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IN FOURTEEN VOLUMES.

Volume 1	No. 1. Diplomatic: Parts 1 and 2.
Volume 2	No. 1. Interior.
Volume 3	No. 1. War: Parts 1 and 2.
Volume 4	No. 1. Navy, Postmaster General.
Volume 5	Nos. 2 and 3.
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Volume 10	No. 52. Patents: Parts 1, 2, 3 and 4.
Volume 11	No. 71. Coast Survey.
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Volume 13	No. 84 to 102, except 87.
Volume 14	No. 87. Commercial relations.

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40TH CONGRESS, 3d Session. } HOUSE OF REPRESENTATIVES. { Ex. Doc. 1, pt. 2.

MESSAGE

OF THE

PRESIDENT OF THE UNITED STATES

AND

ACCOMPANYING DOCUMENTS,

TO THE

TWO HOUSES OF CONGRESS

AT THE

COMMENCEMENT OF THE THIRD SESSION OF THE FORTIETH CONGRESS.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1869.

REPORT

OF THE

SECRETARY OF WAR.

PART II.

seven feet up to Hallowell, and six feet thence to Augusta, in the lowest stages of the water. This width, however, General Thom finds to be insufficient, and recommends that it be increased to 100 feet at bottom. A contract for the work to the extent of 100,000 cubic yards of dredging was made, and it is probable will be completed during the present season,

Amount required to open a channel 100 feet wide, from Gardiner to Shepard's Point, (see survey of Kennebec river,) and to increase the width of the channel thence to Augusta, (in addition to the sum heretofore appropriated).. $30,000 00

(See Appendices T 6 and T 7.)

4. *Improvement of the navigation of St. Croix river, above the "Ledge."*

For this improvement it will be necessary to deepen its channel by the removal of slabs, edgings, and saw-dust, which for 30 years and more have been accumulating in large quantities in the river.

The act making an appropriation for this improvement requires the co-operation of the province of New Brunswick, which has not yet been obtained, so that operations have not been commenced.

Amount appropriated for this work..... $15,000 00
Additional amount required for its completion..... 35,000 00

It being understood that the province of New Brunswick will contribute an equal amount for this purpose.

(See Appendix T 8.)

5. *Survey of Kennebec river, above Gardiner, Maine.*

This survey has been completed, and estimates made for the improvement of the navigation by dredging a channel 100 feet wide at bottom. See improvement of Kennebec river for estimate.

(See Appendix T 9.)

6. *Survey of Penobscot river, above Hampden, Maine.*

This survey has been completed. Very extensive accurate soundings and borings made in the river show that from Crosby's narrows up to Bangor, a distance of some three and a half miles, the bed of the river is seriously obstructed with slabs, edgings, and saw-dust to an average depth of 10 feet, and in some localities more than 18 feet; and that the harbor of Bangor is also obstructed with several large sunken rocks. To restore the channel to the original river-bed would require an excavation of more than 5,000,000 cubic yards of its accumulations. But a passable channel could be made at a cost estimated at from $100,000 to $500,000, according to its width and depth.

(See Appendix T 10 to T 13, inclusive.)

RIVERS AND HARBORS ON THE PACIFIC COAST.

Officer in charge, Brevet Lieutenant Colonel R. S. Williamson, major corps of engineers, who has under his orders First Lieutenant W. H. Heuer, corps of engineers.

1. *Improvement of Willamette river, below the city of Portland, Oregon.*

The operations on this river during the past fiscal year have been confined to dredging on Swan Island bar, and removing snags at that point as well as at the mouth of the river.

Owing to the necessity of repairing the dredging machines loaned by

the city of Portland, the work was not commenced until September 10, 1867. From that date to the end of November, when the work was stopped by high water, 18,184 cubic yards of material were removed, at a cost of $10,484 48, being an average of 57.6 cents per cubic yard.

By this excavation a channel was made 100 feet wide, 900 feet long, and 15 feet deep at extreme low water. The average depth of the excation was 4.18 feet. Work was resumed on the 20th February, and continued to the 11th April, during which time 331 lineal feet of channel of the same width and depth was excavated, by the removal of 7,320 cubic yards of material, at an average depth of 5.9 feet, costing $4,607 19, being an average of 62. 9 cents per cubic yard.

Seventeen feet can be carried at the lowest stage in the Columbia river, below the mouth of the Willamette, and 19 at the highest, hence the officer in charge recommends that the channel of the Willamette at Swan Island bar be deepened to 18 feet, as originally intended. To dredge a channel of that depth would require the removal of about 50,000 additional cubic yards of material, at a cost of $31,200. A survey of the mouth of the river will be necessary before the extent of the excavation required at that point can be ascertained.

It appeared from a survey made after the November rise that the winter freshet caused no material change or filling up of the channel.

Amount on hand available July 1, 1867	$29,000 00
Amount expended during fiscal year	25,284 49
Amount allotted from general appropriation of 1868	21,000 00
Required for next fiscal year	15,000 00

(See Appendices U, U 1, and U 2.)

2. *Removal of Blossom and Rincon rocks in the harbor of San Francisco.*

Minute surveys were made of these rocks by the Coast Survey some years ago, and in the summer of 1866 the board of underwriters, with others interested, caused some experiments to be made on Rincon rock to test the practicability of removing it by blasting, the result of which was an estimate that its removal would cost about $65,000.

Blossom rock is in a much more exposed situation. Lieutenant W. H. Heuer, corps of engineers, experimented upon this rock in the winter of 1867 by removing, by blasting, some 69 cubic yards of stone, to form an estimate of the probable cost of such work.

From his results it is estimated that $60,000 will probably be required for its entire removal. An allotment of $50,000 has been made from the appropriation of July last for this object.

Amount required to be appropriated for the next fiscal year, $10,000.

(See Appendix U 3.)

3. *San Diego harbor, California.*

A special report was made June 22, 1868, in compliance with the request of the chairman of the Committee on Commerce, United States Senate, dated June 5, 1868. The report is herewith submitted.

(See Appendix U 4.)

SURVEYS AND EXAMINATIONS ON THE PACIFIC COAST.

Survey of the Upper Columbia river, Oregon.

The object of this survey is to ascertain the size and position of sunken rocks in the several rapids of the river, with the view of forming an estimate of the cost of their removal.

Between the Dalles of the Columbia and the mouth of Snake river there are six rapids, from which rocks should be removed to secure a depth of seven feet at the lowest stage of water.

Four of these rapids have been surveyed during the fiscal year, from which it is found that 4,726 cubic yards of rock must be removed by blasting. Upon the remaining two rapids, not yet surveyed, it is thought that about 650 cubic yards of rock must be removed.

It is proposed to make trials upon some of these rocks to obtain data for forming an accurate estimate of the cost of blasting. From the best information now in his possession, the officer in charge estimates it at about $28 per cubic yard, making at that rate the whole cost $132,328.

(See Appendix U 2.)

Point Sal, California.

The report upon the survey for an artifical harbor at this locality will be found in Appendix U 5.

SURVEYS AND EXAMINATIONS WITH THE VIEW TO THE IMPROVEMENT OF RIVERS AND HARBORS.

The following estimates af appropriation are submitted, showing the amount required for the purpose of making further surveys and examinations of localities, the improvement of which has been heretofore, or that may be hereafter, authorized.

For the Atlantic coast	$30,000 00
For the Pacific coast	25,000 00
For the western and northwestern rivers	125,000 00

PUBLIC BUILDINGS, GROUNDS, AND WORKS IN THE DISTRICT OF COLUMBIA, AND WASHINGTON AQUEDUCT.

Officer in charge, Brevet Brigadier General N. Michler, major corps of engineers.

For the condition of the public works within the District, and suggestions for such further improvement as appears necessary for the public service, the health of the inhabitants, and the proper arrangement of the public grounds, see report in detail.

(Appendices V and V 2.)

Required for next fiscal year, $526,000.

The recommendations in the report of last year are renewed.

Washington aqueduct.

A report in detail upon the work done during the year, and upon the condition of the finished portions, will be found in Appendix V 1.

The engineer in charge recommends an appropriation for the rent and purchase of the land occupied by the aqueduct, to which the United States have no title; and gives estimates in detail for the entire completion of the work, amounting to $685,338, which is required for next fiscal year.

SURVEY OF THE NORTHERN AND NORTHWESTERN LAKES.

Officer in charge, Lieutenant Colonel and Brevet Brigadier General W. F. Raynolds, corps of engineers, assisted by Captain and Brevet Lieutenant Colonel F. U. Farquhar, and Lieutenants J. F. Gregory,

The European and North American railway is under contract from this city to the city of St. Johns, New Brunswick, and work upon both ends of the line is being vigorously prosecuted; upon this end the rails will be laid to Milford (13 miles) this fall, and to Winn (42 miles further) early next season.

The means is also provided to build a branch of the above road from Milford, 35 miles, to Dover, the shiretown of the county of Piscataquis, a survey for which has been ordered with the intention of putting the road under contract for completion in 1868; thus will be opened to the business and commerce of this port the vast agricultural, manufacturing, mineral, and forest products of the upper Penobscot and Aroostook and Piscataquis counties.

The population of the city of Bangor in 1860 was 16,407, and the town of Brewer, on the opposite side of the river, 2,835; the two may now be estimated at 25,000.

This port is the highest navigable point upon the river, and about 60 miles inland from the coast-line, making it, with its connecting lines of railway, the commercial *entrepot* and business centre for a territory of 14,000 square miles, (larger in area than the States of Massachusetts, Connecticut, and Rhode Island,) and a present population of about 120,000 people. The business of the port will not diminish as the more valuable growth of the forests, upon which it now so largely depends, is depleted, but will increase in double, in treble, and in tenfold proportion as the lines of railway shall be extended into the interior, thereby making the remaining wood and timber more valuable even than the rich product already removed, and bringing to the nearest navigable tide-water, from the immense deposits of argillaceous slate in Piscataquis county, inexhaustible supplies of the best roofing slate produced on the globe; and opening up to manufacturing improvement the vast water-power afforded by the Penobscot and its tributaries. A competent engineer has estimated that from Old Town, 12 miles above the bridge connecting Bangor and Brewer, the main river alone has an available water-power equivalent in the draught to 40,000 horse power, having a fall in that distance of 100 feet. This hidden wealth, these slumbering powers, great, cheap, and accessible beyond any other in the country, must soon be unveiled and wakened into life and made busy in the employment of manufacturing capital, skill, and labor, their products crowding each avenue of transportation from the lakes to the sea, and swelling the commerce of the country.

* * * * * * *

Most respectfully, your obedient servant,

JOHN H. RICE,
Collector of Customs.

Brevet Brigadier General GEO. THOM,
Lieut. Col. Corps of Engineers U. S. A., Portland, Maine.

APPENDIX U.

SAN FRANCISCO, CALIFORNIA,
July 13, 1868.

GENERAL: I have the honor to submit the following report of my official operations during the fiscal year ending June 30, 1868. The operations have been conducted under the following appropriations, viz:

"Survey of military defenses;" "purchase and repair of instruments;" "removing obstructions to Willamette river;" "survey and examination on the Pacific coast." In addition to these I am the engineer of the 12th and 13th light-house districts, and a member of the board of engineers for the Pacific coast.

The operations under the above-mentioned appropriations will be described in the order named.

SURVEYS OF MILITARY DEFENSES.

During this year I have had no opportunity of making a reconnoissance in person. During the fall of 1867 I have had two assistants in Nevada who accompanied a party sent out by the State geologist of California, by which means I have been able to collect information (the only expense being the pay of the assistants) which has resulted in a map, quite in detail, of a large portion of that State. The map was completed and forwarded to the headquarters corps of engineers. During the greater portion of the year I have had an assistant in Arizona, sent there on the verbal order of the general commanding the department of California, to report to the officer commanding district of the Verde. As no special facilities were afforded him in the way of escorts he was able only to collect such topographical information as could be obtained by accompanying scouting or other parties sent out for a different purpose than the collection of topographical information, and hence the results have been meager.

As an engineer officer arrived here in October last who has reported to the general commanding this military division, this assistant has been transferred to him.

The results of observations and investigations in meteorology and hypsometry, which had occupied much of my time during previous years, were sent to the Chief of Engineers in February of last year, with a request that they be published. This request having been submitted to the honorable Secretary of War, and having been granted by him, I was ordered in September last to proceed to Washington on temporary duty for the purpose of making arrangements for superintending the publication. Having performed that duty, I returned to my station here. During the year the collection of data for elucidating some of the parts of this subject still obscure have been continued, but in June last an order was received to stop further expenditures for that purpose, and to close my office under the appropriation, "surveys of military defenses."

The following is a statement of the amount received and expended during the past fiscal year on account of "surveys of military defenses," viz:

On hand July 1, 1867	$3,667 00
Received during the year	22,062 92
Total accounted for	25,729 92
Expended during the year	24,067 64
Balance on hand June 30, 1868	1,662 28

Which amount has since been deposited to the credit of the United States assistant treasurer at San Francisco, California, thereby closing my account with the United States under this appropriation.

Purchase and repair of improvements.

The amount expended under this appropriation has been small considering that, by order of the Chief of Engineers, some instruments have been purchased and repairs made for other engineer officers.

The following is a statement of the amount received and expended during the past fiscal year on account of purchase and repairs of instruments, viz:

On hand July 1, 1867	$1,796 42
Received during the year	
Total accounted for	1,796 42
Expended during the year	1,127 40
Balance on hand June 3, 1868	669 02

REMOVING OBSTRUCTIONS TO WILLAMETTE RIVER.

The operations on this river during the past fiscal year have been confined to dredging on Swan Island bar, and removing snags from that bar and the one at the mouth of the river. As the various machines and vessels furnished me by the city of Portland required extensive repairing and calking before they could be used, they were put on the ways early in July and after receiving the necessary repairs were launched and towed to Swan Island bar, where the work of dredging commenced on the 10th of September, the river having fallen sufficiently to admit of work being done. The cost of these repairs was $9,375 93. The work of dredging continued until the end of November, when it was stopped by high water. The following is the result:

Amount of material removed by dredging, 18,184 cubic yards.

Amount expended during the period of dredging, $10,484 48.

Cost per cubic yard, 57.65 cents.

A channel had been cut 100 feet wide, 900 feet long and to a depth of 15 feet at extreme low water.

The average depth of the excavation was 4.18 feet.

The river continued too high for dredging until in February. On the 20th of that month work was resumed and continued until the 11th of April, when it was again interrupted by the spring freshet.

During this period of work the amount of materials removed by dredging was 7,320 cubic yards.

Expenses during the period, $4,607 19.

Cost per cubic yard, 62.94 cents

A channel of the same width and depth as before was excavated for 331 linear feet. The average depth of the excavation was 5.9 feet.

As the vessels and machinery were in good condition, and ready for use, at the end of this fiscal year, it is fair to infer that it will cost about the same during the following year if the work is prosecuted in the same manner. If we include in the estimate the amount expended during the interval between the periods of dredging, (neglecting the original cost of repairs to the dredger, &c.,) the average cost per cubic yard would be 62.4 cents, and the estimated amount required to finish Swan Island bar to a depth of 15 feet would be $6,240. The expense for repairs alone (exclusive of the original repairs) was $2,649 03, while the corresponding total expenses were $15,908 56, showing that the amount of repairs was 17 per cent. of the whole expenses after work was first commenced.

From the pilot of the Columbia river below the mouth of the Willamette, I learn that at the lowest stage of water and tide there is 17 feet, and at high tide 19 feet. Hence it would be desirable to deepen the channel to at least 18 feet of water, as was originally intended. To dredge a channel of that depth at Swan Island bar would require the removal of 50,000 additional cubic yards of materials at a cost of $31,200. The amount to be removed at the mouth of the river has not yet been estimated, as a survey for that purpose has not been made, but one will be made before dredging can be commenced again. The survey that was made after work was stopped in November last, on account of the rise in the water, showed that no material change or filling up in the channel had been caused by the winter freshet. The result of the more severe spring freshet has not been as yet ascertained. If the amount asked for in my last annual report has been appropriated ($25,000) an additional amount of $10,000 will, I think, be sufficient to make a channel in the river of 18 feet.

I am directed to report on the following 11 points, which I do to the best of my ability:

1st. A survey of Swan Island bar was made after work was suspended in November last, on account of a freshet in the river, and also one at the mouth of the Willamette. Work was again resumed in February and continued for nearly two months. The plan adopted was for dredging with a view to secure a channel 100 feet wide and 15 feet deep at extreme low water.

The items of expenditures have been as follows:

Original repairs of dredger, machinery, scows, &c	$9,375 93
Advertising for proposals	186 78
Dredging during first period of work	10,484 48
Expenses during first interval when no dredging was done	358 66
Dredging during second period of work	4,607 19
Expenses during second interval	271 45
Total amount expended during the year	25,284 49

2d. It is estimated that the amount asked for last year of $25,000, with an additional appropriation of $10,000, will complete the work. It may require a small amount annually to secure constantly 18 feet of water in the channel.

3d. If the amount asked for last year has been appropriated, no more can be profitably expended during the next fiscal year.

4th. The collection district is Astoria, Oregon.

5th. The nearest town is Portland, Oregon.

6th. The amount of revenue collected is unknown to me.

7th. The amount of commerce and navigation to be benefited by the completion of this work is large, and increasing. Steamers drawing 15 feet of water run from San Francisco to Portland regularly three times a month except when stopped by extreme low water at the bars now partially removed.

8th. Proposals were advertised in papers of San Francisco and Portland, and but one bid was received, which was by the city of Portland. The amount of the bid exceeded the amount of the appropriation then available. A second proposal was advertised, but no bids were received. Hence the work was done by hired labor.

9th and 10th. Hence no contract was made.

11th. The following are the amounts received and expended during the

last fiscal year on account of the appropriation for removing obstructions to navigation on the Willamette river below Portland:

On hand July 1, 1867	$9,199 48
Received during the year	25,000 00
Total on hand and received	34,199 48
Expended during the year	25,284 49
On hand June 30, 1868	8,914 99

In operations in this river, I have been assisted by Lieutenant W. H. Heuer, United States engineers, and by Mr. Frank H. West, civil engineer, whose services have been very valuable.

EXAMINATIONS AND SURVEYS ON THE PACIFIC COAST.

The only operations under this appropriation have been on the upper Columbia river. The object of making a survey of the upper Columbia river was to determine the size and position of the sunken rocks in the various rapids, with a view of obtaining the data necessary to estimate the cost of their removal, so that eventually there should be a sufficient depth of water over these rocks during the lowest stage of the river to enable the largest size boats on it to navigate it with safety at all times.

Between the Dalles of the Columbia river and the mouth of Snake river are six rapids, all of which contain rocks which should be removed to secure seven feet of water at the lowest stage. Of these, four rapids have been surveyed during the period of this fiscal year, when work could be done, namely, between the 1st of September and the 1st of December. The result of the survey has shown that the amount of rock to be removed in each rapid is as follows:

	Cubic yds.
John Day rapids	442
Squally Hook rapids	450
Devil's Bend rapids	672
Hematilla rapids	2,512

There are two more rapids still to be surveyed, the amount of rock on which is estimated to be as follows:

	Cubic yds.
Rock Creek rapids	500
Homily rapids	150

The only way of removing these rocks is by blasting. An attempt was made at the lowest stage of water, last November, to explode 200 pounds of powder on the rock known as John Day rock, but on account of the rapidity of the current the attempt failed. An attempt will be made this fall to remove several of the rocks for the purpose of obtaining the data for estimating the cost of removing the others.

From the want of reliable data it was found impossible to make an accurate estimate; but from an approximate one, based upon the best information to be found at hand, it is supposed that it will cost $28 per cubic yard; and the amount required for the removal of the whole of them, at that rate, will be $132,328. It is, however, a very rough estimate, and the expenses per cubic yard may not be one-half of that above stated. I am directed to report on the following 11 points:

1st. The result has been the survey of rocks in four rapids, as above stated. The plan has been to take numerous soundings in and over

the rapids, the place of the soundings being fixed by synchronous observation, taken with theodolites by two observers. The amount expended during the year has been $11,510 16.

2d. The amount required to complete the survey will be $2,400; but, in connection with it, experimental blasting will have to be made to make a closer approximation than is given above for the cost of blasting, for the survey is intended as but a preliminary step to the removal of the rocks on the rapids.

3d. The amount that can be profitably expended during the next fiscal year is $8,100, besides cost of such other surveys as may be ordered during the year.

4th. The collection district is Astoria.

5th and 6th. I have no means of ascertaining the amount of revenue collected at the nearest port of entry.

7th. The amount of commerce is large, and increasing.

8th, 9th, and 10th. The work was not done by contract.

11th. The following is the amount received and expended during the last fiscal year on account of the appropriation for "examinations and surveys on the Pacific coast:"

On hand July 1, 1867	$6,558 85
Received during the year	15,117 25
Total amount received and on hand	21,676 10
Expended during the year	11,510 94
Balance on hand June 30, 1868	10,165 16

Total of the amount appropriated has been $50,000, of which $24,437 is still undrawn from the treasury. The total amount expended from this appropriation up to the end of the last fiscal year is $15,397 84.

No appropriation is asked for next year.

The work has been under the immediate direction of Lieutenant Heuer, United States engineers, and has been conducted in a very satisfactory manner.

My duties as engineer for light-houses on the Pacific coast have occupied a small portion of my time. A keeper's dwelling for the first-order light-house at Cape Mendocino has been erected, and the iron tower for the same is about completed, and will shortly be sent to the same locality. A light-house site at Cape Blanco, Oregon, has been purchased. Negotiations are now pending for the purchase of a light-house site at Santa Cruz, California. The various light-houses in the 12th and 13th districts have been visited, with the exception of those on Puget sound. Several proposed light-house sites south of San Francisco, California, have been visited and examined. Repairs to several light-houses have been made.

Respectfully submitted.

R. S. WILLIAMSON,
Bvt. Lieut. Col. United States Army, Major of Engineers.

Major General A. A. HUMPHREYS,
Chief of Engineers, U. S. A., Washington, D. C.

U 1.

ENGINEER DEPARTMENT,
Washington, March 8, 1867.

COLONEL: Your letter of 28th January, ultimo, was duly received. The instructions of this department for an examination at the mouth of the Willamette did not contemplate such extended observations as you seem to suppose, but merely the collection of the facts necessary to form a plan for improving the navigation at that point. It was thought the cost of such observations would not exceed $1,000, probably not more than half that amount.

If it is known that the channel between J. D. Percy's island and the main shore has a clayey bottom, and that the present ship channel has a quicksand bottom, and that the Columbia slough and the Willamette river maintain always a current through the channel first named, then the governing facts for the plan of improvement are known, and the dredging should be done in the channel between Percy's island and the main shore.

It was not understood from your report that these facts, if they be such, had been ascertained definitely, or that the mouth of the river had been examined by any one under your orders, but that information had been gained directing attention to the points upon which the solution of the question depended.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Brig. Gen. and Chief of Engineers, Maj. Gen. U. S. Vols.

Bvt. Lieut. Col. R. S. WILLIAMSON, U. S. A.,
Major of Engineers, San Francisco, Cal.

P. S.—Further appropriation of $30,000 has been made for the improvement of Willamette river. A copy of the act of the appropriation, with instructions, will be sent to you for your guidance as soon as it can be obtained. J. C. W.

U 2.

SAN FRANCISCO, CAL., *February* 24, 1868.

GENERAL: I have the honor to transmit herewith the report of Lieutenant W. H. Heuer, United States engineer on the survey of the upper Columbia river, Oregon, which had been conducted by him since early in September last, other duties preventing my presence with the party. All the rapids above the Dalles, as far as and including Umatilla rapids, have been surveyed and mapped, leaving but two above, which, it is estimated, will require six weeks of time and $2,400. The amount thus far expended is $9,049 95, the amount originally appropriated $25,000, and the balance available $16,958 05. It is to be regretted that more definite data had not already been collected to guide as an estimate of the amount required to remove these obstructions to navigation; but it is proposed to make experiments during next season of low water in removing one or more of the rocks.

Very respectfully, your obedient servant,

R. S. WILLIAMSON,
Bvt. Lieut. Col. U. S. Army, Major of Engineers.

Major General A. A. HUMPHREYS,
Chief of Engineers U. S. Army, Washington, D. C.

SAN FRANCISCO, CALIFORNIA,
February 17, 1868.

SIR: I have the honor to submit the following report of operations on the Columbia river:

In accordance with special instructions from you I went to Celils, Oregon, on September 1, 1867; there organized a surveying party, consisting of Messrs. Richard Covington, W. Hammond Hall, W. P. Gray, and five laborers. The schooner Maria was chartered from the Oregon Steam Navigation Company to facilitate the survey. The survey was commenced at John Day rapids. The river was then about eight feet above low-water stage, and had a fearfully rapid current. Our resources were somewhat limited, as we had besides the schooner only one small boat or yawl, which was only 12 feet long, and with which we dared not attempt sounding in such rapid water. However, we surveyed the shore-lines and inlands at this rapid, and in the mean time sent down to Portland for a larger boat for sounding purposes; in a few days it arrived, but was utterly worthless; still we attempted to make the soundings, but in that rapid current nothing satisfactory was accomplished. Knowing that in the course of a month or six weeks the river would be much lower and the current much less rapid, I concluded to sail up the river as far as possible, putting in the shore-lines and islands of each rapid as we came to it, so that upon our return we would have nothing but the soundings to make. This was accordingly done, and occupied a month of our time. The (worthless) boat mentioned was returned and a larger and much safer one substituted. In ascending the river we surveyed the shore-lines and islands of John Day rapids, Indian rapids, Squally Hook rapids, and Umatilla rapids. Upon arriving at Umatilla rapids I found the river so low that the schooner could not with safety sail through these rapids and the steamboat could not tow us through. I wanted to get to Homly rapids, 30 miles higher up the river, but owing to the difficulties just mentioned, had to abandon the idea. So the soundings were commenced at Umatilla rapids, and as soon as this was completed we gradually worked our way down the river, sounding on every rapid mentioned until winter prevented further operations.

The survey was conducted in the following manner, viz: A suitable base-line was measured on one shore. From the extremities of this base, at each of which an observer was stationed, angles were taken to a flag man on the opposite shore, who walked from point to point. At the prominent points stakes were driven for future reference, and their positions determined by triangulation. Having one shore thus completed, the stations just mentioned as having been determined by triangulation were now used as theodolite stations for determining the other shore (the one on which the base was measured) and the islands. Tide-gauges were placed in position at suitable points, in order that the necessary reductions might be made in case the river should rise or fall during the progress of the survey. The yawl or small boat (which contained 1,200 feet of line one-half inch in diameter, a buoy, 100-pound anchor, lead-lines, signals, &c.) was then anchored in the river directly above, and a short distance from, the rapids. The theodolite men being at their proper stations, (eyes continually at their instruments,) the boat was allowed to drop into the rapid. As soon as we were in the rapid, the boat would be checked by means of the anchor line. The commands, "Ready; sound," were given from the boat; the lead would be thrown, signal flag hoisted in the boat, and the observers would sight on the lead-line where it crossed the gunwale of the boat; the sounding man

would report the depth of water to the signal man, and he would make a record of the same. Without paying out any more of the anchor-line, we would, by means of the sweep or steering-oar, swing the boat to the right or left, say 20 feet, give another signal, and sound again. When we had swung as far to the right or left as was possible, we would pay out 20 feet more of line, signal, and sound; then swing again to the right or left, again signal and sound, and so on until the 1,200 feet of line had been paid out. When this was done, the boat would be hauled up to her anchor, anchor weighed, and then dropped, say 50 or 100 feet, to the left or right of its original position, and the same operation would again take place, until the whole rapid was sounded.

As might have been anticipated, many of our soundings are incorrect, as the intensity of the current would sometimes deflect the lead-lines materially. The shallow soundings (those less than eight feet) are very nearly correct; but when 30 feet or more is indicated, the soundings are only approximate.

To make the sounding, a lead was used weighing 11 pounds, fastened to an ordinary lead-line properly graduated. We attempted to make the sounding with a wooden pole 20 feet long, in order that greater accuracy might be obtained than with a lead-line, but it was found impossible to do so, for as soon as the end of the pole would be three or four feet under water, the current would throw it as much as 45 degrees from the vertical.

In one or two instances the rapidity of the current was measured by ascertaining the length of time required for a stick of cord-wood, loaded at one end, to float between two given points in a rapid; but the results are only good for that particular stage of the river, for a difference of a few feet of water in the river makes a difference of more than a mile an hour in the current. It may seem strange why steamboats take such different channels during high water from those at low water, although the former are often the more circuitous. It is mainly owing to the rapidity of the current. During the high-water season, the boats hug the shore as much as possible, for should they, in many places, get into the low-water channel, they could make no headway at all against the current.

At Umatilla and John Day rapids, lines of level were run with a view of ascertaining the amount of fall in the river from the head to the foot of each of these rapids. This amount of fall also varies with the stage of the river; and although a rapid may be only a quarter of a mile in length, in some places on that rapid the water will fall two feet, while in other places on the same rapid the fall will be less than a foot. This is owing mainly to large reefs of rock, extending in some places almost entirely across the river. As long as these reefs are entirely under water a fall of one foot in the river above the reef will make a fall of one foot below the reef, but when the reef becomes exposed, a fall of one foot above the reef will, in some places, cause a fall of two feet or more immediately below the reef.

The current of the river on these rapids is rather peculiar. It varies in intensity, depending on the stage and fall of the river, from 4 to upward of 12 miles an hour; but between the rapids the current is very much slower, averaging about three miles an hour during an ordinary stage of the river. When the current pours over a sunken rock having three or four feet on it, the water forms large waves, extending from 50 to 200 feet on the down-stream side of the rock. Some of the waves are very large and extremely dangerous to get into with a small boat, particularly if the boat is anchored with the anchor above the rock. From the appearance of those waves one would suppose that

the current was swifter in them than anywhere else, but such is not the case. In the waves, or breakers as they are commonly called, there is very little current, but directly on top of or over the rock the current is strongest. The under-current is much more rapid than that at the surface, and the danger just mentioned to be apprehended is that the under-current will force your anchor line to pull the nose of your boat under water. Where these sunken rocks were only about a foot or so under water, they would still make a "break," but the current in the "break," instead of running down stream, would have very little or no force at all.

Another great difficulty in making the survey was owing to the presence of whirls in the river. On many of the rapids where large rocks were exposed, the current would be divided by these rocks, and these *divisions* would again come in contact on the lower side of the rocks, which would cause immense whirls, some of them 12 feet in diameter by 5 feet deep in the center, being very much like an inverted cone. They would gradually work down the river until they became smaller and smaller, and would finally disappear. We always managed to avoid those whirls.

The object in making the survey was to determine the size, as nearly as possible, of the sunken rocks on the various rapids, with a view to making an estimate of the cost of their removal; to have such a depth of water over these rocks during the lowest stage of the river as would enable the largest size boats in the river to navigate it with safety at all times. The largest boat now employed on the river will not draw over six feet of water when fully loaded, so that I should think, that if enough rock was removed to have seven feet of water on the rocks at extreme low water, that ought to be all that was required. The estimates of the quantity of rock to be removed will be based on the supposition that they are to have seven feet water over them.

The channel in the rapid is very tortuous, and although in most cases well defined, yet it is very difficult to keep a steamboat in them, owing to the various directions of the currents, and frequently to the intensity of the wind, which generally blows across the channel.

On the maps which accompany this report, many of the rocks recommended for removal are 200 feet or more apart from each other, and it may not be clear why both rocks, so far apart and having good water between them, should be removed. This I will endeavor to explain. Suppose we have two sunken rocks 200 feet apart, but one of them above the other, in the general direction of the current. The boat is probably 170 feet long. She passes the lower rock and heads directly for the upper one, because in the eddy of the upper rock there is little or no current. She is now nearly up to the upper rock, and must turn a little to one side to get out of the way of this rock. The minute she turns her head, the current strikes her bows; her stern still in the eddy, the boat swings, the current strikes her broadsides, and it requires the very best of management to keep her from striking broadside on the lower rock.

That these rocks materially affect the strength and direction of the current there is no doubt. Now suppose these sunken rocks were all removed, what effect would their removal have upon the current? That cannot be definitely answered at present; it would change the direction of the current somewhat, because each rock would then allow the whole force of the current to pass over it and would not split it as is now the case, but its intensity would be increased accordingly. The breaks which these rocks now make enable the pilots to tell exactly where the channel now is, the removal of them will therefore confuse them somewhat. The

rock is a hard basalt, and is not columnar like ordinary basaltic rock. That which is on the bluff banks of the river is nearly all columnar, but that under water looks as though it had been subjected to the action of intense heat, melted and then run into a lump with small sharp points sticking up. Occasionally small crevices can be found in some of the rocks in which a blast would be very effective, but those cases are very few and difficult to find. After having completed the survey this year as far as practicable, I attempted blasting on one of the rocks known as John Day Bock (really the worst rock in the river) in John Day rapids, with a view of making an estimate of the cost of removal of the other rocks. Our efforts were anything but successful. Two hundred pounds of blasting powder were put into a torpedo, which it was intended to ignite simultaneously at three points of ignition by electricity. Everything being in readiness, lines were stretched across the river from No. 1 on south shore (see map of John Day rapids) to rock No. 2, and the boat allowed to drop along this line until nearly over John Day Rock, which I intended surveying carefully both before and after the blast, to ascertain its effect; but as soon as the boat got well over the rock, a wave broke over her bows, and had we not immediately cut the line our boat would have swamped. Seeing that the boat could not be held on the rock, we returned to shore, took the torpedo on board and tried to get about 20 feet above the rock; then I intended drifting the torpedo against the rock, (torpedo being kept in position by 800 pounds of rock as anchors;) then having it fairly on the upper side of the rock, with a pressure of 20 feet of water over it, I contemplated making the blast; but we could not get above the rock in proper position, as the boat would not steer, owing to the torpedo hanging immediately over her stern, and I dared not take it and anchors in the boat, for the boat was incapable of carrying all this extra weight. After 10 hours vainly attempting to place the charge, my line (which was stretched across the river) parted, and we pulled for shore. It was now nearly dark; I then anchored the charge in 18 feet water against a bluff bank of the river, thinking that I could make an estimate by calculating the amount of rock which would be thrown down by the blast, but when I tried my battery the charge failed to explode. Next morning, while examining the wires of the battery to ascertain what the difficulty was, I found that the current had loosened one of the wires where it entered the torpedo, and that the water had been gradually percolating through this small hole all day, so the powder became thoroughly saturated, and my attempts failed. In the maps accompanying this report, the numbers indicating the soundings represent the depth of water in feet during the lowest stage of the river.

JOHN DAY RAPIDS

are in the Columbia river near the mouth of John Day river, and are 33 miles above the Dalles; the first bad rock encountered in ascending this rapid is the one known as John Day Rock. At this place during low water the river runs at the rate of nearly 10 miles an hour. In ascending boats run to the left of this rock in order to get into the comparatively slack water under the island marked No. 2; in descending they also have to keep to the left of this rock. In the cove to the southward of John Day Rock is a very strong eddy, the current of which flows directly contrary to that of the current in the channel. During extreme low water this rock barely comes out of water. To obtain seven feet of water on this rock will require the removal of 200 cubic yards of rock. The next bad rocks in this rapid are directly opposite the mouth

of John Day river and are indicated on the map by red dotted lines or by a red cross. They together contain 242 cubic yards of rock. The rock which is indicated by a small red cross I did not find, but pilots say there is one there; so I have marked it and estimated it to contain six cubic yards of rock. Those are all the rocks that need be removed in this rapid. The channel, which is marked "high-water steamboat channel" on the map, cannot be used during low water, owing to shoals and rocks. Fall in the river from head to foot of these rapids is 5.3 feet. The next rapid surveyed is called

INDIAN RAPID.

There is always sufficient water here for the boats, and no improvements of this rapid are recommended.

We next come to

SQUALLY HOOK RAPID.

This rapid is about 40 miles above the Dalles and has several bad rocks. They are also indicated by dotted red lines. The winds have a great deal to do with rendering the navigation of this rapid dangerous; they blow almost directly across the channel toward the north shore. Commencing toward the right of the map, the rocks recommended for removal contain, respectively, 66, 209, and 175 cubic yards of material.

DEVIL'S BEND RAPID

is about 100 miles above the Dalles. This hardly deserves to be called a rapid. The river bed here is a large shoal flat; during low water it is rather difficult to navigate, owing to the presence of numerous large boulders; a glance at the map will show their relative positions. Blasting will only be resorted to on two or three rocks which are outcroppings of bed rock. The boulders vary in size from 4 to 10 cubic yards; they will have to be grappled and towed to one side. The river at this place was originally much worse than at present; but recently the steamboat company have removed many boulders.

UMATILLA RAPIDS

are seven miles above Devil's Bend, and are upwards of two miles in length; from the head to the foot of these rapids the river has a fall of 18 feet. This rapid requires more work than all the other rapids combined, as a glance at the map will show. Upwards of 2,000 soundings were made here, and as many more might have been made to advantage had time permitted. Still the positions of all the bad rocks were determined. Soundings were only made in and near the steamboat channel, for as soon as we got out of that channel we could easily see bottom, which seemed to be one immense bed of rock, and in but few places did the depth of water exceed five feet. Towards the right of the map (at the upper end of this rapid) is a channel known as the high-water channel, but which is not used during low water on account of the many rocks in it. I think it advisable those rocks should be removed, as that would give almost a straight channel and require less blasting than would be necessary to improve the present low-water channel immediately to its left. The rapids yet to be surveyed are known as Rock Creek rapids and Homly rapids. The survey cannot be advantageously resumed until next October, and will occupy six weeks or two months of time, and will cost $2,400. Neither of the two rapids just mentioned offer very serious obstacles to navigation. From the best information I can obtain, Homly rapids only contain about eight

bad rocks, (chiefly boulders,) whose total measurement will not exceed 150 cubic yards. Rock Creek rapids, I think, will not require the removal of more than 500 cubic yards of rock. To remove these obstructions blasting will have to be resorted to. I would recommend that the same means be adopted here as were contemplated for the removal of Blossom Rock in San Francisco harbor, viz: that a platform be constructed over each and every rock to be removed; that drilling by hand or machinery be then done, the explosive material then placed in a canister and inserted in the drill hole, and then exploded by electricity.

The only data on hand for making estimates for the removal of these obstructions are those deduced from the experimental results on Blossom Rock, which we estimated to cost $14 per cubic yard. That was in comparatively slack water, and the rock a metamorphic sandstone. In the Columbia river we have a violent current and a hard basaltic rock to contend against. Taking these difficulties into consideration, and the fact that everything necessary to prosecute the work to advantage will have to be purchased here, I estimate that it will cost $28 per cubic yard to remove the obstructions in the Columbia river; and as these obstructions measure 4,726 cubic yards, I respectfully request that an appropriation of $132,328 be asked for.

Very respectfully, your obedient servant,

W. H. HEUER,
Lieutenant of Engineers.

Bvt. Lieut. Col. R. S. WILLIAMSON,
Major of Engineers.

RECAPITULATION.

Rocks to be removed to obtain a depth of seven feet of water in John Day rapids. (See map.)

Rock marked—	Size in cubic yards.
A	200
B	6
C	37
D	199
SQUALLY HOOK RAPIDS.	
A	66
B	209
C	175

DEVIL'S BEND RAPIDS.

Rock marked--	Size.	Rock marked—	Size.	Rock marked—	Size.
A	37	H	35	P	0.7
B	49	I	139	Q	9.
C	3	J	15	R	2.4
D	47	K	81	S	2.4
E	29	M	2	T	1
F	120	N	14	U	1
G	35	O	41	V	9

UMATILLA RAPIDS.

Rock marked—	Size in cubic yards.	Rock marked—	Size in cubic yards.
A	153	O	55
B	1.5	P	14
C	14	Q	29
D	3	R	29
E	21	S	17
F	17	T	42
G	26	U	56
H	95	V	19
I	70	W	58
J	201	X	32
K	127	Y	855
L	42	Z	35
L	95	*Z*	55
M	105	*Z*	119
N	35	*Z*	37
		Z	55

	Cubic yards.
John Day rapids	442
Squally Hook rapids	450
Devil's Bend rapids	672
Umatilla rapids	2,512
Rock Creek rapids	500
Homly rapids	150
	4,726

U 3.

SAN FRANCISCO, *March* 28, 1867.

SIR: I have the honor to make the following report in regard to the late experiments on Blossom Rock:

Blossom Rock is a sandstone, rather hard, and is on a line with Alcatraces and Yerba Buena islands, and about midway between them. When the tides are lowest the rock has about five feet of water over it. A horizontal section of the rock 18 feet below the surface of the water at mean low tide gives the greatest length of the rock at 130 feet, by a width of 75 feet. To obtain a depth of 18 feet water at mean low tide would require the removal of 1,000 cubic yards of stone. The experiments were made with gunpowder with a view of estimating the cost of removal of the rock. The charges of powder used were of three sizes, viz: 75, 125, and 175 pounds, in order to enable us to ascertain which sized charge would prove most effectual, due regard being had to economy. Each charge was placed in a strong, water-tight cask, in the head of each of which a small hole was bored to admit of the passage of the wire for exploding the charge; the cartridge was placed as near the middle of each charge as possible. Each of the casks was inserted in a sack of sail cloth which fitted closely, and which was afterwards tarred. Two heavy pieces of iron were then tied to each cask, one on each side, to prevent the tide from washing the charge off the rock. Soundings were then made to enable us to find advantageous positions for the