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REPORT

OF THE

SECRETARY OF WAR;

BEING PART OF

THE MESSAGE AND DOCUMENTS

COMMUNICATED TO THE

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AT THE

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APPENDIXES

TO THE

REPORT OF THE CHIEF OF ENGINEERS,

(CONTINUED.)

1 ENG

APPENDIX GG.

ANNUAL REPORT OF MAJOR N. MICHLER, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1875.

UNITED STATES ENGINEER OFFICE,
Portland, Oreg., July 24, 1875.

SIR: I have the honor to submit herewith my annual reports upon works of river and harbor improvements, and of surveys and examinations under my charge, for the fiscal year ending June 30, 1875.

Very respectfully, your obedient servant,

N. MICHLER,
Major of Engineers, U. S. A.

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

GG 1.

IMPROVEMENT OF THE LOWER WILLAMETTE AND COLUMBIA RIVERS FROM PORTLAND, OREGON, TO THE SEA.

Several distinct localities on the rivers named are embraced in the report of operations during the fiscal year ending the 30th of June, 1875. They will be considered separately and in their regular order of succession. The work already accomplished in past seasons will be stated, as well as that which it is proposed to do in the course of the current year. Such recommendations will be submitted in regard to the future advancement of the works of improvement as have suggested themselves in the course of actual experience; also, after a careful study of the whole subject, to devise the best means to procure the desired results, so as to be amply adapted to all the necessities and requirements of commerce and navigation. Much valuable statistical information in regard to the products of the land, the manufactories, the fisheries, together with the shipments of wheat and flour and lumber, and of all mercantile articles, have been placed in tabulated forms, so as to exhibit the vast resources of this much-favored region of our country.

Tracings from the maps of the different localities where improvements have been deemed necessary are also transmitted with this report. They exhibit the character and extent of the obstructions to be overcome in order to maintain a sufficient depth of water in the channel-ways over the several bars of the two rivers, so as to enable the largest class of sea-going vessels, able to cross the bar at the mouth, to ascend to the head of navigation at Portland during the entire year, and at the lowest stage of water.

I.—SWAN ISLAND BAR, WILLAMETTE RIVER.

The head of this bar is about two miles below the city of Portland. The work during the fiscal year was commenced on the 10th of November, the dredging being performed by the United States dredger, which had been placed in position the previous day. It was suspended on the 25th of the same month, in consequence of the state of the weather and

the stage of the river, the former having become very inclement and the latter having risen very much after the commencement of the rainy season, thereby rendering a continuous prosecution of the work impracticable. Upon an examination of this bar, in September, a considerable fill was found on the west side of the channel at the upper end, rendering it very narrow. The cut made at this time was to remove the fill. Its length was 602 feet, the width only 35 feet, and the depth obtained 17 feet at lowest low-water mark. The dimensions of the entire channel as dredged out are 4,000 feet in length, 100 in width, and 17 in depth. Three black and one red buoys mark the edges. In previous years it was not possible to dredge until about the middle of December.

Work was not resumed, owing to the continued high stage of water. It is proposed to continue operations throughout the next fiscal year by the same process as that already adopted; that is, by dredging. It is intended that the cut shall reach a still greater depth at low-water—to at least 19 feet. At this particular work the amount of filling with sediment and the deposit of roots, limbs, and snags are formed by the freshets of the Willamette, which occur in winter. The outlines of the low-water channel over this bar are well defined by spar-buoys; it runs close to the north bank. Careful soundings were made within a few days of the close of the fiscal year, and a fill was found, mostly at the upper end, averaging perhaps 3 feet, or not less than 2 feet 6 inches. In consequence of the great height of the river at the time, this would leave only about 14 feet 6 inches on the bar at low-water. The least depth obtained was 5 fathoms, (30 feet;) a rise of 15 feet 6 inches. The soundings were made with the lead, and consequently not with that degree of accuracy as to definitely determine the amount of the deposit. During the current year the dredger will be employed in further deepening and opening this channel. A tracing of the map of Swan Island Bar, marked "A," is transmitted with this report.

II.—POST-OFFICE BAR, WILLAMETTE RIVER.

This bar is about nine and a half miles from Portland, and one-half of a mile below the head of, or entrance into, Willamette Slough. The Government dredger commenced work on the 17th, and suspended on the 31st of March. It made two cuts of 496 and 286 feet, opening a channel-way 391 feet in length, 70 in width, and 18 in depth at low-water. During the examination made in September a considerable change was noticed as having taken place since the dredger ceased work in the spring. It resumed operations on the 11th of October, having been towed into position the previous day from the mouth of the river, and continued the same until the 7th of November. During this period the two previous cuts were extended, the one to 914 and the other to 706 feet, thus opening a clear channel-way of 810 feet in length, 100 in width, and 18 in depth at low-water mark. Three spar-buoys were originally anchored at and near this locality. There are two black ones to mark the outer edge of the channel, one of which was carried away by becoming entangled or caught in the propeller of the ocean-steamer Ajax. It was by this mishap that three of its blades were broken and detached, but were subsequently found and raised by the dredger. There is also a red buoy to indicate the outline of a sand-bank which has formed a short distance above. The necessary examinations were made at the end of the fiscal year to ascertain if any changes had taken place on this bar. The latter is caused not only by the high water of the Willamette in winter, but also by the freshets of the Columbia,

which annually occur, in the months of April and June. The soundings were taken with the lead. Owing to the shape of the channel at this locality, combined with the extreme high water and soft nature of the bottom at the time, it was difficult to hold the small boat exactly in the cut and make accurate measurements. The reading of the gauge was 16 feet 3 inches above zero, and the last water found was 5 fathoms, (30 feet.) This would give only 14 feet in the channel at low-water, a fill having been formed in the cut of 3 feet, and mostly at the south end of it. The dredger will be employed during the current year, as in the past, after the receding of annual high water to a level at which it can be worked. Efforts will be made to obtain a depth of 19 feet in the channel at the lowest stage of the river should the approaching season prove more favorable for extended operations than in the previous one. The survey of this locality is shown on the tracing marked B, which is transmitted. This also exhibits the relative positions of the head of Willamette Slough, Post-Office Bar, Columbia and Percy's Sloughs, together with the islands and bar at the mouth of the river.

III.—MOUTH OF THE WILLAMETTE BAR, WILLAMETTE RIVER, NEAR JUNCTION WITH THE COLUMBIA.

The junction is twelve miles below Portland, one hundred above Astoria, and one hundred and fifteen above the mouth of the Columbia. The bar through which the cut for a ship-channel was made is 1,260 feet above the mouth. During the month of August the gauges had been established at this point, and accurate soundings were made. It was found that there was a fill from 1 to 4 feet diagonally across the cut made during the previous fall; it was not as great as the one during the year 1873. It has not been possible as yet to ascertain whether or not any good has been effected by the construction of the dam across Percy's Slough. The action of the June freshet cannot yet be determined, not before the fall takes place in the river. The dredger was towed into position, and the work of dredging the bar was commenced on the 9th of September; the principal object was to remove the fill which was found to exist at the previous examination. By the 8th of October, three parallel cuts had been made, the respective lengths of them being 244, 252, and 206 feet. By this process the entire ship-channel-way was opened through the bar in length 234 feet, in width 110 feet, and in depth $17\frac{1}{2}$ feet at low-water mark. Attention is here directed to the fact that the length of the cut had been diminished, since the previous working season of 1873, from 450 to 234 feet, a very important reduction of nearly one-half. Two spar-buoys, one red and one black, define the edges of the cut. Work has not been resumed since the month of October last, the dredger having been employed subsequently upon Post-Office and Swan Island Bars, until compelled to suspend operations on account of high water and the ice bockade. Nothing more can be accomplished until after the cessation of the June freshets. Soundings at the end of the year were made in the same manner, and under similar circumstances, as at the two previous localities; the gauge read 16 feet 3 inches above zero; the least water found was 5 fathoms, (30 feet,) making 14 feet in the channel at low-water, and indicating a fill of nearly 4 feet. As already stated, in consequence of the extreme depth of the water, the soft mud of the bottom, and the strong currents, these soundings cannot be considered very accurate, and the fills may not prove so great; they can only be reliably ascertained when the river recedes to within its old bed. The project for

the prosecution of the works of improvement at this locality during the current year will be in part a continuation of the method heretofore adopted in connection with a more extended system of dams and jetties, the plan of which is herewith submitted for the consideration and approval of the Chief of Engineers. The full effect, if any, to be produced by the closing of Percy's Slough cannot as yet be estimated, as the first attempt to dam it has proved a partial failure. The extreme high water and swift current of the last freshet in the Columbia undermined its foundation of sand, and carried away a large portion of it, although the one of the previous April, also considered unusually great, had not very materially effected it. Reference to this subject will, however, be subsequently introduced when the matter again comes under consideration in this report.

There will now be presented a synopsis of the system of improvement which it is proposed to adopt to protect the banks from being cut away, and to maintain greater permanency in the depth of the channel by confining the waters of the Willamette to within better-defined and fixed limits; also to prevent, as far as possible, the formation of the bar near the mouth by counteracting and neutralizing the forces of the several powerful currents which, during the different seasons of freshets in the two rivers, act so antagonistically to each other. The eddies, formed by the coalition of their masses, cause the sedimentary deposits of fine atoms previously held in suspension, and thereby produce the fill that has now to be annually removed by dredging.

Although most of the information concerning the importance of the contemplated works has already been compiled, and personal examinations and surveys of the locality been made to decide upon the practicability and expediency of their execution, still it would be desirable, before their final transmission, to study the action and effects produced by the late annual freshets. It is, however, too late to defer the matter any longer, as it is necessary to close this report for the fiscal year, as circular-instructions have been issued from the Department enjoining that all reports shall reach Washington by the 15th of July. The system, in addition to the unavoidable and necessary annual dredging, includes the following special works of improvements, as illustrated on one of the maps in colors and on the other in dark, heavy broken lines:

1. The building of jetties at the head of Willamette Slough, in order to force a larger mass of water down the main channel, and thereby increasing the velocity as well as the quantity. This would also have the effect of removing any deposits by the scouring-process. It would especially be the case during high waters, as the slough at such times becomes a broad river, and through it an immense proportion rapidly escapes to reach the Columbia, many miles below. Only a sufficient width should be left for the passage of such boats as ply along it. A suitable depth can always be maintained for them, as they seldom draw more than 4 feet. The banks must also be properly protected against the wash of the currents and the wear of the waves of passing vessels. The simplest plan consists in planting willows, which grow here in profusion, or any shrubbery that will thrive near water; or with a kind of wicker-work formed by the interlacing of twigs and pickets.

2. The slough between Sauvie's and Coon's Islands must also be entirely closed by a dam. At one time it was cleaned out, snags and sawyers having been removed, and used for more than a year as the main ship-channel. It soon, however, became filled again with drift and other obstructions, thereby becoming useless. During the prevailing freshets this cut becomes filled to overflowing. The strong current

through Percy's Slough even forces its waters completely across the course of the main bed and between the two islands. The north bank of Coon's Island must be strongly protected by sheet-piling or by piles firmly driven and wattled together with willow twigs and backed by loose stone. The high waters are constantly wearing and cutting it away, as the nature of the loamy soil is not of sufficient firmness to resist the swift currents. Within a few years very great changes have taken place at the mouth, so much so as to make it scarcely recognizable to the oldest pilots.

3. A dam should be built across the upper entrance of Percy's Slough, parallel to the thread of the river-channel, in order to prevent in future such a great body of water from rushing down it from out of the Columbia, and by the same means to confine the latter to its own bed. This work will have to be strongly constructed to be able to resist the great force of the water which will be thrown against it. It can be easily executed, as the ground over which the line will naturally run is not submerged. From actual trial it is ascertained that the location will be superior to the site of the one constructed several months ago. In the latter case the water is first allowed to enter the slough, and gains great headway and velocity before reaching the dam, whilst in the change now proposed the river is not at all permitted to be at first diverted from its course, but is only allowed to strike the work at an obtuse angle and glide off again.

4. A jetty should be built to extend out for some little distance from the lower end of Percy's Island, for the purpose of still further separating the channels of the two rivers until the subsequent point of their reunion shall take place where a greater depth of water is found, and some distance below the present junction. With a length of 2,000 feet, a dam built to the edge of the shoal which extends out from below the island will reach a point where soundings of over 60 feet can be obtained at low-water, the particles suspended in the water will be deposited in a much deeper channel, and the bar be shifted to a position where it can do less damage. This dam will have to be firmly built, so as to possess sufficient strength to resist not only the velocity of the water, but also the crushing force of ice in the winter season. A uniform channel for this part of the Willamette should be established by the construction of a longitudinal dike of continuous piles. It may not prove an unprofitable undertaking to convert the jetty into a pier with suitable abutments. The lines of the latter should be curved and follow nearly a parallel direction to the axis of the river-channel. It should be constructed with a double row of piles interlaced with willow twigs, the space between the two being filled with gravel and rubble-stone. At high-water three separate currents are developed: an under one, created by the regular downward flow of the Willamette, a second one on the surface, caused by backwater from the Columbia, and the third the resultant force of those that pass out from the several sloughs. These antagonistic elements, as previously stated, produce the eddies and whirlpools which precipitate the floating matter to the bottom and from the bar near the junction, and also the Post-office Bar. Willows should be planted in profusion for the better protection of the banks of Percy's Island; or the other means, already previously suggested, be employed for the same purpose. In any contemplated works no obstructions should be placed to the free ingress of the tides, which at the mouth of the river rise from $1\frac{1}{2}$ to 2 feet.

When the several works previously enumerated have been completed, the result, it is to be hoped, will prove highly efficacious and satisfac-

tory, and that the improvements will permanently secure and aid in the maintenance of a sufficient depth of water to float the largest class or merchant-vessels between the mouth of the Columbia and Portland. The regimen of the Willamette is by no means fixed, owing to the nature of the soil which forms its banks, and the volume of water which at times rushes swiftly through its often widely-extended bed.

The improvement does not contemplate the construction of a dam to close the Columbia Slough, which enters immediately above Percy's Slough, as its source of supply is mainly backwater from the Willamette; nor does it furnish any sediment, as its banks are fringed and protected by willows and a thick undergrowth. It is used at certain seasons for the navigation of boats carrying supplies to and from different landings, which should not be interrupted. The damming of the cut between Percy's and Nigger Tom Islands would have no beneficial result. It is now virtually closed by drift, and there is no perceptible current through it. The high water from the Columbia, which partially inundates the low lands below the foot-hills, is without any appreciable current, being checked and made sluggish by the thick brush, willows, and heavy trees encroaching upon the banks of the sloughs and encircling the edges of the lakes, so that no earthy material can come from that source; in fact, a natural dike of earth or levee has been formed along its course, upon which a growth of timber and dense thicket also exists. The lakes and small inlets are fed by the waters which pass through Gatton's Slough at the foot of the hills above and the Columbia Slough from below. The freshets in the Willamette usually occur during the winter months and in May and June; the first are from the river itself and the two last are the results of backwater from the Columbia. The maximum height reached during the fiscal year was about the 26th of June, the gauge reading as follows at the different localities named:

Fort Vancouver, on the Columbia, six miles above the mouth of the Willamette, 20 feet.

Saint Helen's, on the Columbia, eighteen miles below the mouth of the Willamette, 15.5 feet.

Portland, on the Willamette, twelve miles above the mouth, 18.1 feet.

Oregon City, on the Willamette, twenty-four miles above the mouth, at the foot of the falls, 11.7 feet.

The greatest height of floods observed at any time was recorded in June, 1862.

The immense quantities of snow which have fallen during the last winter, greater than in any previous season within the memory of man, upon the Cascade Mountains, and over the hills, slopes, and valleys which constitute the watershed of the Upper Columbia and its several tributaries, combined with the unusual rapidity with which it was melted by the remarkably open, clear, warm, bright sunshine spring, gave cause to much speculation and apprehension.

Based upon accurate and recorded data of former years, the impression existed that the water of the river would reach a very great height, much more so than usually is the case. At such a period the banks of the Columbia are not alone submerged, but the waters of the Willamette being dammed up by an immense barrier across its mouth, are forced back to such a height as even to flood the lower streets of Portland. That section of the city is, upon an average, 31 feet above the lowest low-water mark. Those citizens who are reputed to be the best informed and most reliable in their statements, place the period of the annual great rise between the 15th and 22d of June. It is said to take

place almost invariably between those dates. The United States dredger has always been able to commence work about the 5th or 10th of August.

It is expected to use a portion of the appropriation in executing as far as possible the plan of operations to which attention has been previously called, the whole project for the improvement of the Lower Willamette and Columbia rivers from Portland to the sea, transmitted to the Chief of Engineers on May 15, having been approved by telegram of the 25th of June.

IV.—PERCY'S SLOUGH DAM.

The upper entrance into this slough is from the Columbia River, two miles above the junction; it terminates in the Willamette, a few hundred feet above the bar near its mouth. The water only flows through its entire length during the season of freshets; the lower portion, however, being backwater, is in constant use for boats plying between the landings along it and the river. The velocity of the current becomes so great when the Columbia is at its height as to force in a direct line the water running out from this slough entirely across the Willamette into another one passing between Sauvie and Coon Islands, on the opposite shore. In such an event the three currents from the two rivers and the slough meet and antagonize their respective forces, their several velocities receiving a sudden check, and the waters in all being held in abeyance to a more or less degree. The particles of matter suspended in the water, or borne along over the bottom of the bed by the swift under-currents, are deposited upon the bars and create the annual fill.

To prevent the water from passing through Percy's Slough, the plan was adopted of constructing a dam across it at the narrowest portion and head of boat navigation, between Percy's and Bybee's Islands. The plan was matured and acted upon; and it was reasonable to suppose that by this work an immense quantity of material, sand and gravel, could be kept back, and thus prevented from washing into the Willamette, there to assist in the formation of the shoal. The length of the dam was about 900 feet, the ends abutting on high, bluff banks. After collecting piles, caps, braces, and other necessary material, the pile-driver commenced operations on the 4th of May, 1874. A suspension of the work became necessary on the 25th of the same month, on account of the unexpected and rapid rise of the Columbia. On the 30th, the water reached its highest point, nineteen and a half feet above low-water mark on the gauge at Ramsey's Landing. The work was resumed on the 9th of July, the water having receded sufficiently, and completed on the 19th of August. It progressed in a satisfactory manner, and was examined and accepted on the 24th of that month. The dam first suffered some damage during the April high water; a small section was then displaced across the line of the most powerful current, and where most exposed to the force and weight of the heavy drift carried against it.

The bottom at this section proved to be quicksand. During the construction of that portion of the work and at the time of selecting the line there was little or no water, but at the time of the late personal inspection, toward the close of April, there were no soundings obtained at a great depth. The remaining portion then appeared to be still firm and in good condition. Afterward, however, at the close of the fiscal year, a second inspection was made, to ascertain the effect of the June freshet. It was found that the dam had not been able to resist the large mass of water, 20 feet in height, combined with the weight of the drift, which had been borne down upon it; the greater portion had given way before the powerful pressure brought against it.

Much of the material had been saved by inhabitants of the islands,

and is held in readiness for future use. Although the foundation to a great extent proved to be quicksand, and the velocity of the current unusually strong, still, upon an examination of the piles, caps, and braces, it was found that the contractor had sadly abused the confidence of this office. Advantage was taken of the temporary and necessary absence of the superintendent of the work, by the use of drift-bolts of inferior lengths and dimensions, and consequently not securing the caps firmly to the piles; also, by not driving the piles to a solid foundation, and piling in back of them sufficient brush weighed down with stones to prevent the whirlpools of the eddies from undermining them, and causing the vibratory motion which finally loosens them from the caps and braces. In case of necessity upon encountering quicksand, they should have used more care in binding the piles by sufficient tie-beams, and in bracing them firmly up and down stream. These defects were only discovered after the caps became loosened from the piles, the shortness of the bolts then becoming apparent, and by noting the mud-marks, which showed to what slight depth many of them had been driven.

V.—WILLAMETTE SLOUGH.

This slough is entered from the Willamette River three miles above its mouth and nine miles below Portland. It is twenty-one miles in length, and empties into the Columbia immediately at St. Helen's, and nearly opposite to the proposed new cut across the bar above the latter place. It is used the entire year round, except when the Willamette is frozen over, by the smaller class of river-boats, and could be navigated by the larger ones, and even by vessels of considerable draught, should it be improved at one locality. It is said that this slough never freezes up, and in the winter affords a good and sheltered anchorage for steamers and sailing-vessels. This work will consist in blasting out a channel-way of greater depth over a ledge of basaltic rock, which crops out near the entrance to Skapoosh Bay, and extends entirely and diagonally across the Willamette to Taylor's house; continuing thence through Sauvie's Island to Warrior Point, on the Columbia. An old Hudson Bay Company post, Milton, was located on Skapoosh Bay. It is proposed to make a special survey of this obstruction in view of its future removal, and also to prepare a map of the entire length of this channel. One large island is encountered in the slough proper; a good depth of water exists on one side of it. The mouth of Gilbert River, more properly styled slough, is passed; it is in reality during certain periods backwater of the Willamette Slough; at other seasons it receives its supply of water from a large lake in the middle of Sauvie's Island, which is replenished by small tributaries from the main slough and from the drainage of and the percolations through the soil. The island is about eight miles in width at the head of the lake, and about one-half a mile at entrance to Gilbert River. In length it is about eighteen miles. It is almost entirely flooded during very high waters; at such times the cattle, which find excellent grazing on the island, are ferried over the slough to the main land, and there kept until the water recedes. A very small portion of the appropriation for the current year will be required to make the necessary survey of the ledge of rocks across the channel. A personal inspection of the slough was made on the 29th of April.

VI.—SAINT HELEN'S BAR, COLUMBIA CITY BAR, COLUMBIA RIVER.

Saint Helen's Bar (proper) is eighteen miles below the mouth of the Willamette and thirty miles below Portland; eighty-two miles above

Astoria and ninety-seven above the mouth of the Columbia, or from the open sea. The upper end of Columbia City Bar (proper) is less than two miles below the former. Examinations and soundings of the two bars were made in August and October, 1874. The work with the dredger at the proposed new cut (St. Helen's Bar) was only commenced on the 29th of March; previously the necessary soundings of the two channels were repeated and two temporary range-lights established to define the course of the one near Columbia City. In consequence of a freshet in the Columbia River it became necessary to suspend operations with the United States dredger on the 28th of April, the work at that time having progressed but about 600 feet, and to have the boat and dump-scows towed to the old moorings, a short distance below this city. The river had risen 10 feet above the average lowest low-water mark; that rise, the first of the season, caused by freshets which simultaneously occur in the several rivers heading in the mountains to the east and to the south, the Snake, the Walla-Walla, the Umatilla, the John Day, the Clearwater, and other minor streams.

The United States water-gauge on the Government wharf at Fort Vancouver indicated the rise in the river to be $9\frac{1}{2}$ feet higher on the 27th of April than it was one year previous at the same date.

The second rise is caused by the melting of the snows in the mountains to the north, among which the waters of the Upper Columbia proper have their source; this one usually takes place between the 5th and 20th of June, and is generally greater than the first. In connection with the present improvement of the river along that portion heretofore generally known as Saint Helen's Bar, the following propositions were respectfully submitted for the consideration of the Chief of Engineers, and which subsequently received his approval by telegram; too late, however, to ascertain their efficacy before the close of the fiscal year. In the first place to abandon the old channel and open a new one, for reasons hereafter to be assigned; and, in the second place, to temporarily hire for that purpose, only at such times as the nature of the work may imperatively demand, a more powerful steam-tug than the one heretofore employed. The cost will be greater at first, but in the end prove more economical. This tug will temporarily dispense with the use of the dredger, and the consequent wear and tear of the machinery. The conclusions reached, and the best plan to be adopted^e were the result of a very careful personal inspection and study of the locality, made on the 29th of May. This annual report is accompanied by a sketch reduced from the original map; it shows the relative positions of the "old" channel and of the "new" one which it is proposed to cut or scrape out. The former, in reality, should be in future called Columbia City Bar; it is the one in use at present, and has been for a great many past years, terminating near that place. The latter is the intended cut across the bar near and scarcely a thousand feet above the town of Saint Helen's. This one exists at the foot of Sauvie's Island, and a few hundred feet above the mouth of Willamette Slough; a tendency exists at this point on the part of the current to scour out a more direct and shorter channel-way. There has been no change in it for the last eight or ten years; it is short, with very deep water at both ends; the bottom is not as favorable for dredging, but is especially so for scraping; the soundings have always indicated about 10 feet at low water.

It is proposed to dredge or scrape out this one to a sufficient depth and width to allow all seagoing vessels to pass through that are able to cross the bar at the mouth of the Columbia River. The old channel

(marked by four buoys—two black and two red) is about 2,500 feet in length, and will, from its nature, always require more or less work. The new one will only be 1,200 feet long, with a width of 150 feet, and can be more readily kept open, if necessary, the currents and ebb tides having a great set in that direction. The operations will simply consist in deepening the channel now used by the largest river-steamers which run at present between Portland and Astoria. These draw only about 5 feet of water when loaded down to their utmost capacity, although there is at least 10 feet on the bar; the river-barges employed in freighting grain draw 8 feet. The cut will be made through quicksand, and will be kept open and deepened by the great velocity of the current during the season of high-water, and be constantly scoured out by the flow of the ebb-tides. The existing conditions at this place are identical with those of the celebrated "Hog's Back," between Woody Island and Tongue Point, the formation, by scraping, of a new channel over which has so far proved of such practical benefit. It will lead into deep water on the Oregon side of the river, thereby benefiting the town of Saint Helen's, as well as Columbia City, instead of over toward the opposite (Washington Territory) shore, near which the present or old channel runs. The latter is lined upon the northern side by a low ledge of basaltic rocks, covered with water. At times it is more or less hazardous to vessels, especially in the dark and during murky weather. To avoid this ledge, and consequent damages, should be a reason in itself for attempting the improvement suggested. The ocean-steamers from San Francisco, Victoria, and Alaska, by force of circumstances—their movements being influenced by the two high-tides of each day—almost invariably pass this bar at night either in ascending or descending the river, and consequently run considerable risk of going on the rocks. Temporary range-lights have been placed on the Oregon shore to mark the course for vessels to take after dark. The new channel is entirely free from any danger of a similar nature, none having been disclosed by careful examination. As previously stated, there is every indication that the river has a tendency to force a way through it. It appears to be the best in every way, and the cut will be about 1,200 feet shorter than the passage across the bar of the old one.

Again, the depth of the latter, which at the time of the last survey was 17 feet at average low-water mark, cannot be easily increased, on account of the ledge of rocks to which reference has been made, except by displacing it by blasting; if the first method fails, this last will be attempted. As dredging or scraping will be necessary at the new cut, it will be a question of cost and the advantage gained, as compared with the needed work in the old channel.

By obtaining a depth of at least 19 feet at average low-water, the bottom being a thin hard crust of sediment resting on quicksand, any of the vessels which usually cross the Columbia River Bar can safely pass through the cut at St. Helen's, advantage, of course, being taken of the tides. The flood-tide varies from $2\frac{1}{2}$ to 3 feet. This river and the Willamette were at about their lowest stages in October and November. A profile exhibiting the different stages of water for the consecutive years from 1869 to the last of June, and a table of heights for different seasons, has been arranged from it. Being able to run the "Hog's Back" and "St. Helen's Cut," there remains no difficulty in the way until the mouth of the Willamette is reached. As previously stated in the report, a plan had been submitted in this connection, and approved by competent authority, for the construction of such additional works as will obtain and maintain an increased depth, thereby greatly improving

the channel-way near the mouth of that river. This will be undertaken in order that all the requirements of commerce and navigation at that locality may be amply accomplished. With an increased depth to be obtained by dredging over Post-office and Swan Island Bars, between the junction and the city, all that is required for the river-improvements will be substantially obtained. In consequence of the nature of the bottom being quicksand, the dredges cannot be very profitably employed upon the new cut at Saint Helen's, as the greatest portion of the material either escapes from the buckets while being raised, or afterward through the crevice between the jambs and gates at the bottoms of the dumping-scows. It is, therefore, proposed to use the scraping process, assisted by the flow of the ebb-tides, which proved so signally successful at the "Hog's Back." For this purpose, as already stated, the aid of a steam-tug, of greater power than the one heretofore in use, was called into requisition but a few days before the end of the fiscal year; it will not be necessary to employ it for any extended length of time. The results of the trial-operations will be made known through special or monthly reports. The price demanded for the hire of a suitable one was \$45 in currency for each working-day; and it is believed that the work of opening the entire cut to a sufficient depth and width will be greatly accelerated. Authority had, therefore, been requested to allow the hire of a tug for the purpose. The necessary approval of the Chief of Engineers was received by telegram on the 25th of June, and, in addition, the permission to employ such other assistance as may be required. The price includes the entire equipment and furnishing of supplies on the part of the owners, the employment of the master, engineer, and crew; the providing of fuel and oil; the execution of all needed repairs to machinery; and, in fact, to make good, at the company's expense, damages of all kinds which may accidentally occur to the boat.

In order not to delay the commencement of the various works and to be able to take advantage of the first suitable stage of water, it was suggested that the approval of the plan proposed be obtained, and the necessary authority for hiring the tug be granted, at the earliest day possible, especially as a sufficient amount of the appropriation for the fiscal year was still available for the purpose. It would not only facilitate the execution of the special work which was required, but any other that might need its services. It was a matter of great necessity that the improvements should be prosecuted to completion as rapidly as possible, in order to gain every advantage in time during the not very extended season for operations of this nature. While the work is being accomplished, accurate and detailed surveys will be made of the entire locality; the map will include the old and new channels, and the positions of the iron and spar buoys which now mark them; also the sites for a permanent set of range-lights for crossing St. Helen's bar, to be selected by direction of the Light-House Board, and for the establishment of which an estimate will be submitted in the annual report to be transmitted to the Board.

As previously stated, a temporary set of range-lights, with lamps and reflectors taken from the Government dredges, distinguished by shades of red and green, and at a distance of about one-fourth of a mile from each other, were established about the 1st of April, to mark the line of the old channel, for the purpose of facilitating the passage of steamers by night. A portion of the "appropriation for the repair, preservation, and completion of certain public works on rivers and harbors, and for other purposes," may be required during the current fiscal year to over-

come other difficulties, or remove other obstructions to navigation, at this locality, as well as at several other points. They cannot be foretold, but may be always anticipated in rivers subject to the very great changes observable in the regimen of the Willamette and Columbia from the effects of the overcharged waters of its tributaries during the several freshets which annually occur; they bring down huge masses of drift, and bear along movable masses of earthy matter, from the regions by which they are fed, the mountain forests and the cultivated lands above, to be deposited below in the form of snags and rafts, shoals and bars. No specific estimate can be made for this kind of work.

The Government now owns a complete dredger, in thorough repair, which can also be converted into a snag-boat as the necessary appliances are on board, and constructed at a very considerable cost. It will be not only more economical to operate it and perform the required work by day's labor, the material being purchased in open market, and with a great deal more certainty of its faithful execution, than by applying the moneys appropriated by the contract system. The expenditures can always be made more advantageously to the Government by the mode already adopted for executing the work to be accomplished, and which has operated so successfully during the two years since the dredger was built.

Before the close of the fiscal year soundings were made with the lead over the two bars, (Saint Helen's and Columbia City,) to ascertain what changes had taken place in the depth of water through the channels, with the following results:

Saint Helen's Bar, (proper.)—New cut; river-boat channel, twelve feet in depth at low-water, between 19 feet curves for 350 feet, gradually increasing toward the extremities of proposed cut; the latter will be about 1,200 feet in length by 150 in width, and the fill an average of 6 feet through, to be removed to the depth of 19 feet at lowest low-water mark. Bottom is sand and loam.

Columbia City Bar, (proper.)—Old ship-channel; fifteen feet in depth at low-water, on the direct line of channel, and immediately opposite lower black buoy, between 19 feet curves, for less than 300 feet. This is the only place at low-water and ebb-tide where vessels sometimes touch. A depth of 19 feet can be had a little off and south of the direct line, and within the red buoy, but it is not used, as it takes vessels somewhat out of the straight course. The bottom is hard sand, covering perhaps a ledge of rocks. Boring will be made to ascertain to what depth the rock, if any, is reached; and, if the necessary marine armor can be procured, an attempt will be made to blast out a sufficient quantity so as to reach the plane of 19 feet below that of low-water. The length of the bar is less than 2,500 feet, with a width of 400. There is very little annual fill on this bar. Of the two daily high-tides, the highest water of the flood is 3 feet, reckoned from the level of the average lowest low-water. Tracings of the map of the locality, one in colors and one in entire black lines, are transmitted; the relative positions and soundings of the two channels are indicated.

VII.—SNAG ISLAND BAR, COLUMBIA RIVER.

This bar is at the northern lower end of Snag Island, about two and a half miles above the new cut across the "Hog's Back," at a point where the channels unite which pass on the two sides of it. The several river pilots have lately reported that no change of any importance has taken place there since the survey of the previous year. A depth was found

from soundings made during an examination at the end of June of over 15 feet at average low-water for a length of scarcely 200 yards; so that, with two daily strong flood-tides of from 6 to 9½ feet, merchant-vessels drawing not over 21 or 22 feet, and waiting for the tide to serve, can safely pass the bar, which is of a quicksand formation. A little scraping can easily better it if it should ever be found necessary. Gilman's Channel, to the south of the island, has deepened very considerably, it is reported, and is not unfrequently pronounced as better and having more water in it than the one now used, although it is said to be very narrow; this increase has no doubt resulted from the cut made during the fiscal year over the "Hog's Back." An early examination will be made of it. There were, previous to the late improvements over the latter shoals, so many worse places in the vicinity of the Snag Island Bar, that the latter was scarcely noticed until the ocean-steamers and sailing-vessels commenced running up the river at low-tide. This bar is shown on the tracing of the map submitted, and on which the last soundings are laid down.

VIII.—HOG'S BACK SHOAL, OR BAR, BETWEEN TONGUE POINT AND WOODY ISLAND, COLUMBIA RIVER.

In the annual report for the fiscal year ending the 30th of June, 1874, it was stated that by the 24th of that month—

A channel had been scraped down to 14½ feet, which enables a vessel drawing 21 feet to pass over the Hog's Back Bar at between half and full flood-tide without risk of touching. The deep-water channel below the cut has been very little affected by the deposits from the scraping. It is believed that the opening now made will continue to widen and deepen through the active and strong pressure of the current passing through Gilman's Channel, until it again assumes the form shown by the United States Coast Survey chart of 1870.

These predictions prove to have been well founded. A survey was commenced on the 23d of September following, under the immediate direction of Assistant Engineer R. B. Randall, a copy of the map of which, as prepared by him, is transmitted with the annual report. The principal object was to ascertain whether it would be necessary to dredge at a point below the lower-channel buoy, anchored to mark the edge of the old ship-course, and where vessels and steamers were reported to have grounded during the few previous months. A tide-gauge on the east side of Tongue Point, the zero of which was so arranged as to correspond with the average of lowest low-water, was first established; this was done by reduction from the bench set up during the previous spring operations. An examination was then made of the new cut scraped out during the month of June; this extends from buoys 12 and 15; and opposite beacon D it was found that the depth had increased a foot or more, with an evident tendency to widen out on the north side until it merges into what is called the "Blind Channel." Below the lower channel-buoy, at and around the course usually run by vessels, the soundings were found to be very irregular, and the bottom seeming to run in ridges. Some of these had but 10 or 12 feet of water on them, and would be liable to trouble a vessel attempting to pass over or run upon them by careless pilotage. The shoaling at this point appears to have been caused by a weakening of the current; this, apparently, was in consequence of the cut opened by the dredger having caused a large body of water to pass through to the westward, and which would probably find, or make, an outlet in that direction. This examination led to a more extended survey of all the

channels north of the "Hog's Back," which finally resulted in the discovery of an excellent one, having not less than $17\frac{1}{2}$ feet at its shoalest point, and that at an extremely low-tide. The new channel commences from buoy 11, passing beacons A and Middle-Channel buoy toward Tongue Point. The height of the tides is reckoned from the level of the average lowest low-water to which soundings are given on the Coast Survey charts. The greatest variation, as obtained from the "Tide Tables for the Pacific Coast of the United States," between the two high-waters of the same day during the several months of the present year 1875, is from 5.6 to 9.3 feet at Astoria, and about the same at the commencement of the shoals between four and five miles above, according to the varying phases of the moon at the different seasons of the year. This depth affords, at or near high-tide, an excellent channel-way over the celebrated, much-abused, and purposely-styled dangerous "Hog's Back." Ships drawing not exceeding 24 feet can safely cross without grounding. The bottom is a hard deposit of sediment, easily cut through, overlying quicksand; besides, the water is almost invariably smooth, and at no time sufficiently rough as to impede the progress of even river steamers of light draught. The depth in the cut is not sensibly diminished. The lowest soundings on the bar at the mouth of the Columbia River, as shown by the last chart, (1870,) are from $3\frac{3}{4}$ to 4 fathoms at average lowest low-water in the South Channel, between the breakers of Clatsop Spit and the Middle Sands; and from $3\frac{1}{4}$ to $3\frac{3}{4}$ through the North Channel, between the North Breakers and those of the Middle Sands. These depths are, of course, sensibly diminished by the ordinary heavy swells, and especially when the latter are caused by strong southwesterly and northeasterly winds. Vessels are not unfrequently compelled during the winter months to hold off from shore for a few days on account of the breakers, which at times sweep across the bar. As past experience proves, the bar can by no means be considered a dangerous one. Very few wrecks have ever taken place. Temporary spar-buoys having been placed in position to mark the lines of the new channel-way over the shoals, and prominent landmarks established, invitations were extended to several of the very best of the river-pilots to accompany my assistant in making an examination. After sounding and not finding any spot with less than 18 feet, they were satisfied that it would be a better channel than the old course previously used across the "Hog's Back." On the following morning, the 6th of October, the tide being very low, and the sand-banks bare, the ocean-steamer Ori-flamme, from San Francisco, passed through this new channel without difficulty, having always had heretofore to wait until about half-tide to be enabled to get past the old one. The United States light-house tender Shubrick having arrived at the port of Astoria on the same day to examine the buoys, a personal inspection was made from on board of her on the following afternoon, (the 7th,) and arrangements made to locate and mark the sites for the day-beacons which it was contemplated to erect. A special appropriation of \$3,000, to be expended under the authority of the Light-House Board, had been made for the establishment of these very necessary aids to navigation at or near the mouth of the Columbia River. In addition to several of the river-pilots, a few of the most prominent citizens of Astoria were invited on board to accompany me in making an examination. The former being more than any other persons interested in the location of the day-beacons, which, by actual test, have proved to be more economical and of more practical service than the iron-can or nun buoys especially being more distinctly visible at night, the selection of the

sites was left to their better judgment and experience. Tin cans, anchored by bags filled with stones, as buoys to mark their positions, were moored at or near the old iron buoys. The steamer then shifted the upper-channel buoy to the new channel to mark the turning-point, and then anchored a black buoy on its north side, opposite to its shoalest part. The reduced map of the survey, a tracing of which accompanies the annual report, has laid down upon it a number of soundings, many having been left out to avoid confusion. It indicates the courses of the old and new channels; the locality of the new cut; the sites of buoys and beacons, and the soundings in feet at the average lowest low-water mark, as obtained from the soundings made near the end of the fiscal year. The depth of the cut had by that time increased to 18 feet, and the new channel to 19. The latter, in connection with the new cut, as now used by the river-pilots, is frequently declared by them to be the best one discovered in the last twenty-five years. The very tempestuous weather experienced along the whole of the North Pacific coast during the months of November and December of 1874, and at intervals even extending until the first part of April of the next year, during which period the most terrific gales known for years were encountered by the shipping-marine at sea, as well as in some of the inland harbors, which were previously considered perfectly secure and safe anchorage-ground, prevented the commencement of the erection of the day-buoys until the 26th of February. The ice-blockade in the river, which first formed on the 14th of January, and broke up on the 8th of February, together with the floating ice which subsequently passed down and out to sea, also interfered with the prosecution of any work.

All preparations having been made for the erection of the beacons, the steam-tug Brenham, with the necessary piles aboard, towed the pile-driver to the new channel between Tongue Point and Woody Island, and operations were begun. Nine beacons were erected, the locations being designated by three of the river pilots. Each of them consists of a single pile, driven firmly into the bottom, and rising 15 feet above the line of low-water; near the top, two heavy planks in juxtaposition, both combined presenting a surface of 6 feet by 2 to the up-and-down course of the channel, are firmly spiked and braced to the pile. The cross-pieces are painted red or black, in accordance with the regulations of the Light-House Establishment, to show near which edge of the ship-channel they stand. The expense incurred, as already stated, was paid from the special appropriation enacted for the purpose. They are lettered in contradistinction to the numbers on the iron buoys. The latter were anchored in their new positions during a visit of the Shubrick, in the month of March of this year. The numbers of the buoys and the letters of the beacons, as laid down on the tracing transmitted, correspond with their actual positions on the shoals, as all of them have now been accurately located by survey. It was with great difficulty, on account of the heavy seas and high winds, with strong ebb-tides, that the relative positions of the beacons and buoys could be obtained with sufficient accuracy to be laid down on the map at the time of the erection of the former, and after the re-location of the buoys; but subsequently, during the latter part of June, they were all accurately defined. A more complete survey of the several channels between Tongue Point and Woody Island will be made after the annual June freshet of this year. The effect of this high water, produced by the customary annual extreme rise from above, will not be observable until some time after the close of that month, or during the early part of the current fis-

cal year. Owing to the great extent of the "Hog's Back" Shoals, which spread out to about ten miles in width at the broadest part between the shore-lines, there is no perceptible rise in the river at this locality; but the forces of the currents are in consequence of the freshets greatly strengthened, and these, aided by unusually strong ebb-tides, may wash out an entirely new channel. A careful examination after the waters of the upper river commence to recede can alone disclose any changes that may have resulted from the causes enumerated. Should a new channel be formed, the only existing remedy will be to properly locate it, thoroughly dredge or scrape it out, and distinctly mark its outlines. Very little except the necessary soundings need be attempted until the action of the freshet has been ascertained. It has been recommended that a portion of the appropriation "for the improvement of the Lower Willamette and Columbia Rivers, from Portland, Oreg., to the sea," be applied during the current year to all necessary examinations or surveys of the channels at the localities designated, and for the prosecution of such works of improvement as may be suggested by any changes in the regimen of the river. These must naturally be anticipated, but the final results of the June freshets could not be ascertained at the close of the fiscal year. The very great width to which the river expands, and the consequent formation of the extensive and numerous sand-shoals, would seem to interdict even the best-digested plans for the permanent improvement of any one of the channels across or near the "Hog's-Back" Bar. All the attempts, from the uncontrollable difficulties to be overcome, would prove but futile, and at a most enormous expenditure of money, without any beneficial equivalent in return. It may happen that no extensive work during the coming fiscal year will be necessary, except in making at different times the required examinations of the several channels. Should the future prove the necessity for any additional work to be done, it would be scarcely possible by any specific estimates even to approximate to the cost of the same. Before closing these remarks upon the improvements of this particular locality, the "Hog's-Back" Shoals, it may not be amiss to repeat a remark made by one of the citizens of Astoria; one apparently possessed of the greatest amount of energy, and a large proprietor of property in the place; also one of the owners of the bar pilot steam-tugs, and, consequently, the person most interested from individual motives in making that town the great commercial sea-port of Oregon; it was made in conversation with one of the assistants of this office. As the ocean-steamship *Ajax*, drawing 19 feet of water, was making ready to leave the Astoria wharf at a very low-tide to ascend the river to Portland, he remarked that the captain would not have dared at such a stage of water to attempt to pass through the new channel and cut at the "Hog's Back," unless they had been so well defined by the day-beacons; intimating, too, that he was not unaware of the existence of a sufficient depth of water entirely through them, if properly staked out, for all vessels able to cross the bar at the mouth of the Columbia. Previous to the improvements made, even ocean-steamers had to wait for hours for the flood-tide to serve before attempting the passage.

IX.—ASTORIA SAND-FLATS, COLUMBIA RIVER.

The United States Coast Survey Chart, sheet No. I, 1870, indicates by dotted surfaces the locality and dimensions of the flats. These at the average of lowest low-water are either bare, or only covered with but a few feet of water. Immediately along the front of the wharves of the town there appears to have been but little change since that year;

soundings made about the close of June give depths ranging from $2\frac{1}{2}$ to 5 fathoms. The point of a narrow ledge of rocks extends out and near to the farthest extremity of the outer line of the pile-foundation of one of them. Up to the present time five wharves have been constructed, (Holaday's or Steamer's, Flavel's, Saw-Mill, Farmer's, and Booth's;) these are built out to the edge of the flats, immediately along the front of the place, or to the 18-foot curve as it existed at the time. This sand, or mud, of which it is mainly composed, is either partly exposed at low-tide, or only covered with some few feet of water, not exceeding 8. This beach is a suitable one upon which to haul out vessels of light draught for repairs, as the tides rise sufficiently high for the purpose. There is a gradual fill being deposited along this frontage, the effect of the washing-down of earthy matter from the hill-sides upon the front slope of which many of the residences and churches are built, and more especially latterly at a time when most of the improvements by building and opening of streets have been accomplished. It is also increased by the sediment brought down and deposited from the river through the action of the ebb and flow of the tides. Owing to the great velocity of the ebb-tides at this point toward the ocean very little deposit appears to have so far formed during the past several years immediately in the channel; but it should be watched with a jealous care, and some means adopted to prevent the flats as far as possible from encroaching upon it. This fill will, in consequence, either cause in future a farther extension of the wharves, or will have to be removed by annual dredging.

The ship-channel way at the time of the last hydrographic survey by the United States Coast Survey parties (1868) was only about 850 feet between the 18-foot curves. The minimum soundings were recorded at $3\frac{1}{2}$ fathoms at lowest low-water. Scarcely, if any, greater depth can be carried through the channel and cut across the Hog's Back. The ocean-steamers, in order to make a landing at Astoria in approaching from up-stream, when a strong ebb-tide is flowing out, are compelled, in consequence of this narrow channel, to pass the wharf first and then drop down nearly a mile and a half, to where it widens out sufficiently to gain enough sea-room to allow the vessel to turn and head her bow up-stream; or else she has to drop an anchor and let her stern swing round. This is necessary so that she may, in this way, be able to approach the wharf without accident, and make fast her lines. As the last detailed surveys were made in 1868 and 1869, several years ago, under instructions from the Superintendent of the United States Coast Survey, it has been suggested, on a former occasion, that he be requested to again direct new hydrographic ones to be executed, not only at this particular point, but others of considerable importance. Some brief reference will be made to the latter in a subsequent part of this report. It has been proposed already that, in connection with the great importance and advancement of the much-desired improvement, of which so much mention has been made, that the project include, for the present, at least, the making of the necessary soundings, by one of the assistants of this office, in order to verify the old ones; and to measure the extent of the fill of the channel in front of Astoria, if one has taken place, with a view of ascertaining whether any necessity may exist for dredging immediately along the wharves. There seems to be but little doubt in regard to the formation of more extensive flats a short distance above Astoria. The funds for this additional expenditure, which will be small, can be taken from the appropriation for the current fiscal year, as the work, in reality, is a part of the plan of the general system of operations to be conducted along the Lower Willamette and Columbia Rivers from Portland, Oreg., to the sea.

X.—SURVEY OF SAND ISLAND, MOUTH OF THE COLUMBIA RIVER.

The annual survey of this island was made on the 4th and 5th of December, 1874, to ascertain the changes in its outlines, caused by the terrific gales from the southwest which swept along the North Pacific coast on the 23d and 24th of the previous month. The tides, which at the time were unusually high, united with the tempest in creating tremendously heavy seas, the waves being lashed into a violent fury. The entire island was completely submerged, with the exception of one very small sand-dune. Upon this a temporary hut had been erected by the mechanics employed in erecting two large range day-beacons to mark the course of the channel over the bar at the mouth of the river. The sites for these had been selected, and their construction commenced, in accordance with instructions from the Light-House Board. For this purpose a special appropriation had been made. The work was progressing satisfactorily when the extremely high sea, the highest known in eight years, agitated by the fury of the gale, flooded all the island save where the hut stood. Fear was entertained that even this would have to yield to the combined forces of wind and water, and as a precautionary measure a stout raft was built to be used in case of absolute necessity. The entire work of weeks upon the beacons was washed away in a few hours, and all the material lost except the masts or spars. Immense drift-logs, which had become deeply imbedded in the sand, broke loose from their anchorage to be carried out to sea. Upon the receding of the waters it was found that the southern portion of the island, in fact the whole of it, had entirely changed its outlines. The bench-marks and monuments of old surveys had been swept away out of sight; no traces of them existed within hundreds of yards of the newly-established line of low-water mark. A resurvey was consequently ordered, and accomplished during the month of December. Connections by angulations were made for future reference from the sites of the beacons on the island with the flag-staff of Fort Stevens, with the new light-house constructed on Point Adams, and with the Coast Survey signal on Willoughby Point. A map which exhibits the outlines of the island from the several surveys made in this and during several previous years, has been prepared. Copies, one in colors and the other with the outlines entirely in black, will be transmitted with this annual report. If any marked change shall take place it is proposed to make a resurvey during the current fiscal year.

XI.—BAR AT THE MOUTH OF THE COLUMBIA—ENTRANCE TO RIVER FROM THE PACIFIC OCEAN.

The United States Coast Survey Chart, sheet No. 1, 1870, is the last one published for distribution. The hydrographic survey was made in 1869. There can be no doubt that the lines of the 18-foot curves of Clatsop Spit, Middle Sands, and the North Sands have very materially shifted their positions since that year, and must annually do so, in consequence of the severe winter-gales and high-tides along this portion of the Pacific coast. The soundings in the two ship-channels, the north and the south, must have also undergone considerable variations at the same time. It is most respectfully and earnestly urged that the attention of the Superintendent of the Coast Survey be invited to this important matter. Although frequently represented so, the bar cannot be considered any more dangerous than the entrance between the heads of the Golden Gate into San Francisco Bay, especially as no sunken rocks have been as yet discovered. But a very few shipwrecks have ever

occurred, and those have almost invariably resulted from attempts to sail across it against a strong ebb-tide, either when the winds have not been propitious, or have died away before accomplishing the passage. It is proposed to occasionally send the hydrographic assistant of the office to verify the soundings on the bar, so that authentic statements, bearing an official character, can be furnished for the information of ship-owners and the masters of vessels. Reliable information will have a beneficial effect upon the rates of marine insurance, the more especially upon goods imported or exported in foreign bottoms. The greatest depth obtained on the bar, by one of the assistants, near the end of the fiscal year, was $21\frac{1}{2}$ feet. The soundings were made from the steam-tug Astoria, the bar pilot-boat, the best channel having been selected, for the purpose of showing the line of most water. The south channel is the one most generally used by all steamers and vessels entering the Columbia, especially those approaching from the south and west; while the north one is entered by some few coasting down from Puget Sound and more northern latitudes. The former is the more direct one of the two, and the wider. It has been more recently discovered than the latter, which is usually known as the "Old Channel." A very favorable comparison is drawn by a late president, Captain Maginn, of the New York Board of Pilots, between the Columbia River Bar and that at the entrance to New York Harbor. If it is allowable, a few lines will be transcribed upon the subject from the pages of a pamphlet issued under instructions of the board of trade, and styled, "Information for the guidance of foreign vessels proceeding to or from Portland, Oreg., on the North Pacific coast of the United States of America." These interesting pages are well worth an attentive perusal, as they furnish much valuable material in the shape of statistics concerning the Columbia River, especially useful to the masters of vessels. The captain reported in regard to the bar at the mouth as follows:

There is deep water on the bar, it having $4\frac{1}{2}$ fathoms without the addition of the tide, while New York Harbor has on the bar but 4 fathoms without the addition of the tide, which is 6 feet. The bar in the Columbia River is about a half a mile across, while that of New York is three-quarters of a mile. The channel of the bar at the mouth of the Columbia is about 6,000 feet at the narrowest and 12,000 feet at the widest, and then gradually shoals on either side, while the channel of the bar at Sandy Hook is about 600 feet, and shoals rapidly. The channel across the bar is straight at the Columbia; that at New York is crooked. As soon as the mouth is reached at the Columbia two channels present themselves: one on the South or New Channel, (discovered by Captain Wilkes's officers, who made the soundings,) entirely straight, and deep enough for ships of the line; the other the North or Old Channel, being crooked, or rather forming an elbow, and deep enough for any ship after crossing the bar. Both these channels are from 6,000 to 12,000 feet wide or more, and free from shoals; while the New York channels, after crossing the bar, are narrow and crooked, and beset with shoals, which require many changes of course in the ship.

In accessibility to the sea the Columbia River is the best, as it is immediately at the sea, and ships can get out of the sea into the harbor at once, and also get out at once into the high sea, and thus more easily elude "cruisers" in times of war. A great number of good and safe anchorages are found in the Columbia as soon as the ship enters, and there is room enough for thousands of vessels and water deep enough for ships of the line.

The winds at the mouth of the Columbia are marked, regular, and steady; while the winds at New York are entirely variable, and cannot be calculated upon by the mariner for any time.

The mouth of the Columbia is free from ice, and also from great heat. The current of the river is said to be strong; but I cannot see that it offers any serious obstacle.

After suggesting a number of precautions for the greater safety of shipping, such as pilots and tugs, all of which were adopted, the captain concludes his report by saying:

I would deem it a better harbor than that of New York, and capable of containing an unlimited number of ships.

From the same pamphlet another quotation is made, originally taken from the Commercial Herald, 21st of May, 1874, which reads as follows:

In the case of the Columbia River Bar there can be no room for doubt. The number of casualties that have occurred there is fewer than that of any other barred river known to commerce. Prior to 1852 there was no tonnage of note passing in and out of that river; but since that time the number of vessels crossing that bar has been 10,500, of which only eight, or less than one-thirteenth of one per cent., have been lost.

After enumerating a list of wrecks, seven in number, up to that date, it goes on to state that—

It will be observed that four of them were entering without pilots, at night. Furthermore, in each case the vessel was lost in sailing against the tide. Since the steam-tug Astoria was placed near the bar, in 1869, not a single loss has happened.

The pamphlet then observes that—

Since that date, up to the time we now write, but one wreck has happened, the coasting bark Architect, 200 tons, from San Francisco to Astoria, which ran on the sands while going in without a pilot or tug, and sailing against the tide, in April, 1875. This has been the only vessel lost since the tug-boat service was established in 1869, although in 1874 there were ninety-two vessels, with tonnage ranging each from 280 to 1,346 tons register, which entered and also cleared with full cargoes from the Columbia River; out of which eighty-five vessels were loaded with wheat and flour alone, direct for the United Kingdom. In 1874 there also entered sixty-four ocean-steamships, all of which proceeded up to Portland.

It also states that—

The only practicable objections to the Columbia Bar are: 1st, its shifting nature; and 2d, the strong ebb-current, which prevents vessels without a tug from beating in unless a breeze is blowing; and 3d, in a heavy storm it is rather dangerous for vessels drawing over 20 feet, heavily laden, going in without a steam-tug. These disadvantages are entirely overcome by using pilots and steam-tugs; the latter (third) disadvantage by running in at flood-tide, or by waiting the cessation of the storm. Fogs occasionally prevail at certain seasons of the year, and thus prevent the entrance from being seen.

This difficulty, it may be stated, has been obviated by the establishment of a fog steam-whistle on one side and a fog-bell on the other, at or near the mouth of the river.

XII.—POINT ADAMS, MOUTH OF THE COLUMBIA RIVER, OREGON.

This point is at the south entrance. By the recent customary survey made toward the end of June, in comparing it with other similar works annually made during the preceding several years, it is plainly seen what great changes have taken place in the outlines of this point. During the last year, as the result of the fall and winter storms, there has been a very marked effect produced. Accompanying this report is a tracing from the map illustrating the various results of the different examinations. It is plainly apparent that the river is making rapid inroads toward Fort Stevens, located on this point, the shore-line having advanced during the last year over 200 feet toward it from the northwest direction. It has been proposed, in the annual report upon the military defenses at the mouth, that means be taken to protect the shore against further encroachments for the better protection of the work. A light was shown on and after the 15th of February, 1875, from the light-house recently erected at a short distance south of the point, and nearly opposite to the outer channel-buoy. The illuminating apparatus is catadioptric, of the fourth order, lighting the entire horizon; the light is characterized by alternate red and white flashes, with intervals of ten seconds. A fog-whistle was also sounded on and after the same date at this station during thick and foggy weather, giving a blast of

seven seconds, with an interval of fourteen seconds, then a blast of four seconds, followed by an interval of thirty-five seconds. It may be stated that, during the late changes in the outlines of Point Adams and Clatsop Spit, a safe and smooth cove has been formed, which may prove a desirable location for a life-saving station; it terminates but a short distance from the recently-erected light-house.

XIII.—CAPE HANCOCK, (DISAPPOINTMENT,) MOUTH OF THE COLUMBIA RIVER, WASHINGTON TERRITORY.

This bold, rocky promontory, at the north entrance, has received no damage during the year from the effects of the storms and waves which unceasingly beat against it. Upon it are located the three batteries which constitute Fort Canby. This military post and batteries were designated by the Secretary of War, in General Orders No. 5, current series, 1875, from the War Department, as "Fort Canby," in honor of the distinguished officer of that name, and the promontory to be hereafter officially known as "Cape Hancock," (as designated on maps of the United States Engineer Office,) the name given May 19, 1792, to this promontory by Capt. Robert Gray, the discoverer of the Columbia River. On the pitch of the cape a light-house has been established since the year 1856. The illuminating apparatus is catadioptric, of the fourth order, lighting two hundred and thirty degrees of the horizon; the light is characterized as a fixed white light. At this station there is also a fog-bell, struck by machinery every ten seconds.

XIV.—REPAIRS OF OLD DREDGER AND SCOWS—PURCHASE OF A NEW DREDGER AND SCOWS—INDISPENSABLE AND INCIDENTAL EXPENSES—LOWER WILLAMETTE AND COLUMBIA RIVERS, FROM PORTLAND, OREGON, TO THE SEA.

From the appropriation for the current fiscal year a sufficient sum will have to be retained to meet the salary of the assistant engineers and the pay of the engineer and crew of the dredger, also that of office-messenger; the hire of the steam-tug used as a tender upon the dredger and dumping-scows, either to tow them into position from their moorings or to haul them out of the channel; the rent of office; the purchase of fuel, oil, the necessary tackle, anchors, hawsers, chains, buoys, small boats, and all apparatus needed for the working of the dredger; also the painting and calking necessary to the preservation of the boats; the repairs of machinery; the replacing of guide-poles, gauges, and many other details which constantly require attention. Additional expense is sometimes incurred by the removal of snags and cutting away overhanging branches and trees.

The repair of the boats and all preparations for the work are attended to during the one or two months of high water, probably July and August, previous to actively resuming the necessary yearly operations of dredging upon the several bars. Since the commencement, on the 1st of September, 1873, of the work, after the completion of the Government dredger, the old, dilapidated one of the city having been previously employed, the improvements on the two rivers have been executed in the most expeditious and efficient manner during the working seasons. These, unfortunately, are too short, owing to the inclement weather, high waters, and the time daily and necessarily expended in hauling the dredger and dumping-scows out of the channel for passing vessels. The operations extend over a distance of one hundred and ten

miles. It always has been the endeavor of this office to keep the work progressing as rapidly as possible, every advantage being taken of the most favorable state of the elements which war against labor of a like nature, and to have the expenditures judiciously and economically made. A much larger appropriation for the fiscal year ending the 30th of June, 1877, would be desirable, and could be most advantageously used in a furtherance of the work so propitiously begun. In the estimate submitted, which calls for a somewhat more increased sum than in previous years, the following are the main features that entered into the consideration of the subject whilst preparing it: The repairs and incidental expenses enumerated above for the necessary annual dredging; the construction of the dikes and dams recommended in the general project of improvement; and, finally, the purchase or building of an additional dredger, with its complement of scows. The reasons for the first two items have been made apparent in the previous portions of the report; and for an additional dredger of the most approved pattern there are many arguments to be advanced in favor of building it. The constantly increasing and valuable shipping-interests of the country, both in exports and imports, through foreign and home vessels, demand that not only every facility for trade be offered, but that no exigency should ever be allowed to happen by which the continually-growing navigation should be even temporarily interrupted. The limited season for work, the tedious delays and obstructions to be contended against, the speedy attainment of the required depth for sea-going vessels, and the maintaining of it throughout each day of each entire year, the relief experienced at not being entirely at the mercy of the elements, but to be prepared against all accidents to boats and machinery, these all are arguments, each one in itself, why an additional dredger should be always held in readiness, not only to do its own required work, which alone will tax all its power, but to be at hand in case of any great emergency.

XV.—IMPORTANCE OF IMPROVEMENTS—STATISTICAL INFORMATION.

It was intended to submit in this annual report for the fiscal year ending the 30th of June some interesting statistical information in regard to the exports and imports of this favored section of the United States, and to adduce in full well-prepared and reliable data as to its resources, with a view of placing them in the most favorable light before the progressive men of the age, those who are most interested in advancing all the great interests of the country at large; also, to impart useful information to the large class of people who come to the Pacific coast in search of permanent homes. In this matter, however, the board of trade of this city have anticipated the report, by issuing within the last week, not any too early, the pamphlet to which reference has been previously made, and from which copious extracts have been drawn; also, by distributing on previous occasions the several papers bearing the titles of "Western Oregon," "Sheep-farming in Oregon," and "Oregon, its Climate, Resources, and Prospects." These all contain valuable information, and are worthy of a careful perusal. It would be desirable to draw largely upon their pages, but the length of this report is already too much extended. Tabulated statistics, however, of the commerce of this port are furnished for the fiscal year, as well as the detailed list of exports to foreign countries for the current harvest-season of nine months, from September, 1874, to June, 1875, both months inclusive.

A letter was addressed on the 1st of July to Mr. William Reid, Secre-

tary of the Board of Trade of Portland, in this State, requesting certain information for this office regarding "the amount of tonnage to date, especially of grain and flour, exported from Oregon direct from this port in ocean-bound steamers and sailing-vessels, both to home and foreign parts. This information is necessary in connection with the improvements of the Willamette and Columbia Rivers from Portland to the sea, as the views in full of the officer in charge have been requested as to the necessities and requirements of commerce and navigation at this locality." It was suggested that condensed statements from the records of the Portland and Astoria custom-houses would be desirable, so that they might be incorporated in the official report for the fiscal year. In reply, by letter of the 13th of July, Mr. Reid, in regretting that he could not sooner give the information, writes as follows:

I have got compiled from the custom-house records the information you now seek as to the commerce of this port, which I now inclose. It is, as I supposed you wished it, simply an abstract of the commerce for the fiscal year ending 30th of June, 1875. I also inclose you a list of the ships, grain-ships, (with wheat and flour) which departed from Oregon during said fiscal year. Permit me to ask you to represent to the War Department the fact that the reason why we in Oregon collect so little revenue for the United States on imports is because nine-tenths of our imported goods come to us from foreign ports via San Francisco, and consequently our custom-duties are nearly all paid at that port on foreign imports coming to Portland. As our trade develops, direct imports to Portland will increase, but in the mean time we labor under the erroneous impression that the revenue from imported, foreign goods received into Oregon is trifling, for the reason already given, that these duties are nearly all paid at the San Francisco custom-house on Oregon imports.

COMMERCE OF PORTLAND, OREGON, YEAR ENDING JUNE 30, 1875.

The domestic commerce of our port is shown in the following exhibit of monthly arrivals in our port for the fiscal year ending June 30, 1875:

<i>In July.</i>		<i>January.</i>	
No.	Tons.	No.	Tons.
8 steamships.....	10, 239	2 steamships.....	1, 495
6 sailing-vessels.....	3, 052	1 sail.....	550
<i>August.</i>		<i>February.</i>	
5 steamships.....	7, 055	4 steamships.....	4, 190
5 sail.....	2, 044	7 sail.....	3, 450
<i>September.</i>		<i>March.</i>	
6 steamships.....	8, 902	6 steamships.....	5, 582
6 sail.....	2, 467	5 sail.....	2, 000
<i>October.</i>		<i>April.</i>	
4 steamships.....	5, 838	6 steamships.....	6, 160
4 sail.....	1, 520	4 sail.....	2, 055
<i>November.</i>		<i>May.</i>	
6 steamships.....	6, 738	8 steamships.....	8, 563
5 sail.....	2, 079	5 sail.....	2, 030
<i>December.</i>		<i>June.</i>	
4 steamships.....	4, 465	6 steamships.....	7, 719
3 sail.....	1, 4	3 sail.....	1, 500
<i>Recapitulation of foreign and domestic.</i>			
65 steamships.....			76, 999
53 sail.....			24, 247
83 sail to foreign ports.....			83, 252
201	Total tons.....		184, 898

These vessels took away of our grain-crop as follows:

	Tons.
Wheat to foreign countries	70,488
Flour to foreign countries	12,764
Wheat to California	1,450
Flour to California	7,204
Oats to California	8,625
Flour to Victoria and northern ports by water, (estimated).....	2,250
Total	102,781

Oregon exports of wheat and flour, 1874-75, furnished in detail.

WHEAT-EXPORTS TO DATE.

Cleared.	Vessels.	Centals.	Value.
Sept. 16	British bark Alumini, Liverpool	24,159	\$36,238
22	British bark Hermine, Liverpool	18,562	27,840
30	British bark Moonbeam, Queenstown	20,939	31,670
30	British bark Marianne, Cork	14,157	21,250
Oct. 1	British ship Orissa, Queenstown	37,442	57,442
3	British bark Zulette, Queenstown	23,171	36,200
12	British bark Ramolino, Queenstown	12,872	18,859
15	British bark Huntley Castle, Queenstown	20,163	30,245
17	British bark St. Nicholas, Cork	24,631	33,251
19	British bark Brighton, Cork	14,794	21,058
27	American bark Clara, Queenstown	17,133	24,840
29	British ship Sarah Scott, Queenstown	18,639	27,500
30	British bark Lauretta, Cork	16,465	23,900
—	British bark Soren Brenner, Cork	17,726	25,261
Nov. 2	British bark Arbutus, Queenstown	7,264	10,533
2	British bark Beulah, Queenstown	23,250	34,275
10	British bark Hotspur, Liverpool	16,358	23,719
11	British ship Prince Charlie, Queenstown	40,096	60,144
12	British bark Glenlyon, Queenstown	21,278	30,210
12	British ship Dovenby, Liverpool	8,176	12,264
16	British bark Sattara, Queenstown	28,819	40,343
18	British bark St. Patrick, Cork	23,520	32,400
19	British ship Agra, Queenstown	20,263	27,750
20	British ship City of Dublin, Liverpool	2,243	3,252
20	British bark Windermere, Cork	24,977	34,900
20	British bark Harrington, Liverpool	17,932	25,104
25	British bark One, Liverpool	15,623	22,654
Dec. 2	Nemphar, Cork	29,084	40,700
2	British bark Dusinane, Cork	10,195	14,782
9	British bark J. Wishart, Queenstown, (orders)	23,027	33,389
9	British ship Roslin Castle, Cork	20,805	32,600
14	British bark Globe, United Kingdom, (orders)	22,378	34,200
14	British bark C. McLeod, Queenstown, (orders)	21,923	31,326
15	American ship F. N. Thayer, United Kingdom, (orders)	37,278	54,792
17	British ship Zelica, Cork, (orders)	31,125	43,575
19	British bark Rifle, United Kingdom, (orders)	10,125	14,681
26	Norwegian ship Gungner, Cork, (orders)	18,440	25,800
26	British ship Gloria, Cork, (orders)	24,583	35,500
28	British ship Privateer, Cork, (orders)	29,090	40,700
28	British ship Valparaiso, Cork, (orders)	23,236	33,111
30	Norwegian bark Aftensjarnen, United Kingdom, (orders)	16,870	24,462
30	British bark City Camp, United Kingdom, (orders)	31,920	45,484
31	Norwegian ship Heros, Cork, (orders)	18,879	26,760
Jan. 2	British bark Caribou, Cork, (orders)	22,238	32,247
2	British ship Roseneath, Cork, (orders)	19,893	28,844
9	Norwegian bark Grundloren, United Kingdom, (orders)	25,660	36,565
23	British ship Middlesex, Liverpool	31,008	51,000
23	British bark Windward, United Kingdom, (orders)	18,416	29,244
25	British ship Lizzie Troop, United Kingdom	19,-66	27,356
27	German bark Willie Rickmer, Cork	26,980	37,700
Mar. 1	British ship Muriel, Queenstown	19,632	27,990
20	British ship Conflict, United Kingdom, (orders)	32,169	48,253
Apr. 3	British bark Wetterhorn, Cork, (orders)	21,950	30,740
6	British ship Euterpe, United Kingdom, (orders)	32,754	45,900
8	British ship Lennox Castle, Cork, (orders)	21,932	33,380
25	Persian ship Pactolus, Cork	34,806	49,599
27	British ship Sussex, Liverpool	38,267	57,400
30	British bark Corsica, Cork, (orders)	24,273	34,609
May 7	British ship E. Dougall, Cork, (orders)	16,700	25,218
18	British bark Clifton, United Kingdom, (orders)	11,804	18,900
June 5	British bark Carn Tual, Cork, (orders)	15,330	27,500
Total to date		1,299,318	1,907,490

EXPORTS OF FLOUR TO DATE.

Cleared.	Vessels.	Barrels.	Value.
Sept. 30	French bark Marianne	784	\$3, 200
Nov. 2	British bark Arbutus, Queenstown	1, 934	7, 736
7	British bark Eliz. Dougall, Hong-Kong	5, 455	19, 841
12	British ship Dovenby, Liverpool	10, 000	42, 500
16	American ship Garibaldi, Hong-Kong	1, 416	5, 397
20	British ship City of Dublin, Liverpool	12, 508	48, 468
27	Hawaiian bark M. Macleary, Honolulu	355	1, 548
Dec. 19	British bark Reindeer, Cork	4, 568	20, 555
21	British bark Lamari, Rio Janeiro	10, 092	40, 368
24	British ship Cordova, Liverpool	8, 350	35, 000
Feb. 22	British ship Parsee, Liverpool	20, 287	86, 222
25	British ship Lizzie Troop, United Kingdom	12, 000	51, 000
Mar. 4	British bark Spirit of the Dawn, Liverpool	11, 881	48, 700
Apr. 17	British ship La Escocesa, United Kingdom	16, 875	69, 167
—	British bark Arauco, Liverpool	10, 016	40, 064
May 21	Bremen bark Gazelle, Hong-Kong	6, 218	25, 510
	Total to date	124, 530	634, 176

About the highest number of registered tons of any ship was that of the La Escocesa, Captain D. Evans; destination, United Kingdom. She sailed from Portland, with a cargo of 16,875 barrels of flour. She drew, when loaded, 18½ feet. The captain "considers a vessel as safe, with the use of a steam-tug and pilot, in entering the Columbia River, and going over the bar, as going into any harbor in ordinary weather." An exhibit is also made of the increase in number and tonnage of vessels from 1870 to 1874, both inclusive, in which it will be found that in both instances the increase has been more than twelve-fold in the last five years, and almost doubled in number, and more than doubled in tonnage, during the year 1874 over that of 1873. In 1874, the Oregon wheat and flour exports to Europe direct were carried in seventy-five vessels, with a sum total of cargoes amounting to 70,530 (English) tons. These figures are taken from well-ascertained data, and kindly furnished by Mr. Bernard Natorp, manager for Rodger, Mayer & Co., one of the most reliable shipping-houses at this port. These quantities do not include large consignments to South America, Sandwich Islands, Australia, China, and Japan. To show the rapid increase in vessels and tonnage, the table, as prepared by him, has been copied for this report.

Oregon wheat and flour exports to Europe direct.

Year.	Number of vessels.	Cargo, in English tons.
1870.....	6	4, 379
1871.....	11	9, 328
1872.....	17	15, 215
1873.....	39	38, 256
1874.....	75	70, 530

The governor of the State of Oregon, in his last message to the legislature, delivered September 16, 1874, says:

The value of our exports has reached a sum certainly exceeding \$10,000,000. I estimate the export-value of our wheat and flour at nearly \$4,000,000, gold; of oats, other grain, and fruits, at \$1,000,000; of wool, hides, meats, cattle, and horses, at \$2,000,000; of salmon, at \$1,500,000; of lumber and coal, at \$1,000,000; of gold, silver, and iron, at \$1,500,000. This exhibit for a population of 100,000 people is almost without a parallel.

Much the greatest amount of exports passes out from the Columbia River, on which the principal shipping-port of the State is built. The next most important ports are on Coos Bay.

XVI.—APPROPRIATIONS.

A table presenting the amounts of the several appropriations annually made by the Congress of the United States, and expended during the past several years, is appended. As figures cannot deceive, it exhibits too plainly the very small percentage of the value of exports to foreign ports of wheat and flour alone which the Government has donated for the benefit of the improvements on the Lower Willamette and Columbia Rivers.

The total amount of appropriations for *nine* years is less than 8 per cent. of the value of the foreign wheat and flour exports for *one* year, the fiscal one of 1874-'75.

Appropriations by Congress.

	In currency.
1867-'68, appropriated.....	\$30,000
1868-'69, appropriated.....	21,000
1869-'70, appropriated.....	15,000
1869-'70, allotment.....	13,365
1870-'71, appropriated.....	31,000
1871-'72, nothing appropriated.....	
1872-'73, appropriated.....	50,000
1873-'74, appropriated.....	20,000
1874-'75.....	20,000
Total.....	200,365

During the several months of the fiscal year 1874-'75, from September to June, both inclusive, the value of the exports of grain and flour alone to foreign ports exceeded \$2,540,000; and almost the entire amount of that, over 80,000 tons, was shipped direct to the United Kingdom of Great Britain. The value of imports, which are of a mixed nature, either domestic or foreign, are not considered in the count, as the revenues on most of them are collected in San Francisco, the first port of entry. Having been directed to submit in full such views as may be entertained in regard to the necessities and requirements of navigation and commerce along the waters of the Lower Willamette and Columbia, it would seem that the quotations of figures and facts just presented for investigation, amply demonstrate the great and growing, and immediate necessity of placing, and subsequently maintaining, these rivers in a condition such as their great importance and usefulness demand.

Financial statement.

Amount appropriated by act approved March 3, 1875.....	\$20,000 00
Amount expended during the fiscal year ending June 30, 1875.....	13,374 26
Amount available July 1, 1875.....	6,625 74
Amount required for fiscal ending June 30, 1877.....	50,000 00

XVII.—TABLES.

The accompanying tables are appended for general information.

No. 1.—*Tables of distances.*

	Miles.		Remarks.
PORTLAND.			
Swan Island Bar	2	2	
Head of Willamette Slough, (Post-Office Bar.)	7	9	Through slough to Saint Helen's, 23 miles.
Junction of Willamette and Columbia	3	12	
Saint Helen's	18	30	
Columbia City	3	33	
Kalama	12	45	Terminus of Northern Pacific Railroad, 105 miles to Tacoma and Puget Sound by rail.
Rainier	7	52	
Monticello	3	55	On the Cowlitz River.
Oak Point	12	67	
Eagle Cliff	3	70	
Westport	10	80	
Cathlamet	80	
Astoria	32	112	Astoria to Fort Canby, Cape Hancock, 12 miles.
Fort Stevens, (Point Adams)	12	124	Astoria to Fort Stevens, Point Adams, 7 miles.
Mouth of Columbia	3	127	

No. 2.—*Table of high-waters at Astoria, reckoned from the level of average lowest low-water for the year 1875, as prepared and published by the United States Coast Survey.*

Date.	Highest high-water.	Date.	Lower high-water.	Remarks.
	<i>Feet.</i>		<i>Feet.</i>	
Jan. 5, 1875	8.6	Jan. 31, 1875	5.7	The tides on the western coast of the United States are of so peculiar and apparently complicated a character that it is deemed well to give a general explanation of them here. There are generally in each twenty-four hours, or rather in each lunar day of twenty-four hours fifty minutes, two high and two low waters, which are unequal in height, and occur at unequal intervals, in proportion to the moon's declination, differing most from each other when the moon's declination is greatest, and least when the moon is on the equator. The high and low waters generally follow each other thus: Starting from the lowest low-water, the tide rises to the lower of the two high-waters, then falls slightly to a low-water, which it is sometimes merely indicated by a long stand, then rises to the highest high-water, whence it falls again to the lowest low-water. See preface of "Tide-tables for the Pacific coast of the United States for the year 1875."
Feb. 24, 1875	8.6	Feb. 14, 1875	5.6	
Mar. 24, 1875	9.3	Mar. 1, 1875	5.6	
Apr. 8, 1875	9.3	Apr. 13, 1875	5.9	
May 7, 1875	9.3	May 11, 1875	6.4	
June 5, 1875	9.3	June 9, 1875	7.0	
July 4, 1875	9.1	July 17, 1875	7.0	
Aug. 2, 1875	8.8	Aug. 1, 1875	7.5	
Sept. 1, 1875	8.3	Sept. 23, 1875	7.4	
Oct. 27, 1875	8.1	Oct. 24, 1875	7.0	
Nov. 12, 1875	8.9	Nov. 21, 1875	6.5	
Dec. 11, 1875	8.7	Dec. 21, 1875	5.9	

No. 3.—Table of high-waters above lowest low-water mark at different localities on the Columbia and Willamette Rivers during the fiscal year ending June 30, 1875.

Month.	Monday.		Tuesday.		Wednesday.		Thursday.		Friday.		Saturday.		Remarks.
	Date.	Height.	Date.	Height.	Date.	Height.	Date.	Height.	Date.	Height.	Date.	Height.	
1874.													
September.....	14	" "	15	" "	16	3 0	17	12 10	18	2 3	19	2 0	Mouth of Willamette. Do. Do.
	21	2 0	22	1 10	23	2 0	24	2 4	25	2 4	26	2 4	
	23	17 4	29	17 0	30	17 0							
October.....	5	1 3	6	1 3	7	1 3	8	1 6	9	1 6	10	1 4	October 10, moved to Post-Office Bar. Post-Office Bar. Do. Do.
	12	1 6	13	1 6	14	1 6	15	1 4	16	1 0	17	1 0	
	19	1 0	20	1 0	21	1 0	22	1 0	23	1 6	24	1 6	
	26	1 6	27	1 6	28	1 6	29	1 3	30	1 3	31	0 6	
November.....	2	1 0	3	0 8	4	1 0	5	1 0	6	1 0	7	1 0	November 10, dredger moved out of position.
	9	2 4	10		11	2 6	12	2 6	13	3 0	14	3 6	
	16	2 6	17	2 4	18	2 0	19	1 8	20	1 0	21	1 0	
	23	1 6	24	6 0	25	8 0	26	8 0	27	7 6			
December.....	30	5 6	1	5 6	2	5 0	3	5 6	4	6 6	5	December 5, dredger ceased operations on account of high-water.	
1875.													
March.....	29		30	18 6	31	18 6							March 29, moved dredger to New Cut, Saint Helen's.
April.....	5	6 0	6	5 3	7	4 6	8	4 0	9	2 6	10	2 6	Saint Helen's. Do. Do.
	12	1 6	13	2 6	14	1 6	15	2 0	16	3 6	17	4 0	
	19	7 0	20	8 0	21	8 4	22	9 0	23	9 6	24	10 0	April 30, moved dredger back to Portland.
	26	10 0	27	9 6	28	9 6	30	9 0					
May.....	3	12 7	4	12 9	5	13 4	6	14 4	7	14 9	8	16 6	
	10	16 6	11	16 4	12	15 7	13	15 0	14	14 7	15	14 5	
	17	14 8	18	14 8	19	15 2	20	15 2	21	15 0	22	14 7	
	24	14 8	25	14 8	26	14 8	27	14 9	28	14 9	29	14 1	
	31	14 0											
June.....	7		8	13 9	9	12 2	10	12 2	11	12 6	12	13 2	
	14	14 0	15	14 4	16	15 0	17	15 6	18	16 2	19	16 8	
	21	17 6	22	18 0	23	18 1	24	18 1	25	18 0	26	17 9	
	28	17 6	29	17 4	30	17 2							
	23	17 6											

No. 4.—Table of lengths, widths, and depths of cuts by United States dredger, together with quantities of material removed from bars in the Willamette and Columbia Rivers, during the fiscal years of 1872, 1873, 1874, and 1875.

FISCAL YEAR ENDING JUNE 30, 1872.

		Length in feet.	Width in feet.	Depth in feet.	Cubic yards.	Remarks.
Swan Island Bar.....	Willamette River.....	4,400	100	17.	16,296	Maj. H. M. Robert's report. Work performed by the old city dredger.
Post Office Bar.....	do.....	1,000	100	15.	3,703	
Mouth of river.....	do.....	475	120	15.	2,111	
Total amount of material removed.....					22,110	

FISCAL YEAR ENDING JUNE 30, 1873.

Swan Island Bar.....	Willamette River.....	4,400	100	17.	21,560	Maj. H. M. Robert's report, August 10 to December 19. Only a slight change, September 11 to 30. Work performed by old city dredger.
Post Office Bar.....	do.....	400	60	15.5		
Mouth of river.....	do.....	500	120	15.5	4,165	
Total amount of material removed.....					25,725	

FISCAL YEAR ENDING JUNE 30, 1874.

Swan Island Bar.....	Willamette River.....	4,400	100	17.	(*)	Maj. N. Michler's report. Government dredger completed the last of August; towed to mouth of Willamette September 1; completed work at mouth November 19; commenced work at Post Office Bar November 21 and continued until December 9; stopped on account of high water; operations resumed March 19 and continued to April 1 and then suspended on account of freshet. No work upon Swan Island Bar during the year.
Post Office Bar.....	do.....	776	60	17.	5,100	
Mouth of river.....	do.....	450	120	17.	9,250	
Total amount of material removed.....					14,350	

FISCAL YEAR ENDING JUNE 30, 1875.

Swan Island Bar.....	Willamette River.....	4,000	100	17.	1,800	Maj. N. Michler's report, November 10 to 25 and December 2 to 5. Interval engaged in removing log from channel and repairing machinery broken by it; suspended on account of high water; on December 5 removed dredger to old anchorage-ground below Portland. October 10 to November 7, 1874, moved dredger to Swan Island Bar.
Post Office Bar.....	do.....	391	70	18.	7,050	

Mouth of Willamettedo	234	110	-17.5	4,600	September 12 to October 8, 1874, moved dredger to Post Office Bar. Previous examinations made of all the bars preparatory to commencing operations. Dredger arrived on March 23; soundings made; gauges established; beacons arranged; commenced dredging March 29, completed April 27; cut not completed; work suspended on account of high water; dredger towed back to Portland April 28. Survey commenced September 25; new cut examined, and a new and better channel below it also discovered; sites for beacons located and marked; final examination made October 7, 1874; during the last few days of February, 1875, the day-beacons were placed in position to mark the channel along its entire length.
Saint Helen's Bar, (new cut).	Columbia River	600			3,750	
Hog's Back, (between Tongue Point and Woody Island.)do				(f)	

* No work.

† Scraped out.

No. 5.—*List of tracings of maps of the Lower Willamette and Columbia Rivers from Portland, Oreg., to the Pacific Ocean.*

1	A ^a and A ^a 2	Swan Island.
2	A ^b and A ^b 2	Mouth of Willamette and Post Office Bar.
3	A ^c and A ^c 2	Saint Helen's Bar, Columbia City Bar.
4	A ^d and A ^d 2	"Hog's-Back" Shoals, between Tongue Point and Woody Island.
5	A ^e and A ^e 2	Point Adams.
6	A ^f and A ^f 2	Sand Island Survey.
7	A ^g and A ^g 2	Sand Island.

G G 2.

IMPROVEMENT OF THE WILLAMETTE RIVER ABOVE OREGON CITY,
OREGON.

The report in regard to this improvement for the fiscal year ending the 30th of June, 1875, is respectfully submitted. The operations consisted in the removal of snags, roots, rocks, and overhanging limbs of trees, with such other obstructions to the navigation of the river as were deemed necessary. These were all executed by the United States snag-boat, manned by a master and a crew of seven men under the employ of the Government. In a great many cases giant-powder was successfully used in blowing to pieces and loosening such snags as were deeply embedded in the gravel or sand, and which resisted the power of the boat. She was amply supplied with the usual mechanical appliances of derricks, capstans, gearing-tackle, and a full assortment of all necessary tools for the performance of the work. The machinery was worked by hand. The boat was either warped from point to point at the scene of her labors, or between distant points was towed by the steamboats plying regularly on the river. As the appropriation for the fiscal year was so very limited, no additional improvements could be attempted with a view to deepen the bed at many points where bars and elbows exist, by either the dredging process or by the construction of wing-dams, or by longitudinal dikes for the establishment of uniform channels, made of continuous piles, backed by heavy timbers. Many useless sloughs, however, were closed by cutting trees across them, and damming them by floating drift, in order to increase the volume of water in the main channel. The following is a brief synopsis of the work performed, prepared from the monthly reports for the year:

1874. *July*.—Snag-boat, after being thoroughly calked and painted, was towed to Jarvis' Slough on the 15th of July. Thirty snags were removed at this place, many of them by the aid of giant-powder, averaging from 30 to 150 feet in length and from 1 to 5 feet in diameter.

August.—Snag-boat still continued to work at Jarvis' Slough for a time, and during the remainder of the month opposite to Wheatland. Fifty snags and stumps were taken out, at an average of 75 feet in length by 6 in diameter. Many of these trees were so long that it became, in many instances, necessary to saw and cut them into from four to nine pieces. Giant-powder was found to be indispensable for the removal of stumps where firmly embedded, which was frequently the case in the bottom of the river, and considered dangerous obstructions to navigation.

September.—Snag-boat was engaged between the 1st and 12th of the month in removing snags, stumps, and rocks from the following localities: Gates' Bar, Jackson's Warehouse, Five Islands, Davidson's Landing, and Champoeg. Seventeen snags and stumps were removed from these several places, their total length being over 1,000 feet, with an average of 7 at the butt. This being completed, operations were commenced at Rock Island on the 13th. Capstan was repaired and drills sharpened. Floating stage was also prepared and work begun on the rocks. A boulder among the Taulitan rocks, 6 feet in diameter, was also blasted and displaced from the channel.

October.—From the 1st to the 14th of the month the snag-boat remained at Ash Island, removing forty-two snags, ranging from 20 to 200 feet in length and in diameter from 1 to 4½ feet. Thence she was towed to Carey's Bend, where she lay until the 20th, displacing twenty-

two snags of from 20 to 90 feet, some of which were deeply embedded in the gravel, and consequently very difficult to remove. On that day she reached Weston Bend and took out thirty more; it was there necessary to use the powder. On the 27th she arrived at Bennett's Dread; at this place three large stumps were blasted to pieces, and twelve trees cut down from off the land which raked the cabins of passing steamers as they hugged the banks to avoid the currents. The boat was then dropped down to Chrisman's Bar, where eight snags were pulled out.

November.—Work was continued at the same locality for a few days. Thence the boat was temporarily dispatched to the mouth of the river to remove some dangerous snags which had lodged across the only channel for ocean-steamers and sailing-vessels. She arrived there on the 7th, and continued operations until the 25th. Subsequently, a very long snag was dragged out and cut to pieces from the channel and anchorage in front of Portland.

Thirty-two large trees and stumps were removed from the mouth; of the former the largest was 180 feet in length and 16 feet in circumference at the butt. The boat was then towed to Canemah, about two miles above Oregon City, at the falls of the Willamette, where she was temporarily laid up for the winter and the crew discharged.

December.—No work accomplished on account of high water in the river. During this freshet many new snags became lodged in the channel, rendering navigation dangerous and difficult.

1875, *January.*—Operations were still suspended for the same cause. The steamers Shoshone and Albany were snagged, and nothing but the machinery saved from the wrecks. On the 2d of the month, the following report was rendered by Capt. James Wilson, pilot of the Governor Grover, as to the localities and numbers of snags which had lodged in some of the most dangerous places during the winter high waters:

	Snags.		Snags.
At Ash Island	4	Turntable	8
Weston	1	Peoria	5
Bennett's Dread	1	Mouth of Long Tom.....	4
Five Islands.....	2	Eagle Bend.....	1
Mouth of Danger Slough	1	Coreovan Root	5
Bitterman's Bend	9	Hamilton Warehouse	2
Buena Vista.....	6	Irish Bend.....	6
Spring Hill.....	3	Monroe Landing	10
Between Albany and Corvallis.....	15	Spelling's Fish Bend	6
Mouth of East Channel.....	5	Elfin's Chute	5
Booneville Slough	12	Harrisburgh Bend	12
Raft snags.....	4		
		Total	127

Between Harrisburg and Eugene City they were too numerous to count.

February.—On the 8th of the month the crew of the snag-boat was again shipped.

On the 9th and 10th she was towed by one of the river-steamers to Salem, to attempt the removal of a large snag near that place, the same upon which the Shoshone had been sunk a few weeks before. On the 11th she worked with success in pulling it out, but the steamer proved to be too badly damaged to attempt to do anything for her in the way of repairs, and she was consequently abandoned, after her machinery had been removed. On the 12th, the snag-boat was towed up past Albany to Magoogalon's Slough, where four snags of the usual dimensions were displaced. Subsequently she was taken up on the 13th, and commenced operations at the mouth of Booneville Slough, four miles above Corvallis. At this locality, during the remainder of the month,

one hundred and ninety-three snags, from 150 to 30 feet in length, the majority of them very long, were removed, cut up, and thrown on the bank, completely out of the way, on account of the narrowness of the channel; it is two miles long, and full of obstructions throughout its entire length.

March.—The snag-boat continued operations at Booneville Slough until the 8th of this month, during that time disposing of thirty additional snags. On the 9th, she was taken up to Turntable, at the head of Big Island. This is a peculiar elbow, where the channel takes a sudden bend; a boat in descending at high water, first runs into the right-hand channel for a short distance, then, after making a complete rotation, shoots back into the left one before resuming its course. Forty-eight snags were pulled, all averaging about the same dimensions as at previous places. On the 20th, the snag-boat arrived at Peoria; at this place seventeen snags were taken out from a new chute, which has been used by steamboats since the closing of the east channel. Many overhanging trees were cut down. On the 25th, she reached Wilson's Chute. On account of a rapid rise in the river at this time, the water assumed a very muddy appearance, and it became impossible to see the snags. The masses of drift from above also endangered the boat so that her position had to be shifted to secure her safety. Very little work was, in consequence, accomplished at this place; it was found necessary to postpone it until a more favorable time should offer during the down trip. On the last day of the month the snag-boat was towed up to Harrisburg Bend.

April.—Operations were commenced soon after the beginning of the month; the boat had to be shifted often on account of drift-wood, much of which was caught and used for filling up the mouths of useless sloughs. In consequence of the rise in the river from the melting of the snow in the mountains, and the effect of the warm weather, which had been recently experienced, the work with the snag-boat was frequently suspended. On such occasions the men were engaged on a large drift formed at the head of Wilson's Slough—working, with the skiff, lines, axes, and saws, Spanish windlass, and small tackle, by hand. During the month forty trees and stumps were removed at Harrisburg Bend from the small and large sloughs, and two hundred similar obstructions from the head of the chute. The deck of the boat and the sheers of the hoisting-apparatus were painted during the time she was not otherwise employed. On the 26th, she was lined up part of the way to Harrisburgh. The mouths of three sloughs near that place, which carried off a large body of water from the main channel, were filled with drift and closed.

May.—Work was continued at Harrisburg Bend for the first six days of this month, during which time twenty-six snags were removed—all that could be seen above the surface of the water. It was then necessary to suspend further operations, on account of high water and its muddy condition. It had commenced to rain very hard much earlier than was anticipated. Between the 24th and 29th, the master and crew were detached from the snag-boat and directed to assist the steamer Ohio in cutting her way through a drift-pile in a new chute, afterward known as the Ohio Chute, which the river had recently opened for itself. Between two successive trips of the steamer the old channel had become almost dry and useless, only one out of the many hundred freaks of the same nature caused by the velocity of the current receiving some sudden check from newly-accumulated drift or rafts. Upon returning to the snag-boat several more snags were removed, the water

having become clear and low. The river was found to be full of obstructions between Corvallis and Harrisburg, and its condition far worse between the latter place and Eugene City.

June.—On the 4th of this month the snag-boat drifted down to Ingram's Bend, and subsequently to Alpin's Chute, a mile below the former, and about the same distance above Wilson's. From these two localities one hundred and thirty-five obstructions were removed; stumps and snags from 180 to 30 feet in length, and in circumference from 4 to 19½ feet. A great portion of these were deeply imbedded in the center of the steamboat channel; oftentimes the entire bodies of the trees would be covered by gravel, with nothing but a single root standing erect to bid defiance to passing boats. A great deal of difficulty was experienced in getting hold and displacing them. During the last two months good work was accomplished; two new chutes, Alpin's and Wilson's, each about a mile in extent, had been opened, in addition to a great improvement effected in the sloughs at Harrisburg Bend. Steamers could no longer run the old river, from the many sudden changes in its channel, and which were constantly occurring; these works consequently became a necessity, whilst at the same time the distance was shortened about two miles.

The trunks of trees of which the snags are composed are principally cottonwood, maple, ash, and willow.

From the above monthly details some conclusions may be reached as to the amount and character of a certain class of work to be annually executed, as long as the banks remain so densely covered with timber and subject to the powerful effects produced by the great volumes of water which will seek an uninterrupted passage to the open sea. Before submitting, on the 22d of May, the project for the continued prosecution of the improvement of the Upper Willamette during the current year, it was found impracticable to make a careful and precise examination of that portion of the river which extends between Oregon City and Eugene City, and for which the appropriation of \$25,000, in currency, by the act of Congress approved March 3, 1875, was specially intended. The unusually high stage and muddy appearance of the water precluded any intention of the kind, although anxiously desired. It had also been ascertained that many new chutes had been forcibly cut at many unexpected and undesirable points, and that serious departures had been effected from the channel of the previous year. The time had not been propitious for several months for the purpose of ascertaining the exact nature of the work to be accomplished. It was desirable to make an inspection at the lowest stage of water to view the river at its worst possible phases. The office was constantly advised by the master of the snag-boat as to its condition. On the last day of March the Willamette had risen 7 feet above low-water, the highest mark reached at any time during the four previous years—so high as to render it unsafe and risky to venture with the boat into the channel, owing to the number of floating logs and large trees displaced from the banks. The water was also so thick with mud as to render it impossible to discern the positions of snags below its surface. Its appearance indicated that great damage must have been done by the washing away of the banks at points on the upper river. It was not before the week commencing on the 6th of June that all the conditions of low, clear water and suitable light-draught steamboats between intermediate points were favorable for a detailed examination in person of the regimen of the river. The ascent was necessarily slow, and the trip almost entirely performed by daylight, so that, through the politeness and knowledge of

intelligent pilots, the nature of the obstructions to navigation were made plainly discernible; the extent, depth, and general character of the many bars and shoals; the localities where generally occur the lodgments of rafts, drift, snags, stumps, and roots during each successive annular winters-freshet; the positions of ledges of rocks and bowlders—all were made apparent, and a proper understanding and appreciation of the necessity of the improvements was attained by an actual observance and study of the subject, made under the most favorable circumstances. The result of this reconnaissance was the preparation of a project for the further prosecution of the works of improvement on the Upper Willamette, confirmatory to a great extent of the one previously submitted. It comprises not only the specifications for the construction of wing-dams or longitudinal dikes, for narrowing, deepening, and rendering more uniform the channel, and at what particular localities, but also the displacement of such ledges of rock and bowlders as may be found to interfere with the safe passage of boats. For these specific purposes the larger portion of the appropriation will be allotted; the balance will be partly retained for the payment of the salaries of the assistant engineer in charge of the survey of the river, also of the location of the lines of work, and of his special party of subassistants, rodmen, flagmen, boatmen, and employes generally; for the employment of master and crew of the snag-boat engaged in the removal of snags, sawyers, stumps, and roots from the channel, and all incidental expenses relating to its repairs and its intended use; for the cost of material and supplies; for the purchase of small boats; for the rent of office; and for the employment of a superintendent of construction during the progress of the work, whose duty it will be to see that the contractors strictly and faithfully conform to each and all of the requirements of the specifications. It was recommended by this office, and authority subsequently granted by the Chief of Engineers for the purchase, that more suitable hoisting-apparatus be erected on the snag-boat, comprising the necessary machinery, engine, and boiler, and also two capstans, with all gearing, shifting-levers, and connections, to be run by steam-power. It is estimated that more than double the amount of work can be accomplished in the same length of time than can be effected with the present slow process by manual labor. The engine will be a portable horizontal one, on an iron bed, with vertical boiler. The plan is for two capstans, which can be used either in hoisting or hauling the boat to and from position, or for lining her up stream. The additional expense is nothing, consisting only in the employment of an engineer with an increased pay per month, compensated by the reduction in numbers of the old crew. Fuel is always readily to be had for the cutting. The usual expense of towage will have to be taken from the appropriation when necessary to move the snag-boat between distant localities, although the Willamette River Transportation Company have kindly offered, on different occasions, to attend her free from charge. The number of obstructions to be displaced cannot even be approximately ascertained, and consequently no direct contract could be judiciously made to meet the entire and constantly-changing features of the case. Even at this time it is not known what obstacles of that nature will have to be removed; and certainly there is no foretelling what may be required of the snag-boat after the occurrence of the annual freshets during the current fiscal year. The amounts to be retained, as far as practicable, for the previously-enumerated cases, must be especially and solely assigned for those objects. The major part of the appropriation, as before stated, will be applied to the construction of suitable wing-dams

or longitudinal dikes at the several localities where most needed, and in order to narrow and thereby obtain a greater depth of water and a more uniform steamboat-channel of the river. At the points where the work is to be executed, the bed of the stream becomes generally very considerably widened out. There bars of gravel and sand are formed, which, at the time of an extremely low stage, are covered with but little water; in many instances not more than from 17 to 20 inches. This condition of affairs continues from about the 1st of July until the commencement, in the latter part of October, of the rainy season. Whilst making the examination of the river, between the 7th and 11th of June, both inclusive, the water at the time being very near its lowest stage, a great many rapids were passed between Oregon City and Corvallis, and the steamer Governor Grover often scraped the bottom on account of the shallowness of the stream. Between Corvallis and Eugene there were many more, upon which even the "Ohio," carrying about seventy tons, would occasionally stick, or drag very heavily over them. The latter was built to draw but 12 inches; but, being a propeller, drew, when moving, several more. The localities of the dams and the section from which snags and other obstructions will have to be removed, extend along the river from Oregon City, at the Falls of the Willamette, to Eugene City, a distance approximately estimated, in the absence of actual measurements, to be nearly one hundred and ninety-five miles. The last-named place has been usually considered the head of steam-navigation for light-draught boats during average stages of high water, and only continuing for a few months of each year. Boats have ascended as high up as Springfield, some six miles above Eugene. The names of the localities along the river, at most of which it is proposed to confine operations for the current fiscal year, have been placed in a tabulated form. In this table the intermediate distances are given, the probable length of dams at each, and the places where the displacement of rock must be effected, together with such remarks as may be applicable to the subject, placed in a condensed form, and briefly descriptive of the character of the most dangerous difficulties to be overcome.

The estimate prepared and submitted in regard to the work to be performed during the current fiscal year was based upon personal examinations, and reliable information; and upon this representation the appropriation of \$25,000 was made for the improvement of the channel. It was at the time intended that the construction of wing-dams should be confined to that portion of the river between Oregon City and Corvallis, in addition to the removal of snags and other obstructions along the entire distance between the first named and Eugene City. Since then, after more extended examinations, no good reason has become apparent to justify a change in the plan then decided upon; on the contrary, the opinion then entertained is strongly confirmed. As the Willamette above Corvallis is cut up into so many useless sloughs, and at each liable to undergo very marked and frequent changes, it would be impossible to confine its waters in one main and permanent bed. New channels are not unfrequently cut out and old ones have been left nearly bare; the latter, after being closed for years are again reopened. The yielding nature of the soil cannot resist the action of the strong currents which strike the banks. The latter are low, composed of fine gravel overtopped with alluvial soil, and although covered with timber and thick brush to the water's edge, are easily washed out, or cut through as if they possessed only the consistency of sand. The river above Corvallis is very tortuous, at places very narrow, and runs at many localities with great rapidity. Only two large tributaries

empty into the river below Harrisburg, the Mary's River immediately above Corvallis and the Long Tom above Peoria. The river has but recently left its old bed and made a cut across a neck of land into the Long Tom, using the bed of the latter stream in place of its natural one. Such changes are only too frequent. Three other streams—the McKenzie, the Middle, and the Coast Fork—unite below Eugene City, and form the main body of the river. The principal obstructions to navigation are found between Eugene City and Harrisburg, a distance of twenty-eight miles by the river. Between these two points there are eleven bars with from 10 to 12 inches of water at the lowest stage; wherever they exist the river is divided into two or more channels of about equal capacity, from 100 to 200 feet in width, and from 2 to 4 in depth. The bars extend entirely across the river. The volume of water is sufficient, if confined within one channel, to float boats of 3 feet draught at all seasons of the year. The fall is uniform, the only changes in the velocity being found on the bars, which are invariably near the heads of the sloughs. Through the latter nearly, if not quite, one-half of the water is dispersed. The adjacent country, as well as the banks, is flat, from 5 to 8 feet above the line of low water; the river-bottom is from one to two miles in width, and the soil is nothing more than a bed of gravel of unknown depth, with a surface-layer of sandy loam from 1 to 3 feet in thickness. The timber, consisting of cottonwood, or Balm of Gilead, maple, ash, alder, and willows, is dense, and covers the whole bottom-land. The latter is traversed by sloughs and bayous, large and small; and in times of floods is covered with swiftly-running water to a depth of from 5 to 10 feet. Several farms have been inundated and washed away, the river entirely devastating them by cutting a network of sloughs through their broad fields; the farmer along its banks cannot tell at what time his hundreds of acres may be swamped and disappear from his sight forever. Each year new channels are opened, old ones closed; new chutes cut, old ones obstructed by masses of drift; sloughs become the main bed, while the latter assume the characteristics of the former; extensive rafts are piled up by one freshet only to be displaced by a succeeding one; the formation of islands and bars is in constant progress where the velocity of the current receives a sudden check only to disappear at the very next high water. Captain Miller, one of the oldest and most experienced pilots in shoal waters of the same nature as the Willamette, has stated that he has never run the same channel for two consecutive years between Harrisburg and Eugene City. The map of the river, compiled from surveys made from fifteen to twenty years ago, a tracing of which is transmitted with this report, differs so widely from the present meanderings of the channel and its many sloughs along that section of the river to which reference is made, as to be of very little use in an examination for the purpose of projecting or devising a plan of permanent improvement. If any attempt of the kind should ever be made, it must be at an enormous expense of time and money; the small appropriations annually contributed for the purpose of meeting the immediate exigencies of the case would soon be swallowed up in the whirlpools and eddies created by the rushing waters of the winter freshets. Even in the lower portions of the river it may prove a difficult matter at many points to construct wing-dams, on account of the great velocity of the water, and the temporary formation of eddies, and the consequent undermining of the piles during the progress of the work. Crib-work may then have to be substituted for piling. The only feasible and sensible plan in this case is the annual removal, by the snag-boat, of the snags and other obstructions, as they are

brought down from above and lodged on the bottom; together with the additional work of filling up as far as possible the heads of all useless sloughs. "Most rivers acquire in time a fixed regimen, although periodically, and sometimes accidentally, subject to changes from freshets caused by the melting of snow and heavy falls of rain." In the particular case under consideration it will be many years before any permanency can be effected; not until the dense growth of timber disappears from the banks, the cause of all the difficulties to be contended with even in the best-devised system of improvement, can any real and permanent good be accomplished. As an instance of the nature and suddenness of the changes in the Willamette between Harrisburgh and Eugene City, the following may be furnished as a fair illustration: The pilot and master of the steamer Ohio, after having made but two favorable trips to the latter place during the first part of May, reported at the time to this office that "since the last one was successfully made," to quote his own expression, "our river has left Eugene." In other words, that, at a point about ten miles above Harrisburgh, the channel, facetiously styled by the pilots the "Grave-yard," the original old bed of the river which had been run for fifteen years, had become so low in the course of a few days as to be no longer navigable, even for that steamer with her very light draught; this, too, at a time when she was favored with a high stage of water. It is six miles in extent, very narrow, crooked, and rapid. This condition of affairs had been occasioned by the river forcing for itself a new cut through a narrow strip of land, opening a chute six hundred feet in length and about forty feet in width in its narrowest place, clear of drift, with a fall in that distance of 3 feet, and nearly straight. A large raft had been lodged at the upper end of it, which impeded its passage.

The master of the snag-boat was directed to move at once, with a portion of his crew, to the obstruction, in order, with the assistance of the steamer's crew, to break it up and remove it from the channel. This was successfully accomplished between the 26th and 28th of May inclusive, during which time about twenty-two hours' work was performed. In consequence of the great fall, boats will have to be warped up and down. It has been named the "Ohio Chute;" the distance saved by running it cannot be less than three miles. Subsequently, within a very short time after the first removing of the raft, and whilst making a personal inspection, the cut was found to have considerably changed by the washing away of the banks and the deposit of additional snags and stumps. The precaution had been taken to again carry up the master and part of the crew of the snag-boat, with the necessary tools and a supply of giant-powder, to the scene of their previous labors, and it was fortunate that such a step had been taken. Another detention of seven hours occurred in the attempted removal of snags by the "Ohio;" but success only attended the application of a charge of the powder, by which they were displaced sufficiently to allow the boat to be lined past them. On her downward trip still another detention of several hours took place. Only two satisfactory results were obtained by the experience of this trip: In the first place, that a steamer of her build does not have the necessary stiffness for work of that class; nor is she possessed of sufficient power and the needed hoisting-apparatus to drag out or raise up, and then throw completely out over the bank, any snags of large dimensions to which she might tackle. In the second place, most of them cannot be pulled straight out by mere force, as the roots are generally so deeply embedded in the bottom; but the latter must be first loosened by blasting, and the trunk be then raised up and hoisted

out perfectly clear of the water, and afterward cut into several pieces, so as not to again become an impediment in the channel. The case alluded to fully demonstrates the very sudden changes in the channel of the river; an old one used for many years suddenly becomes useless even at an unusually high stage of water; and a new one is opened, which has to be improved upon during each attempted trial of the boat to make the ascent, and then without any certainty of a successful or even a partially durable result. There can be no longer any doubt as to the fruitlessness of experimenting for the present upon any so-called permanent improvement along that portion of the river between Corvallis and Eugene City. The former place is scarcely out of sight before the difficulties commence; the river almost immediately above the town divides into two principal channels, known as the East and West Channels. The latter is the one now navigated, but the other is said to have plenty of water, requiring only the removal of snags and drift.

It will be ascertained whether it cannot be made navigable and useful, as it is shorter than the other by from two to three miles. No large rapid was found to exist, either by one of the assistant engineers of this office, Mr. Robert A. Habersham, who was directed to make an examination of the river, and from whose notes upon the same many items of useful information have been abstracted and incorporated in this report, or by the officer in charge during his personal reconnoissance made at a later period. The river appears along that section to be almost a continuous series of rapids, connected here and there by short, smooth sheets of water. All that can be done in the furtherance of any improvement will be to remove as rapidly, and as far as possible, according to the means at the disposal of the office, all such obstructions, of whatever nature they may prove to be, as will be encountered in any one of the new channels which the river shall in future be forced to make for itself. The construction of the wing-dams must, from necessity, be commenced at the lowest bars, along that section of the river more immediately above the falls, between Oregon City and Salem, to be continued thence up and along it to each of the several other points in their regular order of succession, preference always being given to those places where the channel contains the least depth of water and where the work is most needed. It would be useless to attempt anything in the upper portion of the river before the lower section has received attention. The great necessity of improving the upper river above Albany is very readily conceded, but it must not, however, be forgotten that to render any such improvements beneficial, if accomplished, it will be most important and necessary to attend to some other and very needed works lower down than that place. Lone Tree Rapid and Union Bar, below Salem, are known to be much worse obstructions than any others to be encountered in the river; from 17 to 18 inches can only be carried over them at low-water. These will, of course, have to be improved first, otherwise any contemplated works further up the stream need not be attempted. Already the greatest difficulty opposed to the navigation of the Upper Willamette, along its entire length, has been successfully overcome. A company, aided by the State, have built a canal and locks at the falls opposite to Oregon City, enabling boats to pass up and down without difficulty.

The following data are taken from a previous report on the improvement of the Yamhill River: The canal and locks "were finished and opened for business on the 1st of January, 1873. The cost of construction was \$600,000. The length of the work is nearly three-fourths of a mile, consisting of a canal with four lift-locks, and a guard-lock, size

of locks 210 feet long by 40 feet wide, and 10 feet lift to each." "The height, from the head to the foot of the falls and rapids, is 39.75 feet in a distance of 3,100 feet. The difference between extreme low and extreme high water at the foot of the fall is 47.15 feet, (1861-'62,) and at its head 18.10 feet."

These observations were made at Oregon City and Canemah. The importance of the improvements on the Upper Willamette can be best demonstrated by a statement of the actual amount of tonnage transported through the canal and over the portage at the falls during the fiscal year ending the 30th of June, 1875:

	Flour, wheat, and miscella- neous—tons.	Passengers.
Amount of produce and merchandise transported down the Willamette through the canal by the Willamette River Transportation Company and other companies.....	38,422	5,763
Amount of produce and merchandise transported down the Willamette and Yamhill and over the portage by the Oregon Steamship Company.....	34,527
Total	72,949	5,763

The above information was kindly furnished by the officers of the respective companies, and to whom much indebtedness is due. To exhibit the yearly increase, Mr. B. Goldsmith, president of the Willamette Transportation Company, prepared the following statement for this office:

The Willamette River Transportation Company's steamer Grover commenced running on the 18th day of March, 1873, since which time the company have added more steamers to their line. The following is the amount of merchandise and the number of passengers passed through the canal:

	Tons.	Passengers.
From January 1, 1873, to December 31, 1873.....	18,775	5,426
From January 1, 1874, to December 31, 1874.....	32,340	6,383

The Oregon Steamship Company not passing through the locks have probably carried on the Willamette River not less than 40,000 tons during 1874. With the river properly improved, I think the amount to be transported by river would, in the course of a couple of years, amount to not less than 150,000 tons; and it is devoutly to be wished that the present Congress may make an appropriation large enough to enable you to improve the river.

The additional amount of tonnage transported by the Oregon and California and Central Railways from the valleys of the Willamette and Yamhill Rivers of Western Oregon to Portland, the terminus of the two roads, is estimated at _____ tons for the fiscal year ending the 30th of June.

The following information has been politely supplied from a report addressed to this office by Mr. S. H. Brown, jr., purser of the steamer Ohio, of the amount of freight moved down the Willamette by that steamer:

From September 20, 1874, to November 4, 1874, low stage of water: Aggregate, 1,332 tons wheat and flour; 17 trips.

From November 4, 1874, to June 13, 1875, high stage of water: Aggregate, 4,992 tons wheat and flour; 35 trips.

Amount to be moved from points above Corvallis during the next month, (July,) 550 tons.

Carrying capacity steamer Ohio, 190 tons; draught, 12 inches.

This steamer, being of very light draught, has been principally employed in transporting freight, almost entirely of wheat and bacon, from warehouses between Corvallis and Eugene City. In passing from the last place to Harrisburg, the boat is only able to touch the main land at three points owing to the country being so cut up by a perfect network of sloughs. The several companies engaged in river-transporta-

tion have, in addition to the many boats now plying upon the river, already completed, or are about to do so, several new light-draught steamboats for the trade of the Upper Willamette. The *Champion*, the *Orient*, the *Occident*, the *Bonanza*, and the *City of Albany*, will all be soon floating upon the waters of the Willamette, in order to accommodate the rapidly-increasing trade.

The Willamette Valley is considered by many the most valuable agricultural, wheat-growing region of the State of Oregon, whilst others point to the Walla-Walla section as being unsurpassed. The former is certainly the most densely settled of all the sections, and has the advantage over others in many improvements, such as railroads, steamboats, manufacturing establishments, flour and woolen mills, iron-furnaces, and all the improved machinery and appliances for the most advanced states of agriculture. This valley, lying between the Coast and Cascade Ranges of mountains, is about sixty miles in breadth, by almost one hundred and fifty in length.

In the character of its soil, the beauty of its scenery, the purity and abundance of its water, the benefits of its climate, its magnificent, never-failing water-power, its exhaustless mountain forests, and its natural facilities for commercial intercourse with the world, in all of these great and everlasting benefits, it will compare most favorably with even the most favored countries.

Financial statement.

Amount appropriated by act approved March 3, 1875.....	\$7,500
Amount expended during the fiscal year ending June 30, 1875.....	7 500
Amount required for fiscal year ending June 30, 1877.....	30,000

Distance from Oregon City and between intermediate points by water.

Names.	Miles.	Length of dams in feet.	Remarks.
Portland.....			Head of ship-navigation.
Milwaukie.....	5½	5½	Standard Mills flour-mills.
Oswego.....	2	7½	Oregon Iron Company; iron-ore found at the place.
Oregon City.....	4½	12	Canal and locks on west side.
Canemah.....	1½	13½	
Tualatin Rocks.....	1½	15	Mouth of Tualatin; rocks removed.
Rock Island.....	1	16	River widens; channel tortuous; rocks and rocky reef; at high water difficult to navigate.
Polally Bar and Reef... ..	1½	17½	500 Rocks to be removed from reef; deep water then to Yam Hill.
Fisk's Eddy.....	1½	19	
Molalla River.....	1½	20½	Shoal of gravel and small boulders.
Butteville.....	5½	29	
Champoeg.....	3	32	Railroad-shops.
Rogers's Landing.....	4	36	
Mouth of Yam Hill.....	4½	40½	400 To Dayton, 4½ miles; to La Fayette, 8; to Saint Joseph, 11; to McMinnville, 17. Shoal extends entirely across the river, gravel; a wing-dam built, partly destroyed.
Cary's Bend.....	3½	44	500
Weston.....	2	46	
Chrisman's Bar.....	½	46½	
Bennett's Dread.....	1½	48	Extend wing-dam already built with slight change of direction; or, perhaps, better to throw all water into the left chute more direct.
Sargent's Slough.....	2	50	
Union Bar.....	1½	51½	300
Fairfield.....	½	52	
Five Island Bars.....	2	54	600 A deep channel, but narrow; dam at upper end of right-hand chute.
Bitterman's Bend.....	2	56	600 Shoal and snaggy; water should all be forced down Jervis Slough.
Jervis Slough.....	½	56½	A new channel-way opened.

Distance from Oregon City and between intermediate points by water—Continued.

Names.	Miles.	Length of dams in feet.	Remarks.
Matheny's Bar.....	$\frac{1}{2}$	57	Good water; a wing-dam built by the company; river widens to 750 feet; quick current; a gravelly bottom.
Wheatland.....	1	58	
Beam Island.....	$\frac{1}{2}$	58 $\frac{1}{2}$	
Beaver Rapids.....	3 $\frac{1}{2}$	62	In reality one continuous rapid. Beaver no longer considered dangerous since construction of wing-dam; one of the worst places on the river between Oregon City and Salem; 17 and 18 inches of water on them; sometimes only 15; river very wide; gravel-bar down the center; banks to be protected.
Lone Tree Rapids.....	..	62	
McCloskey's Chûte.....	2	64	River very broad, divided by several islands; one of the worst places above Salem. The boat struck in ascending.
Lincoln.....	$\frac{1}{2}$	64 $\frac{1}{2}$	
Chitwood's Bar.....	3 $\frac{1}{2}$	68	Channel less wide and more tortuous than on other bars; at shoal widens out to 600 feet; difficult for boats at a low stage of water.
Chitwood's Island.....	$\frac{1}{2}$	68 $\frac{1}{2}$	
Salem.....	2	70 $\frac{1}{2}$	Capital of the State. From the 1st of October to the 1st of August following, the river is said to be high; during August and September navigation ceases above Salem.
Eola Chûte and Reef...	2	72 $\frac{1}{2}$	500 Rocks to be removed; the chûte is used; shoal at the end of it; old bed closing up.
Eola.....	3	75 $\frac{1}{2}$	Mouth of La Creole River.
Eola Rocks.....	2	77 $\frac{1}{2}$	Rocks to be removed.
Rocky Rapids.....	3	80 $\frac{1}{2}$	Rocks to be removed; not very bad.
Independence.....	1 $\frac{1}{2}$	82	
Humphrey's Bend.....	6	88	300 Rock to be removed; two parallel rocky reefs, 150 feet apart, putting out from opposite side of channel.
Long Crossing Rapids..	2 $\frac{1}{2}$	90 $\frac{1}{2}$	300 A very bad place.
Buena Vista.....	1 $\frac{1}{2}$	92	
Luckimutte River.....	1 $\frac{1}{2}$	93 $\frac{1}{2}$	500
Santiam River.....	1	94 $\frac{1}{2}$	
Black Dog Slough.....	..	94 $\frac{1}{2}$	
Lower Fickles.....	2 $\frac{1}{2}$	97	200 Shoal-water; boat drags heavily.
Upper Fickles.....	$\frac{1}{2}$	97 $\frac{1}{2}$	400
Albany.....	7	104 $\frac{1}{2}$	
Bower's Bar.....	3	107 $\frac{1}{2}$	400 River suddenly widens from 200 to 400 feet; shoal formed; 16 inches of water; a great velocity; banks protected.
Magogaloon Slough.....	2	109 $\frac{1}{2}$	400 Shoal and full of snags.
Snag's Bend.....	$\frac{1}{2}$	110	
Half Moon Bend.....	$\frac{1}{2}$	110 $\frac{1}{2}$	300 Boat touched; a bad place; narrow channel; full of snags; channel changed entirely in last two years.
Corvallis.....	6 $\frac{1}{2}$	117	8.000 Below mouth of Mary's River.
Foot of Long Island, (Elk Bar).....	2	119	Between Corvallis and Eugene City, river tortuous; channels mostly narrow, and filled with snags.
Booneville Slough.....	2 $\frac{1}{2}$	121 $\frac{1}{2}$	
Turntable.....	6 $\frac{1}{2}$	128	The entire bottom-land, from one to two miles wide, entirely cut up by a perfect net-work of sloughs.
Deer Island.....	1	129	
Peoria.....	4	133	
Long Tom Creek.....	1	134	
Wreck of "Albany".....	$\frac{1}{2}$	134 $\frac{1}{2}$	
Cochrane Rapid.....	1 $\frac{1}{2}$	136	
Wild Horse Prairie.....	1 $\frac{1}{2}$	137 $\frac{1}{2}$	
Oregon Settlement.....	1	138 $\frac{1}{2}$	
Thompson's Bend.....	$\frac{1}{2}$	139	
Irish Bend.....	2	141	
Monroe Landing.....	$\frac{1}{4}$	141 $\frac{1}{2}$	
Wilson's Chûte.....	3 $\frac{1}{2}$	145	
Albridge Chûte.....	1 $\frac{1}{2}$	146 $\frac{1}{2}$	
Ingram's Bend.....	1	148	
Harrisburg Bend.....	1 $\frac{1}{2}$	150 $\frac{1}{2}$	
Harrisburg.....	2 $\frac{1}{2}$	151	
Bromley's Bend.....	5	156	
Scatter Bend.....	1 $\frac{1}{2}$	157 $\frac{1}{2}$	
Saw-Mill Bend.....	3 $\frac{1}{2}$	161	
Hog's Prairie.....	$\frac{1}{2}$	161 $\frac{1}{2}$	
McKenzie's Bar.....	4	165 $\frac{1}{2}$	
McKenzie's Fork.....	1	166 $\frac{1}{2}$	
Piper Bend.....	1 $\frac{1}{2}$	168	
Low's Chûte.....	1 $\frac{1}{2}$	169 $\frac{1}{2}$	
White's Rapids.....	3	172 $\frac{1}{2}$	
Davis Chûte.....	1	173 $\frac{1}{2}$	
Eugene City.....	1 $\frac{1}{2}$	175	
Springfield.....	6	

Distances from Portland by the Oregon and California Railroad.

Names.	Miles.
Portland	
Oregon City	16.16
Salem	37.53
Albany	93.81
Harrisburg	95.106
Eugene City	18.124

GG 3.

IMPROVEMENT OF THE UPPER COLUMBIA AND SNAKE RIVERS, OREGON,
AND THE TERRITORIES OF WASHINGTON AND IDAHO.

The sections of the two rivers to which reference is particularly intended comprise those portions from above the "Dalles," on the Columbia, a succession of falls and rapids cleft through deep cañons, and extending over a distance of fifteen miles up to Priest's Rapids, in Washington Territory, on the main fork of the river; and up its tributary, the Snake, to Lewiston, in Idaho Territory, at junction with the Clearwater. These are the principal tributaries of the Columbia, draining an immense extent of country, from the north, east, south, and west.

The distance from the head of the falls, at Celilo, to Priest's Rapids is one hundred and ninety-five miles, and to the junction of the Snake and Clearwater two hundred and fifty. From the foot of the falls and rapids, at the town of Dalles, to the sea, is two hundred and twenty-five miles. Along this portion but one serious obstruction exists, and that at the Cascades; the latter, a series of rapids, with a fall of 37.3 feet in a distance of five and three-quarters miles, is now passed by a railway-portage, the cars being drawn by locomotives. A survey has been made for the purpose of ascertaining the practicability and cost of constructing a canal and locks at this point, a separate report of which, with plan and profile, was submitted during the year. The length of the proposed canal is 2,600 feet, with a total rise of 21 feet. To overcome the difficulty at the "Dalles," a canal, with locks, will have to be constructed around Celilo Falls, at the head of it; a total fall of 36 feet in 4,500 has to be overcome. As in the previous case, a survey has already been prosecuted, with similar objects in view, and a report submitted. The improvements for the fiscal year were confined to two localities, between Celilo and Wallula, the *Squally Hook Rapid* and the *Umatilla Upper Rapid*. The working season is a very short one, being generally confined to the winter months, during which period the river reaches its very lowest stage, and the water is rendered extremely clear. The rocks below the surface are then more readily exposed, and the workmen operate to much greater advantage. The temperature becomes extremely cold, the thermometer (Fahrenheit) not unfrequently indicating 25° below zero; the river becomes ice-bound above and below the rapids, thereby preventing any floating ice from impeding the progress of the work. The days and nights are always clear; very little snow ever falls, and the men soon become habituated to the extreme severity of the weather. The one great difficulty to contend against is the force and duration of the prevailing winter winds. The commencement of the annual spring-rise of the river, bearing down upon its waters the accumulated ice of the more northern regions, early necessitates the suspension of all fur-

ther operations for the season. The following is a *résumé* of the nature and quantity of the work accomplished during the fiscal year, and which continued until the limited appropriation became exhausted :

SQUALLY HOOK RAPIDS.

The preliminary measurements of the rocks to be removed having been previously made, and estimates of quantities prepared by the assistant engineer in charge, the contractor began the work after having previously completed his arrangements, about the latter part of November, 1874. The contract called for the removal, above the level of the plane 6 feet below lowest low-water mark of both of the two rocks designated in the specifications, and for the depositing of all *débris* at such suitable places as might be selected by the engineer in charge, or his deputed agent. The drilling and blasting continued from the 3d to the 26th of December, and the clearing-off of the loosened and broken-up rock by raking and blasts occupied a week longer. By the removal of the two rocks a third, but not very large one, with only 3½ feet of water upon it, appeared in the middle of the channel, and had to be blasted out and brought down to grade. The work having been entirely executed, a final examination was made, and a depth everywhere found exceeding that required by contract. The reefs which extend from the south shore cause, perhaps, a third of the entire river, when at a low stage, to flow through this channel. The velocity of the current was obtained by several trials, and was found to be at the rate of about seven miles per hour; when the water is confined, and obtains a considerable fall, it may possibly reach ten miles. In a distance of 1,800 feet the fall is 3.2. The stage of the water at the commencement of the work corresponded with the zero on the gauge at Umatilla; when completed and ready for examination it had fallen 14 inches at the rapids, and 24 at the local gauge; showing that the surface at the latter had been made 10 inches lower by the removal of the rocks than it probably would have been. In all cases of such displacements the surrounding water will be more or less affected in depth, the change being materially influenced by the proportion which the sectional areas of the former bear to that of the channel. In similar operations on rapids like that of Squally Hook calculations would be of very little use; all that is necessary is to be careful in the selection of the rocks, keeping in mind that by taking out too much material a more serious injury may happen to the water-course than by removing too little. The work being completed, the superintendent of the party made preparations to start on the 5th of January for Umatilla, the assistant engineer having preceded him a few days by the overland route. The intention was to move up by water the scows, furnace, tools, blasting-material, and all the other working appliances, to the future scene of labor. After a fruitless endeavor to ascend the river, the ice having prevented him from doing so, the whole party and effects were transported overland. The weather continued very cold, the thermometer generally ranging from zero up to twenty-five degrees, only on two occasions reaching thirty-two; on the night of the 13th and morning of the 14th it indicated twenty-three degrees below zero. Two tracings of the map of Squally Hook Rapid, one in black ink entire, and a second with rocks represented in colors, the rocks displaced being lettered on both, are transmitted with this report. After a careful final examination, measurement, and acceptance of the work, the quantities removed are stated as follows :

	Cubic yards.
Rock A.....	17.05
Rock B.....	140.30
Rock C.....	.89
Total.....	158.24

UPPER UMATILLA RAPIDS.

The superintendent of work reached this locality with men and material transported on his small boats transformed into wagon-bodies and placed on wheels, on the 13th of February. The scow used at Squally Hook having been left at that place, those employed during the previous winter at this rapid, and which had been moored up in the summer months at Umatilla, were caulked and placed in readiness for service. On the 20th of that month one of them was warped up to a point just below the Lower Rapid by tracking along the edge of the ice; it was fortunate that it had not succeeded in getting farther around it, as such a large field of ice came down from above as to have fatally nipped the craft. Navigation is hazardous anywhere among ice when it is 20 inches thick; the weather had suddenly become mild and thawed it out, so that the strong current had set the detached masses in motion. There was very considerable risk in working in anticipation of the ice-gorge above suddenly giving way, and sweeping down upon them. The river was very low and clear, and seemed to justify the chance of losing boats and all. For their safety in case of accidents, the men were compelled to live on shore. A great deal of ice was lodged on the rocks at the Upper Rapid; in fact, as the assistant engineer in charge reported, it was all ice except at the channels, (high and low water channels,) and where the current was swiftest. One-half mile above the river was gorged completely across. No work was accomplished during the month of February, in consequence of the difficulty experienced in placing the scows in position. On the second of the following one, the work of the removal of rock was resumed at the Umatilla Upper Rapid, in continuance of the improvement of the "High-Water Channel." During the previous winter, operations had commenced about the first week of February, nearly a month earlier. As stated in the last annual report and by reference to the map of the locality, "it will be seen that what has always been known as the 'Low-Water Channel,' and which has been used up to the present time, is a very long and circuitous one, bounded on both sides by reefs and shoal water. Experienced pilots can alone navigate it." The one called the "High-Water Channel," which hitherto has been only used during the season of high water, and can now be safely run during the lowest stages of the river in which boats can pass over the rapids between Wallula, the shipping point of Walla-Walla, thirty-five miles distant from the river, and the head of the Dalles at Celilo, has been made a direct and short one. At the termination of the work of the season of 1873 and 1874, its width at the narrowest point was scarcely 40 feet. This, for several reasons, was by no means sufficient, and it was deemed advisable that an increased breadth be given to it as soon as the necessary funds became available for the purpose. It was also then stated upon the authority of the pilots that "notwithstanding the unevenness of the bottom on the outside of the channels from which the rocks had been removed, that boats ascending with a draught of 4 or even 5 feet of water would experience no difficulty; but that in descending considerable risk would be encountered on account of the swiftness of the current, there being danger of a sudden sheer-off

on account of the boats not being entirely manageable. At the head of the rapid the river has a velocity of twelve miles an hour." To make the High-Water Channel perfectly safe at every stage of water, it was estimated that it would require the removal of about 100 cubic yards of rock on the south side of the head of the rapid, a like amount from the edge of the reef (at the narrowest point) on the south side of the channel, and a similar quantity, as contained in four rocks, on the north side. This work accomplished, a width of more than 75 feet would be obtained throughout its entire length; by then using it steam-boats coming down stream against the strong summer winds would not only have a less tortuous and deeper chute, but would avoid the trouble and risk often experienced in running the other channel. The appropriation for the fiscal year was, however, inadequate for the completion of the work. At this rapid only such rocks were selected for removal as would most benefit navigation. Only a limited quantity could be displaced in order not to exceed the amount. On account of the small yearly appropriations the work at Umatilla Upper Rapid has already extended over three working seasons. On the 2d of March, as already stated, the removal of the rocks was continued at this locality and progressed as well as could be expected. On the 5th the ice-gorge above broke up carrying away lines and causing the loss of anchors. Loose pieces continued to come down, but being rotten failed to do much damage, and did not cause any great delay in prosecuting the work. Occasional terrific winds interfered with its advancement, although the gauge read but 15 inches below zero of the low-water mark at Umatilla; still the necessity for its quick completion was urgent before any interruption should occur from a spring-rise in the river. The water was also very clear, and consequently the drilling was easily effected and operations very much facilitated. By the 22d of the month, at which date the limited appropriation became exhausted, all the rocks from the edge of the reef on the south side, at the narrowest part of the channel, had been removed; there were four large and two small ones. The entire improvement contemplated, however, had not yet been accomplished. A large mass of rock on the south side, at the head of the channel, where the width already attained was but 75 feet, still requires displacement, as well as the four rocks on the north side previously estimated for as forming part of the yearly work. This portion of the improvement, for the further enlargement of the channel, will form part of the operations during the approaching working season of the current fiscal year, 1875 to 1876. The depth of water obtained on the rocks after blasting was 6 feet at the very extreme low stage of the river existing at the time. The current then ran at the rate of twelve miles per hour for 150 feet at the upper entrance to the rapid. The length of the upper rapid is about 850 feet, with a present width of over 75 feet throughout, except immediately at the head; the entire length of the rapids—upper, middle, and lower—from the head to Umatilla, is about six miles. Two sets of tracings of the two maps of the Umatilla Upper Rapids, (drawn on two different scales,) one set in black ink alone and the other partially in colors, intended to exhibit the rocks removed at different periods, and which are respectively numbered, are transmitted with this report. Upon the termination of the work for the season the final measurements were made, and it being found executed in conformity with the terms of the specifications, the contractor was paid the full amount due him, in accordance with the terms of the contract. The following is a statement of the several quantities of rock displaced at this locality :

	Cubic yards.
Rock No. <i>Sa</i> }	42.18
Rock No. <i>Sb</i> }	85.40
Rock No. 13	49.48
Rock No. 14	15.00
Two small rocks near No. 14	15.00
Total	192.06

Sum-total of quantities displaced at both Squally Hook and Umatilla Upper Rapids during the winter working season of 1874 and 1875:

	Cubic yards.
Squally Hook Rapid	158.24
Umatilla Upper Rapid	192.06
Total	350.30

In addition to the work previously suggested for the Umatilla Upper Rapid to be executed during the current fiscal year, it is also proposed to continue operations at the following localities. At the foot of Rock Creek Rapid there is a large rock to be blasted and thrown out of the way; in ascending, boats run close to its south side; in descending, owing to the swiftness of the current, they hug close to the Washington Territory shore, and make quite an elbow to avoid it, thereby incurring great risk at the same time of running upon a dangerous ledge of rocks. At the Owyhee Rapids there are a number of bowlders to be displaced. The river at this point is both wide and shoal, with a gravel bottom covered with them. The improvements contemplated consist in the establishment of leading marks on the shores to mark the course of the channel-way, and the removal of all obstructions within 50 feet, and on both sides of its axis. At the Homly Rapids there are also some bowlders to be removed in the low-water channel; the bed is of a gravelly formation, upon which they are imbedded, having been borne down on drifting ice from more northern latitudes and deposited. The current is very swift and the channel crooked; it is similar in its character to Devil's Bend. Before being able to run up its main tributary, the Snake River, with boats upon the spring-rise, a delay of several days is experienced at these rapids, on account of the rocks, while waiting for the water to reach a sufficient height to pass over them.

Homly Rapids are six miles below the mouth of Snake River, about half-way between it and Wallula, the terminus of the Walla-Walla and Columbia River Railway. This road has recently been extended from the former town as far as Frenchtown, some sixteen miles, and will in all probability be completed by the commencement of the ensuing year. Among the several plans which are projected to connect Oregon and Washington Territory with the Pacific coast roads and the general railway system of the Atlantic States is the Northern Pacific Railroad. It is intended that the main trunk-line shall reach the Columbia River near the mouth of the Snake, the construction of the section between the junction and Pend d'Oreille, Idaho Territory, having been early contemplated; and it is, therefore, extremely important that all obstructions to navigation be removed at least up to that point. Besides those works already enumerated, it is intended to apply during the current year a portion of the appropriation toward the improvement of Pine Tree Rapid, on the Snake River, about thirty-two miles above its mouth. This is the worst rapid at low water on the river; there is scarcely width enough for a boat to pass through, and at one time it was customary to warp around the opposite side of the island which here divides the river into two channels. If enlarged, each boat could make

from three to four additional trips per season to Lewiston, Idaho Territory, situated at the junction with the Clearwater. While navigation remains open on the Columbia to Wallula during the entire season of low water, and is only suspended on account of the river becoming gorged with ice, still it only continues on the Snake for a period of about four months, from the first week in April to about the middle of August. There are two rapids—"Five-Mile," (which is crooked and narrow,) and "Fish-Hook," neither of them requiring any immediate attention—which exist between the mouth and Pine Tree Rapid. Upon the improvement of the latter and Homly Rapids boats which now run to Wallula can easily ascend for the greater part of the season to Palouse Landing and Ferry, about seventy-five miles above and at the mouth of the stream of the same name. The road from Walla-Walla to Fort Colville crosses at this place, the town at a distance to the south of forty-five miles, and the military post one hundred and sixty miles to the north.

The work to be executed during the season of 1875 and 1876 has now been stated, with the exception of those minor details at various points which may be developed as it proceeds, and will be advanced toward completion as far as the available funds will admit. During the three fiscal years for which appropriations have been made, closing with the one just terminated, operations have been successfully accomplished at the several localities of John Day, Squally Hook, Devil's Bend, and Umatilla Lower and Upper Rapids, by the removal of such rocks as have hitherto proved serious obstacles to navigation.

To complete the system of improvement so favorably commenced, one all-important to the interests of the vast sections of country embraced not only in the State of Oregon, but in the two Territories of Washington and Idaho, and which will be thus opened for settlement and commerce, it will be necessary to still further prosecute the work. An estimate for that purpose is respectfully submitted with this report. Some of the particular points will now be enumerated. Between Palouse Landing and Lewiston, the present head of river steamboat-navigation, a distance of about sixty-two miles, some dangerous rapids exist. In a few thousand feet after passing the mouth of the Palouse, the foot of the rapid of the same name is reached; this is considered a very bad one. At a low stage of water the channel is lined on both sides with rocks; although not so narrow as "Pine Tree," still it is scarcely wide enough at different points for boats to run in safety, in consequence of the strong currents and eddies tending to throw them against the rugged edges of the outline of the chute. During the high water in the last week of May, while a personal reconnoissance of the Snake was being made, more than an hour was occupied in ascending this rapid of about four miles in extent, and less than five minutes in making the descent. At a short distance above its head is old Fort Taylor, at the mouth of the Tucanon; this landing is the most convenient one for Dayton, and Wakesburg, and the surrounding wheat-growing country, the distance to haul from the mills being only twenty-five miles, against from sixty to sixty-five to Walla-Walla. Texas Rapids, about six miles above the fort, presents at low water the most rugged appearance of them all, and will require, with the others, some improvement. Here the current is very swift. There is a ferry at the mouth of Texas Creek, a short distance above the head of the rapid; the locality being known as "Colfax Landing," about forty miles north of the town bearing the same name. The road to Colville, Paradise Valley, and other settlements crosses at this place. Several different ferries are in operation along the river at

important points above: Brown's, Penawa, and Selkirk; the latter only seven miles by water below Lewiston.

After leaving Texas Creek, and before arriving at Lewiston, some interesting settlements and Indian villages are observable from the boat, and worthy of notice. Penawa, about fifty miles below the town, is the best improved place on the river since entering it; there are already quite a number of houses, with fully the usual complement of men, women, and children. The fields are fenced in and cultivated; extensive flats and a beautiful grazing country exist, but there is no timber. A large number of horses and cattle are seen upon the hillsides. At the mouth of Penawa Creek is an Indian village, only temporarily occupied, however, as the occupants are migrating, existing on fish and such game as they can procure; they raise large herds of ponies. At Alenota Creek is another small settlement, containing some few buildings, and is a landing for a very considerable section of country. Alpoway is an Indian village, twelve miles below Lewiston; it was established by the missionaries a great many years ago. An old orchard, the trees regularly set out, still flourishes at the mouth of the creek. The Indians of the Nez Percés and Cœur d'Aléne tribes, have some fine farms on the Clearwater, extending for thirty miles above its mouth. Some fields were planted with corn. Owing to the close proximity of this section to the Blue Mountains, more rain falls; averaging about two inches per month, and the vegetation appears more fresh and green than on the lower portions of the river. In winter, scarcely a foot of snow covers the earth at any time, and then very seldom; it rapidly disappears under the mild influence of the prevailing northerly winter winds, called by the natives, "chinook." A short distance below Alpoway is Granite Point; this is the only spot where that rock is known to appear at the surface along this lower section of the river. The country is of volcanic formation, with terraces of basaltic trap cropping out.

Lewiston is not at the present time a very thriving place. Business is very dull. During the great excitement existing in the years after the first discovery of gold in the mountains to the east, and from the washing of the sands along the river banks, the place grew to be of very considerable importance. Since, however, the mining-operations have not proved to be remunerative, it has become simply a shipping-point for the country surrounding it. The town was established in 1861 and 1862; the first trip to reach the place was made in July, 1860, by the steamboat Tenino, Captain White. Considerable up-river freight is delivered during the few months of the navigable season, but there appears to be but a limited amount of tonnage shipped from there. Two main roads depart for the interior; one toward the east, to Campbell's Prairie, from sixty to seventy miles, and thence by pack-mules to the gold-mining regions, Elk City, Oro Fino, and Mount Idaho, lying in the west basin of the Bitter Root Mountain range; the other in a northerly direction, to the Spokane and Cœur d'Aléne regions, a distance of eighty miles. Two roads leave for Walla-Walla, a distance of eighty miles, both passing through Dayton and Wakesburg; one crosses the Clearwater just above its mouth, and then passes over the Snake at Selkirk's Ferry; the other uses the ferry over the Snake, immediately at the town. During extremely high water, once in eight or nine years, the plateau upon which the site of the town is located is slightly submerged, but at a low stage the river becomes very narrow, and a large sand-bar extends out and almost entirely across it.

There is a good road for fifteen miles to the military post of Fort

Lapwai, situated on Lapwai Creek, three miles above its junction with the Clearwater; the latter, which is but a mountain stream, is only navigable for steamboats as high up as that point, and then only for a few months during a very favorable condition of the water, when raised by the melting of the snow in the spring of the year.

The velocity of the current is greater in the Snake than in the Columbia River; in the former, the general average is very nearly four miles an hour, and in the latter, a little over three. In descending the Snake from Lewiston to Alpoway, twelve miles, the Tenino, with a very light freight, ran the distance in thirty minutes; and down the Columbia, from the junction to Wallula, eleven miles, in thirty-five minutes. The boats now employed on the Columbia from Celilo to Wallula, and which during the highest stage of water in the Snake ascend to Lewiston, are generally loaded to a depth of between $3\frac{1}{2}$ and 4 feet; their capacity is from 100 to 150 tons of freight. The only three boats now engaged in the trade are the Yakima, Tenino, and Owyhee—named after some of the tributaries of the Columbia.

In order to obtain the most reliable and official information in regard to the aggregate amount of tonnage carried by the boats of the Oregon Steam Navigation Company ascending and descending between Portland and points above on the Columbia and Snake Rivers, during the last fiscal year, as well as the probable percentage of increase during the one just commencing, a letter from this office was addressed to Capt. J. C. Ainsworth, the president of the company, requesting him to furnish the necessary data to be used in the preparation and embodied as part of this report upon the improvement of the Upper Columbia.

The very interesting reply, of which the following is a copy, and for which much indebtedness is due to that gentleman, supplies a much-needed desideratum to prove the importance of the work under consideration:

OFFICE OF OREGON STEAM NAVIGATION COMPANY,
Portland, Oreg., July 2, 1875.

DEAR SIR: Yours of yesterday duly received. In reply have to say that the aggregate amount of tonnage carried on company's boats between Portland and points above, on the Columbia and Snake Rivers, for the year just closed, is 18,230 tons, of which 6,500 tons were of wheat and flour, and 2,025 tons of cattle, wool, hides, &c. It is estimated that there will be 15,000 tons of wheat and flour to ship from Walla-Walla Valley alone during the coming year. It is presumed that other freights will increase in proportion.

Very respectfully,

J. C. AINSWORTH,
President Oregon Steam Navigation Company.

Maj. N. MICHLER, U. S. A.

The above letter is a distinct statement of the past necessities and requirements of commerce, and of the possible future needs for not only the most direct and economical, but, at the same time, the most safe channel, one perfectly free from all obstructions to navigation. It is highly advantageous to the country to obtain the most secure and speedy transportation by which to convey to the nearest shipping-port the immense stores of wheat and flour which will sooner or later replete the granaries of the rich valleys contiguous to the two rivers, and which also extend for miles up and along their many large tributaries. These figures are deemed a sufficient argument in justification of the expenditure of the small outlay of money so advantageously applied during the past few years toward the advancement of the system of improvements on the Upper Columbia, and offer unanswerable reasons why the liberality

of the Government should be still further manifested, by promoting with ample appropriations a continuance of a work so beneficial to the country. In order to exhibit the great height above established low-water mark reached by the Columbia, Snake, and Willamette Rivers at different prominent localities during the annual June freshet of 1875, the maximum having been reached about the 26th of the month, the following statement has been prepared:

	Feet.	Miles.	Remarks.
Saint Helen's, Columbia River.....	15.5	
Fort Vancouver	20	24	
Lower Cascades, foot of rapids	26½	50	
Upper Cascades, head of rapids	30	6	
Dalles City, foot of falls and rapids	30	50	
Celilo, head of falls and rapids.....	16	15	
Squally Hook.....	16	15	
Umatilla	16	60	
Wallula	16	23	
Mouth of Snake	16	11½	
Lewiston	13	137½	Snake River, May freshets.
Portland, Willamette	18.1	12	Above mouth.
Oregon City, foot of falls.....	11.7	24	Do.

The greatest height of floods observed at any time was recorded in June, 1862. The lines on the rocks indicate a rise above low-water mark, at Celilo, 29 feet; at the Dalles and Upper Cascades, a long stretch of uniform current for a distance of fifty miles between the two points, 41 feet, and at the Lower Cascades, 40 feet. Advantage being taken of such very high stages of the river, the Oregon Steam Navigation Company have on several occasions run boats over the Cascades. Three similar attempts to run the Dalles were made, all of which proved successful, by the steamers Okanogan, Nez Percés Chief, and the Shoshone. The rise in the Willamette at the two last places is caused by back-water from the Columbia during the annual freshets of May and June; the one at a distance of twelve, and the other twenty-four miles, above the junction. During the winter months the Columbia at different points is filled with large bodies of ice of great thickness, especially at the gorge, to which the name of "Hell-Gate" has not inappropriately been given. The river here forces a narrow passage between the low hills on its banks, and rushes forward in its descent with great rapidity. It at times becomes so jammed by such immense masses of ice as not unfrequently to become piled up to a height of from 60 to 70 feet. This well-known locality is a short distance above the mouth of the Des Chutes, and a little less than three miles from Celilo.

At the low stage of water which usually occurs in the fall of the year, before the close of navigation for the season, the channel-way of the river becomes contracted from 1,550 to 440 feet, with an unfathomable depth. The line of high water, as indicated on the faces of the rocks, is only 20 feet above the low-water plane, showing with what extreme velocity the water shoots through this funnel-shaped passage. During very high freshets, the river is divided into two channels by Des Chutes Island; the one just described, on the south side, and the other on the north. The latter joins with the Des Chutes, and through its bed again reaches the main river. At such times it is occasionally used by boats in making the descent, as the "Hell-Gate" then becomes very "rough and wicked," although at all periods, and under the most favorable conditions, it does not present a very inviting appearance to the casual traveler. A sketch of this gorge is transmitted with the report. A

table of distances between the different points on the several rivers has been also prepared. The following is a copy :

	Miles.		Remarks.
Portland—			
Mouth of Willamette	12	12	
Fort Vancouver	6	18	
Lower Cascades	50	68	
Upper Cascades	6	74	By railroad.
Dalles City	50	124	Foot of the Dalles.
Cello	15	139	Head of the Dalles; by railroad.
Hell-Gate	2½	141½	Above mouth of Des Chutes.
Columbus	2½	145	Do.
John Day Rapids	10	155	Mouth of John Day's River.
Indian Rapids	3	158	
Squally Hook Rapids	3	161	
Rock Creek Rapids	4	165	
Owyhee Rapids	10	175	
Willow Creek	13	188	Mouth of Willow Creek.
Canoe Encampment Rapids	10	198	
Foot of Long Island	4	202	
Grand Ronde Landing	13	215	
Devil's Bend	3	218	
Umatilla	4	222	Mouth of Umatilla River.
Head of Umatilla Upper Rapid	6	228	
Walla	17	245	Terminus of Walla-Walla and Columbia River Railroad, 30 miles.
Homly Rapids	5	250	Mouth of Touchet Creek.
Mouth of Snake River	6	256	To Priest's Rapid, on the Columbia, 80 miles, and to White Bluffs, 50 miles.
Five-Mile Rapids	5	261	
Fish-Hook Rapid	10	271	Lower end of cañon, 1 mile in length.
Rattlesnake Flat	2	273	
Jim Fort Island	8	281	
Pine Tree Rapids	7	288	
Palouse Rapid	30	318	Mouth of Palouse; landing and ferry.
Fort Taylor	5	323	Mouth of Tucancon Creek.
Texas Creek Rapid	6	329	Colfax Landing and Ferry.
Brown's Ferry	7	336	
Penawa	7½	343½	
Alemata Rapid	15	358½	
Alpaway	28	386½	Mouth of Alpaway Creek.
Selkirk's Ferry	5	391½	
Lewiston	7	398½	Junction of Snake and Clearwater.
Fort Lapwai	12	410½	Three miles above junction of Clearwater and Lapwai Creek.

In accordance with instructions, a reconnaissance has yet to be made of the Snake River between Lewiston and the Great Shoshone Falls. The object to be attained is not very apparent, as the difficulties and almost the impossibilities of rendering this section of the river navigable are already too well authenticated. For the greater part of the distance the river is confined within a deep cañon; a trail leads up along the bank for thirty miles above Lewiston to the entrance of the long series of cañons, estimated at one hundred and forty miles in extent, and then runs back some distance from the river, as high up as Bois  Crossing, a distance of two hundred miles. Along that portion the river can only be reached, and then not very often, by cattle-trails leading down to it through narrow, steep cañons or ravines. It could not be attempted during the fiscal year just ended, for the reason that so many much more important duties required immediate attention, and entirely occupied those seasons during which an examination of that nature could have been undertaken with the slightest prospect of success. Before its completion the winter rains would have commenced to fall and bring with them an almost impassable condition of the roads. The passes of the Blue Mountains, through which they cross, would also have soon become covered with snow, as well as the country adjacent to the river, so that no land travel could have been attempted without great risk and hardship. And, finally, the swollen condition

of the river during the winter and spring months, together with the reputed dangerous character of the channel in its passage through the cañons, from rocks jutting out into the stream and dashing its angry waves high against the opposing banks, would have caused one to hesitate before trusting his boat upon its turbulent waters. A reconnaissance by the river could not have been safely effected without more than ordinary preparations for the purpose, and for which a special appropriation should be made. The inclemency of the weather would also have interfered with any extended examinations. An attempt will be made during the coming fall months to ascertain, from actual personal observation, the nature of the river, with a view to ascertaining the practicability of improving it, and whether the necessities of commerce will justify the enormous outlay of money necessary to undertake such a stupendous piece of work.

From the most reliable information to be obtained through various sources, the following brief description of the river between the designated points enables one to form some idea of the nature of the reconnaissance, and what in all probability will prove to be the result. The Great Shoshone Falls of the Snake River, which rises in the Wind River range of the Rocky Mountains, are about five hundred miles in a southerly direction from its source. They are situated about thirty miles above the mouth of Rock Creek; the latter place is one hundred miles by stage-road, through City of Rocks, from Kelton, on the Central Pacific Railroad. The falls are described as presenting a very magnificent appearance in the midst of superb scenery; a series of cascades from 30 to 60 feet in height, and terminating in one grand leap of 210 feet. The river at this great natural point of interest becomes diminished in breadth to 700 feet. Before reaching the cascades, the channel is confined between high perpendicular walls of rock, until but the narrow gorge is left for the passage of the water, at a depth of 1,000 feet below the tops of the bluffs. Near the center of the river are several islands, the largest one being called Billard's Island. It there leaves the elevated plains of Idaho, and pursues a westerly course for over two hundred miles, until it reaches War Eagle Mountains. The river then, twelve miles above old Fort Boise crossing, and at the mouth of the Owyhee Creek, suddenly makes a great bend and follows a northerly course for over one hundred and eighty miles, until its waters are united with those of the Clearwater at Lewiston. After leaving the Shoshone Falls the country becomes less broken, but ranges of hills still skirt the course of the river along its entire length to the mouth. In May, 1865, the Oregon Steam Navigation Company completed the building of the steambot Shoshone, at old Fort Boise, mouth of the Boise River; she was intended to run between Owyhee and Farewell Bend, a distance of one hundred and thirty miles. Owyhee is a small place at the crossing of the river between Boise City and Silver City; and Farewell Bend is five miles above the junction of Burnt River. As the undertaking proved a great loss to the company after making about thirteen trips, the boat was laid up, with only a watchman on board, for three years, at Fruit's Ferry, known also as Owyhee Ferry, about thirty miles above old Fort Boise. It was finally determined to make an attempt to run her down to Lewiston. The season selected was in March, 1869, in order to take advantage of the unusual high water at that time in the Snake. After consultation with all the river pilots, one of them, Capt. Cyrus Smith, with John Anderson as engineer, was found willing to make the first trial. The boat was safely brought down from Owyhee Ferry to within a short distance of the head of Copper Ledge Falls, at the mouth of the creek

of the same name. The river there widens out very considerably, and a convenient basin was found in which to lay her.

The falls or cascades are three miles below Lime Point. The latter is the only place where a mass of limestone, in contrast with the almost continuous layers of basaltic rock, crops out in the form of a high white bluff bank, visible from many miles above, and fifteen miles below the mouth of Pine Creek. In its passage down both the junctions of Burnt and Powder Rivers were passed. Lime Point is at the head of what is known by the miners as the "Great Cañon of Seventy Miles." The Shoshone was tied up and properly secured in the basin above Copper Ledge Falls, and left in charge of watchmen. The pilot had announced the impossibility of proceeding farther down with the steamer, at least without warping her by the aid of heavy hawsers around the sharp, abrupt, rocky projections of the perpendicular banks of the river. The captain and engineer descended the remaining distance to Lewiston in a small boat. The second attempt, and which proved a successful one, was made by Capt. Sebastian Miller as pilot, familiarly known as "Bas Miller," during the month of April, a year after the first effort. The engineer on this occasion was D. E. Buchanan, at present and for several years past the engineer in charge of the United States dredger now employed in deepening the bars of the Lower Willamette and Lower Columbia Rivers. From the memoranda contained in the diary of the latter, kept at the time, and from several conversations had with him and the pilot, a brief synopsis has been prepared of the trip. It may not be uninteresting to relate the route pursued by them after leaving, at Uniontown, the stage-route between Umatilla, on the Columbia River, Boise City, in Idaho, and Kelton, on the Central Pacific Railroad. At that point they procured pack-horses, and made all necessary preparations for the trip. The services of John McCam, as guide to the steamer, of whom they speak in the most complimentary terms, were subsequently engaged at Carter's, on the way. The direct trail from that place crosses the north and south fork of the Powder River, and then passes over the mountains into Pine Creek Valley, which it follows down to the Snake. Owing to the miry and slippery condition of the mountain-passes, a portion of the trail had to be abandoned; it was too early in the season to be used, as it had not as yet had an opportunity to become dry. The course had to be deviated from, and the party then followed down the valley of Powder River to the Snake at Dean's Place. It continued for a short distance along this river; then leaving the banks for a time to cross over a spur of the mountain, and around the "Indian Cave," it again returns to the valley. The cave is a place well known as the spot where many whites were massacred; the natives have painted in their own style the atrocious manner in which they killed their captives. Again compelled to go back from the river, Bromlee's trail, a very bad and miry one, was followed up to Pine Creek Valley, down which it continued until the mouth was reached. The route then lay along the Snake until Lime Point, just below Patrick McGrath's cabin, was reached. Beyond this locality the horses brought from Uniontown could not proceed, and were consequently relieved their packs and discharged; the guide, packers, and animals then retraced their steps, homeward bound. Before reaching the steamer another spur of the mountains, opposite to Lime Point, had to be crossed by a steep and dangerous trail, in order to pass around a perpendicular wall of rocks, against which the waters of the river wash with great force. Mr. McGrath here offered the services of some small Cayuse ponies, which, loaded with the same heavy packs previously borne by

the much larger animals, were driven over the trail by the ordinary appliances of much shouting and many stones to urge them forward. The pilot and engineer proceeded on foot; after three miles of the worst road of the whole route, the party with their traps finally recrossed the Snake at Snow's Shanty, and arrived at Chaffin's or Miner's Camp. Thence, on foot and by a small boat, the steamer Shoshone was finally reached on the morning of the 16th of April. Nearly sixteen days had been consumed in accomplishing the journey from Uniontown, a distance of about one hundred and fifty miles, over a rugged mountainous trail, and along the bank of the river; all requisite supplies and camping equipage, with such material as heavy ropes and lines, having been packed on horses. The officers and crew of the boat were to consist of the captain, the engineer, the firemen, and two deck-hands. Four days were consumed in making needed repairs to the boat and the machinery, and in necessary preparations to start upon the downward trip. Steam was raised, and a trial made for testing the movements of the machinery; everything was found to work as satisfactorily as could be expected. The river at the time was about 8 feet above low-water mark. For the safety of the crew, in case of accidents, a small boat was placed on the stern of the steamer, for the use of the engineer, the only one in that part of the craft, while a larger one was laid on the bow for the use of the other men. On the morning of the 20th the Shoshone cast loose and started on her perilous descent. She drifted down under slow-bells to Copper Ledge Falls, and passed, very luckily, through them; for some 5 or 6 feet her bow was crushed and ground off by contact with the rock wall against which she was forced, but almost instantaneously thrown back by the heavy swell; as the bow dipped into the water the wheel of the propeller, revolving under a heavy pressure of steam, was raised out of the water and badly broken by the increased rapidity of its revolutions in the absence of any force against the blades to counteract it; pieces were thrown up as high as the upper-deck—so miners state who gathered to witness the run through the rapids. The river at the falls presents a most remarkably interesting appearance; the channel courses around a sharp elbow which juts out almost entirely across the bed, dashing the waters with great momentum against the bold rock-wall of the opposite bank. They are there divided, part resuming the natural course of the stream and part whirling into the basin of an eddy, above the point of contact, where the steamer was thrust, which has become deeply worn into nature's masonry. Large rocks also rise up from the bottom, and dangerously impede the channel-way, breaking the waters into surging waves. To run the falls, to avoid the eddies, to clear the rocks, all required a cool head and steady hand at the helm, with a perfect knowledge of the pilotage of channels of the nature described; also a determined, skillful engineer, ever prompt and obedient to the call of the bell, and with machinery under perfect control. A crushed stem, a badly damaged wheel, with boats and loose material all displaced by the deck being washed over by the waves, were some of the effects of the dangers passed. The providential escape of the crew was almost miraculous. Their safety was a sufficient compensation for any loss that otherwise could have been sustained. Such was one of the episodes of the venturous trip, the details as incidentally related by one of the actors in the scene, one whose plain statement is reliable in every respect, and free from all exaggeration.

At the foot of Copper Ledge Falls the Shoshone was laid up for several hours, to repair damages to her stern and wheel. During the run of the 21st she passed through several rapids, the river retaining the

same character, very narrow with perpendicular cliff rocks, at a height of from 25 to 30 feet. From the tops of the bluffs the hills rise at a steep acclivity to the snow-line which marks their crests. While stopping at the Oregon Bar to wood up, the captain and engineer occupied the time in attempting to walk along the river to look at the falls below, but were not able to proceed very far. In the afternoon of the same day the steamer ran two remarkably bad rapids, which were very near breaking her to pieces; towards evening she arrived at the foot of the "Seventy-Mile Great Cañon." She was there tied up for the balance of that day, and during the whole of the following one, in order to repair the wheel, which had received additional damage. It rained at night, and at times through the entire day, while the snow fell on the top of the mountains. The river continued to rise slowly. A start was again made on the 23d, some very bad bends were passed in two miles, when it became necessary to lay by for the remainder of the day, on account of the very high winds blowing up through the funnel-shaped bed. On the 24th she steamed up again, and made only eight miles, through some very narrow, rock-bound, *snaky* river, having been compelled to stop twice on the way in order to prospect ahead for falls. The landing where she lay all night, and during the following day, was named Pine Flat. On the 26th the steamer left this place at an early hour, making no landings, and accomplished the run of thirty miles to Salmon River by noon. At this point the hitherto almost continuous cañon character of the Snake can in reality be said to terminate. From the mouth of the Okanogan Creek, six miles above, the river, aided by the impetuous current of that mountainous stream, attains a very great velocity, and rushes down over the foaming cascades with extreme rapidity; the steamer, drifting under a slow-bell, ran the distance in twenty minutes, a little over three minutes per mile, as timed by the engineer. She continued on her course during the afternoon of the same day, until the mouth of the Grand Ronde was reached. About thirty miles below the Salmon, between the two rivers, six miles of walled rock banks had to be passed through. On the following day, the 27th of April, an early start was made from the Grand Ronde, and in two hours, after a run of thirty miles, the Shoshone arrived safely at Lewiston. One of the river pilots, Captain Miller's term of engagement having expired, then took her in charge, and continued on down the Snake and Columbia to Celilo, at the head of the Dalles. The same steamer successfully ran the falls and rapids of the Dalles, first into the basin at the foot of the Celilo Falls, at the high stage of water of 1871, under the pilotage of Captain Miller; and subsequently the remaining portion of the distance, with Captain McNulty at the wheel, the season of low water being selected for the lower part. Capt. Thomas J. Stump made an examination, in 1861, of the Upper Snake, on the steamer Colonel Wright. He ascended eighty miles, at a low stage of water, to a point designated Twin Rock, about twenty miles above the junction of the Salmon. The object then had in view was to search for a trail leading from the river to the mining regions of the Idaho Basin. Fourteen days were occupied in making the ascent, forty-five miles having been accomplished on the first one. The descent was made in one day. No important benefits were derived from the examination, as the navigation of that portion of the river proved to be too difficult and unprofitable. As previously stated, a route leads down the banks for thirty miles from the Grand Ronde to Lewiston; several crossings and ferries are passed, and along the banks are many Indian rancherias. Above the mouth of the latter river the Indian trail, seldom used by white men, turns away from the Snake, and

only again occasionally touches it at a few particular falls or rapids, such as at the mouth of the Salmon, where the natives go to fish. The other approaches, few and far between, are only used by the Indians, while herding their horses and cattle on the adjacent hills, to enable them to obtain water for their stock. They generally lead down almost impassable ravines. The names of the most prominent localities along the Upper Snake, and estimated distances between them, may be reiterated for general information :

Great Shoshone Falls, mouth of Rock Creek, Rock Creek City.....	30	Chaffin's Branch, (miners' camp) ...	2
Boisé City and Silver City Crossing, Fruit's Ferry, or Owyhee Ferry	130	Copper Ledge Falls and Creek.....	1
Mouth of the Owyhee.....	40	Foot of Great Cañon, of seventy miles	70
Old Fort Boisé Crossing.....	12	Pine Flat.....	10
Farewell Bend.....	80	Twin Rock	10
Burnt River.....	5	Okanogan	14
Powder River	10	Mouth of Salmon	6
Pine Creek	15	Mouth of Grand Ronde.....	30
Lime Point, (McGrath's cabin)	5	Lewiston.....	30

From the description given of the Snake, obtained from different sources, some faint idea may at least be formed of the probable difficulties to be encountered in making a reconnaissance. Should a detailed examination be required, it will be necessary to have suitable boats built, and to have them transported to the Shoshone Falls, for the purpose of making the descent of the river. By this plan considerable time will be required to perform the entire journey. The distance by water from Portland to Umatilla, and thence by land to the falls, will be five hundred and eight miles; the length of the descent by water from the falls to Lewiston is five hundred miles at least; and the return-trip, by water, from the latter place to Portland, is four hundred, a sum-total of over fourteen hundred miles. Should the examination be made by land, approaching the river at all accessible points, and, when possible, following along its banks, the best plan would be to first ascend the Snake from Lewiston, collecting all available information by inquiry and by actual observation as the journey progresses.

Projects have been submitted for the improvement, during the current fiscal year, of the Upper Columbia and Snake Rivers; also the necessary advertisements, instructions to bidders, and specifications of work for removal of rock from the channel have been prepared for publication and distribution. As operations cannot be commenced before the 1st of November, on account of the height of the water, in all probability not receding sufficiently before that date and a suitable depth obtained for prosecuting the work advantageously, there will be sufficient time to make all the required preparations in order to take advantage of the first favorable opportunity to resume the plan of improvement after its late interruption. Personal inspections were made during the fiscal year to ascertain the results of the labor performed, and to gain such additional information as might prove serviceable in future operations of a like nature.

The improvements upon the Upper Columbia have, since their incipency, been almost entirely under the immediate charge of R. B. Randall, an assistant engineer of this office. His untimely death by drowning, by the capsizing of his boat on the 10th of March last, at the scene of his labors on the Umatilla Upper Rapids, and when almost within the very last hours of closing the allotted work assigned him for the season,

it became a painful duty to announce to the Chief of Engineers. He was true to his manhood and his profession ; and, as then truly written—

He was a most able and reliable civil assistant, always prompt and energetic, perfectly fearless, inured to the greatest hardships by a previous seafaring life, and with his whole mind and heart given to the duties intrusted to him.

He was a true friend, ever in sympathy with all in need or distress.

Financial statement.

Amount in hands of officer and subject to his check July 1, 1874	\$55 85
Amount appropriated by act approved March 3, 1875	20,000 00
Amount expended during the fiscal year ending June 30, 1875	19,411 34
Amount available July 1, 1875	644 51
Amount required for fiscal year ending June 30, 1877.....	30,000 00

GG 4.

SURVEY OF THE CASCADES AND DALLES OF THE COLUMBIA RIVER, OREGON, AND WASHINGTON TERRITORY.

UNITED STATES ENGINEER OFFICE,
Portland, Oreg., January 16, 1875.

SIR: By your directions a "survey of the Cascades and Dalles of the Columbia River, for the purpose of ascertaining the practicability and cost of constructing canals and locks at these points," has been made. The immediate charge of the party in the field was placed under Robert A. Habersham, civil engineer, at present an assistant in this office. The operations were conducted during the months of September and October, 1874. Since the first part of November, he has been engaged, in addition to other duties, in the preparation of the maps and profiles of the river between Dalles City and Celilo, and also at the Cascades ; the instrumental lines were conducted along the water's edge, and adjacent to the beds of the railways constructed by the Oregon Steam Navigation Company to overcome the falls and rapids at the two localities. The season was most favorable, the stage of the river being very low at the time. The field-operations were of a most interesting character, and the importance of the proposed improvements cannot be overestimated. The difficult problems of engineering which must be solved will, at least at one of the localities, the Dalles, at first study appear almost insurmountable ; but at the other, the Cascades, no more difficulty will be encountered than upon works of a similar nature constructed through rocks. The magnificent, bold, and peculiar scenery at the two places can only be appreciated after a personal inspection.

An attempt, in this report, to describe the passage of the Columbia, the great river of the northwestern section of the United States, through a channel confined between perpendicular basaltic-rock walls, and reduced in widths at certain localities to only 125 feet, as at the Dalles, would prove inadequate. It may not be uninteresting to state, before proceeding, that the same mass of water which is forced over this chute, aided by its tributaries, the Willamette, Lewis, and Cowlitz Rivers, spreads out over a broad space on the shoals between Tongue Point and Woody Islands of more than ten miles in extent before it empties into the Pacific Ocean. Tracings of the complete maps and profiles of the surveys are transmitted with this brief preliminary report ; an in-

spection of them will exhibit more clearly than words can impart the characteristic details of the regimen of the river.

The obstacles in the nature of rocks to be blasted out and displaced from the channels, as well as the plans, but partially suggested, for ascending or descending the falls and rapids by means of canals and locks cut through solid rock, are stated in the report presented to this office by the assistant civil engineer, a copy of which is forwarded, explanatory of the principal points of interest along the lines of survey. It furnishes a very concise and accurate explanation of the drawings. In deciding upon the manner of executing the plans of improvements, even should they be deemed practicable, more extended examinations must be made; this should especially be done between Dalles City and Celilo, not only during low water of the winter season, but at the extreme stage of the summer months. The time has been too brief to study all the varying features which will enter into the execution of such a grand and useful work. The very strong currents; the sudden bends; immense rise in the river during freshets; the eddies; the whirlpools; the large quantities of drift during the high freshets in the main river and large tributaries above the two localities; and the masses of floating ice from above during the winter months—all must be considered.

At Hell Gate, less than three miles above Celilo, the river becomes gorged with ice to the height of from 60 to 70 feet, which, when loosened by the mild spring-weather, comes down with great force. The steamboats of the Oregon Steam Navigation Company, however, lay tied up at the wharf at Celilo with safety all the time. The thermometer (Fahrenheit) was, during January, 1875, at the Dalles, 6° below zero, and at Wallula, in February, 26° below zero. These are but two of the readings taken from the weather-records. The Columbia is always frozen over, or blocked up, each year above the Dalles, although not very frequently below that place.

At the Cascades all of the same difficulties will not be encountered as at the Dalles. A permanent improvement can, without any doubt, be successfully accomplished at this locality by the construction of a canal, and locks across the rocky neck of land indicated on the map between the head of the upper rapids and the basin at the foot of them. The works will be almost identical in character with those at the falls of the Willamette, opposite to Oregon City, and, in reality, will not, in many respects, offer the same difficulties. The neck is a rocky plateau, over which the line of the canal will be direct, within the limits of high-water mark, and not less than 200 feet from the slope of the adjacent hills. Without more extended examinations, it would not be expedient to submit final estimates for such important works. They are difficult to prepare, and require very much more careful study than what I have been able to devote on account of other pressing duties. It was necessary at the same time to await the results of more extended examinations in regard to the probable effect of the annual floods upon the canals and locks when constructed; and to determine what safeguards must be employed as preventives against the destruction of the works during their construction and after their completion. Borings over the respective lines of the canals should be made to ascertain the existence of fissures in the rocks; for this purpose, as well as to make more extended examinations to aid in a more perfect solution of the problem in addition to the surveys already completed, a small appropriation is needed, and an estimate for the same submitted.

The following has been telegraphed to the Chief of Engineers on the 12th of February, 1875:

Length of canal through solid rock around Cascades of the Columbia, 2,600 feet; rise, 21 feet at low water; length of locks, 215 feet; width, 40 feet; three locks, lift of each 7 feet; draught of boats, 8 feet loaded; greatest depth of water in locks, 16½ feet; removal of a ledge and other rocks 1,800 feet below canal; current below, nine miles per hour; difference between extreme high and low water, 41½ feet; substantially built; probable cost of canal and locks and removal of rocks, \$700,000.

As the difference of level at low water is only 21 feet, the question must be decided whether it will be necessary to construct two locks, of sufficient strength and easily manipulated, with lifts of 11 feet each, or whether three will be required to furnish the necessary solidity, in addition to the guard-lock.

As stated in the report of the assistant engineer, the total fall from the head of the rapids to the foot of the Celilo Falls, a distance of 4,500 feet, is 36 feet, 26.5 of which is in a distance of 800 feet. Around this fall a canal and locks will be required. This work will also require additional study before a final report can be submitted.

The very great importance of the two works, both at the Dalles and Cascades, especially at the latter, and the great benefits which will accrue to Eastern Oregon by their construction, can be easily and satisfactorily demonstrated. The aggregate amount of tonnage carried on the river between Portland and points above, on the Columbia and Snake Rivers, for the fiscal year just closed, was 18,230 tons, of which 6,500 tons were of wheat and flour; and it is estimated that there will be 15,000 tons of wheat and flour to ship from Walla Walla Valley alone during the current year.

The different stages of high water for several successive years have been placed in a tabulated form, and will give an idea of the great height to which the river is accustomed to rise. Advantages having been taken of very high stages of the river, the Oregon Steam Navigation Company have on several occasions ran boats over the Cascades; three similar attempts to run the Dalles were made, all of which proved successful, by the steamers Okanogan, Nez Percés Chief, and the Shoshone. When the works are accomplished and a reality, which will most undoubtedly be the case in the course of a few years, a continuous and uninterrupted water communication can be had by steam-boats from the mouth of the Columbia River for a distance of five hundred and fifteen miles, up to Lewiston, at the junction of the Snake and Clearwater, for several months of each year; and upon the completion of the improvements above Celilo, and when not prevented by ice, for four hundred and twenty-three miles up to Palouze Landing, at the foot of Palouze Rapids, the crossing of the road between Walla Walla and Fort Colville, the extreme northern military post of the country.

The following is a list of maps transmitted with this report:

1. 2 A^a, A^{a2}, Dalles, Celilo.
2. A^b, A^{b2}, Dalles, Celilo profile.
3. 2 A^c, A^{c2}, Cascades.
4. A^d, A^{d2}, Cascades profile.

Very respectfully, your obedient servant,

N. MICHLER,
Major of Engineers.

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

REPORT OF MR. ROBERT A. HABERSHAM, ASSISTANT ENGINEER.

PORTLAND, OREG., *December 11, 1874.*

SIR: I present, herewith, tracings of the preliminary maps and profiles of my surveys of the Columbia River, between the Dalles and Celilo, and at the Cascades.

The obstructions to the navigation of the river between the Dalles and Celilo are, taking them in the order of their position, as follows:

First. A line of rapids, about five miles above the Dalles, and marked on the maps and profile the "Five-Mile Rapids," 9,500 feet in length, with a total fall in that distance of 17.02 feet. The average width of channel here is about 200 feet, and the maximum velocity of current does not exceed nine miles per hour; this for a distance of 4,100 feet. At the head of the rapids the channel is contracted to a width of 125 feet, by a ledge of rock which juts out from the north side of the river. By the removal of a portion of this ledge, sufficient to increase the width of the water-way to 175 feet, the rapidity of the current will be so diminished as to allow steamers to ascend without difficulty. The water here is so deep that this may be done without danger of exposing sunken rocks. Accurate soundings could not be made at this point, as boats could not be obtained. Near the foot of these rapids there are four rocks, colored in sepia on the map, to be removed from the channel. I am informed by river-pilots that in time of freshets the largest of these rocks would be a serious obstacle to navigation. Their removal would afford easy passage for steamers at all times, except, perhaps, at extreme high water, possibly even then. But this I cannot affirm positively. At all events, by widening the narrow canal on the south side, now dry, it may be used during extreme high water, which occurs in June and July of each year, lasting from four to six weeks; this would also reduce the water in the principal channel, making the ascent for steamers easier. To report fully on this part of the work it would be necessary that I should have an opportunity of observing the velocity of the current during the time of high water, as I have no data from which to ascertain it, even approximately, by calculation.

Second. About one and a half miles above the "Five-Mile Rapids," there are three rocks to be removed from the channel. They are about 6 feet above the surface of the water. But for the rapidity of the current, about six miles per hour, steamers could easily avoid them. Their removal is, however, necessary in order to straighten the channel, and allow steamers to head directly up stream. An estimate of the cost of this work, as well as that of the "Five-Mile Rapids," will accompany my final report and maps.

At the "Ten-Mile Rapids," so called, the water is deep and the current slow, not exceeding four miles per hour, although full of eddies. Steamers can ascend and descend with ease and safety at all times, there being a natural high-water canal on the north side, 1,000 feet wide, with from 10 to 25 feet of water during freshets. I notice this point only to remove the existing impression that it is a dangerous place.

The Celilo Falls present the greatest obstacle to the opening of the river to navigation from its mouth to Wallula. The total fall from the head of the rapids to the foot of the lower falls, a distance of 4,500 feet, is 36 feet, 26.5 feet of which fall is in a distance of 800 feet. Here a canal and locks will be required. The map and profile will show better than a written description the features of the locality. The south channel, which gives outlet to the upper and lesser fall, I consider impracticable. It is one mile long, falling 20 feet in that distance; is crooked, and in places very narrow. The current is very swift, running in some places ten miles per hour; and there are a number of large rocks under and near the surface, causing dangerous eddies and whirlpools.

The north shore is better adapted to the work to be done. The rock marked (A) on the map is flat on top; is 25 feet below the freshet-mark of 1862, and 37 feet above the surface of water in the deep basin at the foot of the lower or principal fall. This rock, which is a portion of the ledge forming the fall, is large enough to allow two locks, 60 by 200 feet each, to be excavated in it, and is, as far as I can judge, free from fissures; so that the locks can be blasted out down to the invert without interruption from water. Above, a canal can be opened without extraordinary expense; and the canal and locks would be in the same straight line, coinciding with the general direction of the river. In my judgment, based upon as careful a survey as I could make at the time, the north shore, at the point which I have just described, offers the best site for canals and locks. The exact spot can only be selected after a more thorough examination of the bed of the river than, with the time and means at my disposal, it was possible for me to make.

The elevations of high water given on the profile at Celilo, and in tabular form at the end of this report, were taken from marks left by the floods, and the date recorded at the time, by persons residing there; they may therefore be accepted as reliable. Those shown at intervals on the profile were taken from marks on the rocks probably made by the floods of 1873 and 1874. The highest freshet recorded is that of 1862. I am informed, however, that that of 1849 was 5 feet higher. Excepting the three points

above described, the river is at all seasons navigable between the Dalles and Celilo to the largest river-steamers, the channel being from 600 to 2,000 feet wide, from 10 to 90 feet deep, and the average velocity of the current not exceeding three miles per hour.

THE CASCADES.

As you will see from the accompanying profile, the total fall from the upper to the lower landing is 37.30 feet. The distance is five and three-quarters miles. The principal rapids, three-quarters of a mile below the upper landing, are 2,000 feet in length, having a fall of 21 feet. One-quarter of a mile lower down is a lesser rapid, formed by a ledge of rock which extends across the channel from shore to shore, having, however, a depression 200 feet wide and from 40 to 60 feet deep near the north shore, through which the current runs at the rate of nine miles per hour. This depression forms the principal channel at this point, and by blasting a portion of the ledge so as to increase the water-way, the force of the current will be so reduced that steamers can easily ascend to the foot of the principal rapids just below the neck, the point which, in a former report, I designated as the best site, in my judgment, for a canal and locks. The mail-boat, a small steamer of inferior power, ascends daily without difficulty, passing through a rapid 2,100 feet long, where the current has a velocity of eight miles per hour, to the head of Bradford Island. From this point to the basin at the foot of the main rapids the river is clear of obstruction, excepting the ledge noted above, and which can be easily reduced, the rock lying exposed at the level of low water.

The accompanying tracing shows the configuration of the ground at the neck, the sepia-curves representing contour-lines of 10 feet each.

The soundings in feet are taken for a sufficient distance above and below the neck to show that the approaches to the locks will be easy, the water being from 10 to 40 feet deep, and the bottom tolerably uniform. So far as I can judge from the surface, the bed of rock which forms the neck is solid, without fissures. If this prove true, the locks here, as at Celilo, can be excavated to their inverts without interruption from water. The rock (basalt) is of good quality for masonry, and will blast easily.

I must say that the difficulties of opening the river to navigation at this point have been greatly exaggerated. From the lower landing to the foot of the principal rapids steamers can ascend at this time; and a moderate expenditure will make this portion easily navigable, while the passage of the principal rapids, or cascades, by means of a canal and locks, is easier than similar works lately completed at Oregon City, on the Willamette, both in point of engineering difficulties and expense.

With the general map I will make a full report of my surveys, including estimates of cost of proposed work.

Flood-levels recorded at Celilo.

June, 1866	112. 77	June, 1868	105. 41
May, 1869	100. 81	June, 1870	106. 96
May, 1863	106. 11	June, 1871	112. 74
June, 1874	105. 40	June, 1862	115. 74

Low-water mark, varying but a few inches each year, 86.75.

Very respectfully,

ROBT. A. HABERSHAM,
Assistant Engineer.

Maj. N. MICHLER,
Corps of Engineers, Bvt. Brigadier-General, U. S. A.

GG 5.

EXAMINATION OF SKAGET RIVER, WASHINGTON TERRITORY.

An examination of Skaget River was made in October, 1874, by Major Michler, in compliance with provisions of the river and harbor act of June 23, 1874, to ascertain the nature and extent of the jams or rafts which interrupt its navigation.

The main entrance to the river is by the most southern of several mouths through which it empties into one of the inlets of Puget Sound, and is accessible only at half-tide, owing to flats which, extending some