the Atlantic are scarce introduced on the Pacific, but the tendency is at all times to encourage fast mail delivery, and at this harbor the rail meets the ocean and a whole day can be saved over any other route. The main reward, however, to be obtained is a perfect harbor of refuge, and the saving of fine vessels and valuable lives.

Facts are stubborn things and are incontrovertible in argument; therefore, to prove that this is the best location for a harbor of refuge on this coast, it is only necessary to state the following, viz., last January was a very stormy month, so much so that the two lighthouse tenders *Manzanita* and *Columbine* were bar bound for 23 days in that month at Astoria, inside the mouth of the Columbia River, with a flag of distress flying from the Tillamook lighthouse, and could not get out, and during that time there were only five days that vessels did not pass in or out over the Gray's Harbor bar, and Lieutenant Crosby has told me that he passed in during a severe gale and did not ship one drop of water.


High Water
Low Water
Sheet Piling
Scale 10 ft to 1 inch


GRAYS HARBOR
OCEAN
PACIFIC
Ogeliout
Hoquiam River
Chenois Cr
Typso Cr
Neds Peck
Gray's Harbor City
Hoquiam River
Hoquiam
Aberdeen
Chehalis River
Charlies Cr
Newskah River
Northern Pacific R R
O'Leary Cr
Markham
John's River
Oosta
Westport Beach
Peterson
Chenamis
Chasset
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Elk River
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NORTH CHANNEL
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SOUTH CHANNEL
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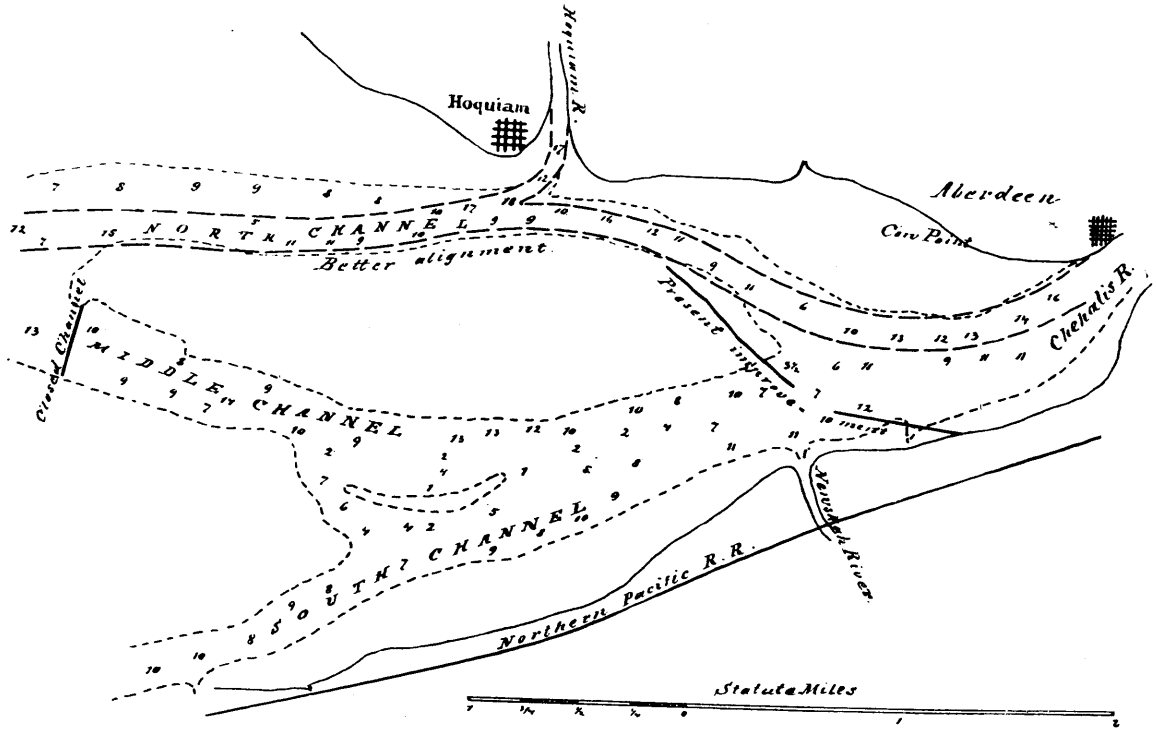
Hoquiam
Hoquiam R.
Aberdeen
City Point
NORTH CHANNEL
Better alignment
Present survey
Chehalis R.
Cloquato Channel
MIDDLE CHANNEL
SOUTH CHANNEL
Wishkah River
Northern Pacific R.R.
Statute Miles