CONGRESS, } HOUSE OF REPRESENTATIVES. { Ex. Doc. 1,
d Session. } { pt. 2, vol. II.

ANNUAL REPORT

OF THE

HIEF OF ENGINEERS,

UNITED STATES ARMY.

TO THE

SECRETARY OF WAR,

FOR

THE YEAR 1892.

IN FOUR PARTS AND ATLAS.

PART III.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1892.

CONTENTS.

[Alphabetical index will be found at the end of each part.]

PART I.

OFFICERS OF THE CORPS OF ENGINEERS.

FORTIFICATIONS.

PROTECTION OF SITE OF FORT NIAGARA, NEW YORK.

…WALL AND EMBANKMENT AT DAVIDS ISLAND, NEW YORK HARBOR.

SEA WALLS AT GOVERNORS ISLAND, NEW YORK HARBOR.

…CH PROTECTION, WATER SUPPLY, AND SEWERAGE SYSTEM AT FORT MONROE, VA.

REPAIR AND PRESERVATION OF FORT MARION, FLORIDA.

THE BOARD OF ENGINEERS.

…ST OF WILLETS POINT, NEW YORK.—UNITED STATES ENGINEER SCHOOL.—BATTALION OF ENGINEERS.—ENGINEER DEPOT.

CONTENTS.

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ART I.

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F RTII ONS.

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IN THE CHARGE OF LIEUT. COL. PETER C. HAINS, CORPS OF ENGINEERS—

IN THE CHARGE OF LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS—

IN THE CHARGE OF CAPT. W. H. BIXBY, CORPS OF ENGINEERS—

IN THE CHARGE OF COL. D. C. HOUSTON, CORPS OF ENGINEERS—

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IN THE CHARGE OF MAJ. A. N. DAMRELL, CORPS OF ENGINEERS—

IN THE CHARGE OF MAJ. JAMES B. QUINN, CORPS OF ENGINEERS—

IN THE CHARGE OF CAPT. JOHN MILLIS, CORPS OF ENGINEERS—

IN THE CHARGE OF MAJ. CHARLES J. ALLEN, CORPS OF ENGINEERS—

WESTERN RIVERS.

BRIDGING NAVIGABLE WATERS OF THE UNITED STATES.

BRIDGES OBSTRUCTING NAVIGATION.

MISCELLANEOUS.

WASHINGTON AQUEDUCT.

BUILDINGS AND GROUNDS AND WASHINGTON MONUMENT, DISTRICT OF COLUMBIA.

RVEY OF THE NORTHERN AND NORTHWESTERN LAKES.

UCTION AND IMPROVEMENT OF ROADS AND BRIDGES IN YELLOWSTONE NATIONAL PARK.

RECONNAISSANCES AND EXPLORATIONS.

OFFICE OF THE CHIEF OF ENGINEERS.

FORTIFICATIONS, ETC.

APPENDIX No. 1.

REPORT OF CAPT. DAN C. KINGMAN, CORPS OF ENGINEERS.

APPENDIX No. 2.

REPORT OF COL. D. C. HOUSTON, CORPS OF ENGINEERS.

APPENDIX No. 3.

REPORT OF MAJ. CHAS. E. L. B. DAVIS, CORPS OF ENGINEERS.

APPENDIX No. 4.

REPORT OF MAJ. J. C. MALLERY, CORPS OF ENGINEERS.

APPENDIX No. 5.

REPORT OF LIEUT. COL. W. R. KING, CORPS OF ENGINEERS.

RIVERS AND HARBORS, ETC.

APPENDIX A.

REPORT OF LIEUT. COL. PETER C. HAINS, CORPS OF ENGINEERS.

APPENDIX B.

REPORT OF LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS.

APPENDIX C.

REPORT OF CAPT. W. H. BIXBY, CORPS OF ENGINEERS.

APPENDIX D.

REPORT OF COL. D. C. HOUSTON, CORPS OF ENGINEERS.

APPENDIX E.

REPORT OF LIEUT. COL. G. L. GILLESPIE, CORPS OF ENGINEER

APPENDIX F.

REPORT OF CAPT. THOS. L. CASEY, CORPS OF ENGINEERS.

APPENDIX G.

REPORT OF MAJ. C. W. RAYMOND, CORPS OF ENGINEERS.

APPENDIX H.

REPORT OF WM. F. SMITH, UNITED STATES AGENT, MAJOR OF E NEERS, U. S. ARMY, RETIRED.

PART II.

APPENDIX I.

REPORT OF COL. WM. P. CRAIGHILL, CORPS OF ENGINEERS.

APPENDIX J.

REPORT OF MAJ. CHARLES E. L. B. DAVIS, CORPS OF ENGINEERS.

APPENDIX K.

REPORT OF LIEUT. EDW. BURR, CORPS OF ENGINEERS.

APPENDIX L.

REPORT OF MAJ. W. S. STANTON, CORPS OF ENGINEERS.

APPENDIX M.

REPORT OF CAPT. FREDERIC V. ABBOT, CORPS OF ENGINEERS.

APPENDIX N.

REPORT OF CAPT. O. M. CARTER, CORPS OF ENGINEERS.

APPENDIX O.

REPORT OF MAJ. J. C. MALLERY, CORPS OF ENGINEERS.

APPENDIX P.

REPORT OF CAPT. PHILIP M. PRICE, CORPS OF ENGINEERS.

APPENDIX Q.

REPORT OF MAJ. A. N. DAMRELL, CORPS OF ENGINEERS.

APPENDIX R.

REPORT OF MAJ. JAMES B. QUINN, CORPS OF ENGINEERS.

APPENDIX S.

REPORT OF MAJ. JAMES B. QUINN, CORPS OF ENGINEERS.

APPENDIX T.

REPORT OF LIEUT. JOHN MILLIS, CORPS OF ENGINEERS.

APPENDIX U.

REPORT OF MAJ. CHAS. J. ALLEN, CORPS OF ENGINEERS.

APPENDIX V.

REPORT OF CAPT. J. H. WILLARD, CORPS OF ENGINEERS.

APPENDIX W.

REPORT OF CAPT. H. S. TABER, CORPS OF ENGINEERS.

APPENDIX X.

REPORT OF MAJ. A. M. MILLER, CORPS OF ENGINEERS.

APPENDIX Y.

REPORT OF MAJ. A. MACKENZIE, CORPS OF ENGINEERS.

APPENDIX Z.

REPORT OF MAJ. W. A. JONES, CORPS OF ENGINEERS.

APPENDIX G G.

T OF MAJ. D. W. LOCKWOOD, CORPS OF ENGINEERS.

APPENDIX H H.

REPORT OF CAPT. W. L. FISK, CORPS OF ENGINEERS.

APPENDIX I I.

PORT OF MAJ. JAMES F. GREGORY, CORPS OF ENGINEERS.

APPENDIX J J.

REPORT OF CAPT. W. L. MARSHALL, CORPS OF ENGINEERS.

APPENDIX K K.

REPORT OF MAJ. WILLIAM LUDLOW, CORPS OF ENGINEERS.

APPENDIX L L.

REPORT OF COL. O. M. POE, CORPS OF ENGINEERS.

APPENDIX M M.

REPORT OF LIEUT. COL. JARED A. SMITH, CORPS OF ENGINEE

APPENDIX N N.

REPORT OF MAJ. E. H. RUFFNER, CORPS OF ENGINEERS.

APPENDIX O O.

REPORT OF CAPT. DAN C. KINGMAN, CORPS OF ENGINEERS.

APPENDIX P P.

REPORT OF MAJ. M. B. ADAMS, CORPS OF ENGINEERS.

APPENDIX Q Q.

REPORT OF COL. G. H. MENDELL, CORPS OF ENGINEERS.

APPENDIX R R.

T OF LIEUT. COL. W. H. H. BENYAURD, CORPS OF ENGINEERS.

APPENDIX S S.

REPORT OF MAJ. W. H. HEUER, CORPS OF ENGINEERS.

APPENDIX T T.

EPORT OF CAPT. THOMAS W. SYMONS, CORPS OF ENGINEERS.

APPENDIX U U.

REPORT OF MAJ. THOS. H. HANDBURY, CORPS OF ENGINEERS.

APPENDIX V V.

EPORT OF CAPT. FREDERICK ROGERS, UNITED STATES NAVY.

PART IV.

APPENDIX W W.

REPORT OF THE MISSISSIPPI RIVER COMMISSION.

APPENDIX X X.

REPORT OF THE MISSOURI COMMISSION.

APPENDIX Y Y.

BRIDGING NAVIGABLE WATERS OF THE UNITED STATES.

APPENDIX Z Z.

OCCUPANCY OF AND INJURY TO PUBLIC WORKS BY CORPORATIONS AND INDIVIDUALS.

APPENDIX A A A.

REPORT OF LIEUT. COL. GEORGE H. ELLIOT, CORPS OF ENGINEERS.

APPENDIX B B B.

REPORT OF COL. O. H. ERNST, UNITED STATES ARMY.

APPENDIX C C C.

SURVEY OF THE NORTHERN AND NORTHWESTERN LAKES.

APPENDIX D D D.

REPORT OF MAJ. WILLIAM A. JONES, CORPS OF ENGINEERS.

APPENDIX E E E.

EXPLORATIONS AND SURVEYS IN MILITARY DEPARTMENTS.

APPENDIXES

TO THE

REPORT OF THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

(CONTINUED.)

APPENDIX D D.

[IMPR]OVEMENT OF OHIO, MONONGAHELA, CHEAT, ALLEGHENY, AND MUSKINGUM RIVERS.

[RE]PORT OF MAJOR AMOS STICKNEY, CORPS OF ENGINEERS, OFFICER IN [CH]ARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892, WITH OTHER [D]OCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

[1. O]hio River.
[2. O]perating snag boats on Ohio River.
[3. O]perating and care of Davis Island Dam, Ohio River, near Pittsburg, Pennsylvania.
[4. M]ovable dam in Ohio River below mouth of Beaver River, Pennsylvania.
[5. M]onongahela River, West Virginia and Pennsylvania.
[6. O]perating and care of Locks and Dams Nos. 8 and 9, Monongahela River.
[7. P]urchase of Lock and Dam No. 7, Monongahela River.
8. Purchase of Lock and Dam No. 6, Monongahela River.
9. Cheat River, West Virginia.
10. Allegheny River, Pennsylvania.
11. Dam at Herr Island, Allegheny River, near Pittsburg, Pennsylvania.
12. Ice harbor at mouth of Muskingum River, Ohio.
13. Operating and care of ice-harbor lock at mouth of Muskingum River, Ohio.
14. Muskingum River, Ohio.
15. Operating and care of locks and dams on Muskingum River, Ohio.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, July 16, 1892.

GENERAL: I have the honor to transmit herewith the annual reports [of] the works under my charge for the fiscal year ending June 30, 1892.

Very respectfully, your obedient servant,

AMOS STICKNEY,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

llotted, and various incidental expenses which were not con-
at the time the allotments were made.
owing works were in progress during the year:
tween Davis and Neville islands, 5 miles below Pittsburg.—At
ning of the fiscal year some minor repairs, consisting of repav-
grouting the slopes of the dam, were being made. These re-
e completed August 15, 1891.
t Marietta Island, 168 miles below Pittsburg.—This dam was
l in December, 1890. During the winter of 1890–'91 some
vas done to the paving and filling of the downstream slope.
ginning of the fiscal year this damage was being repaired.
: was done by hired labor and was completed October 21, 1891.
t foot of Marietta Island, 171 miles below Pittsburg.—Under
dated February 14, 1891, with J. C. Graham. The object of
is to hold the water coming down the right-hand chute of
Island and prevent it from spreading until after it has passed
etta Wharf. It was originally built in 1844, and was repaired
nded in 1875. It was in good condition, but owing to the in-
ieight given to the dam at the head of the island it was neces-
aise the dike to the same height in order to cut off the cross
Work was commenced July 6, 1891, and completed October

it head of Blennerhassett Island, 185 miles below Pittsburg.—
ontract dated February 14, 1891, with Richardson & Monroe.
ect of rebuilding this dam (originally constructed in 1844),
id been gradually worn down, was to send more water down
gable channel on the Ohio side of the island and to improve
at the foot. Work was progressing at the beginning of the fis-
, and the dam was completed December 28, 1891.
t Eight Mile Island, 256 miles below Pittsburg.—Under contract
ebruary 9, 1889, with John J. Shipman. The object of the dike
epen the water on the bar at the foot of Eight Mile Island.
o high water the contractor failed to complete the dike within
specified, and on the recommendation of the officer in charge
tract was extended to December 31, 1891. Work commenced
15, and the dike was completed November 19, 1891.
at Cullums, 471 miles below Pittsburg.—Under contract dated
y 9, 1891, with John J. Shipman. The object of this dike is to
en and widen the channel by cutting off the narrow and crooked
down the right-hand shore, and thus compel the river to make
nd more commodious channel across the present bar. Work on
was progressing at the beginning of the fiscal year and was
ed December 9, 1891.
it lower bar at Rising Sun, 502 miles below Pittsburg.—Under
t dated February 9, 1891, with John J. Shipman. The object of
e is to improve the lower bar at Rising Sun, which, since the
ment of the upper bar, has been the chief sticking place be-
Cincinnati and Louisville. Work on this dike was progressing
beginning of the fiscal year and was completed November 25,

it Madison, Indiana, 552 miles below Pittsburg.—Under contracts
February 9, 1889, and February 14, 1891, with William Kirk.
istruction of this dike was ordered by Congress, and its object
prove the harbor of Madison by deepening the water on the flat
r that lies along the whole front of the city. Work on this
progressing at the beginning of the fiscal year and continued

g. Under cont
e pier is locate
commenced No
1892, when the
10 per cent o
officer in charge
to June 1, 1892,

urg.—Three sectio
year ending June 30,
d May 23, 1891, w
ompleted Decem 4.

Under contract
ommenced July 6,

Pittsburg.—The
object of this work is to
in great floods, to the
o River, now forming
The extension
1, with John Jo
r by this contract
of material put
Chief of Engineers, d N
with the Cleveland,
ny for a further
le funds. Under

BIG HOCKING RIVER.

This river enters the Ohio at a point 197 miles below Pittsburg a[illegible] 14 miles below Parkersburg. The work of improving navigation [illegible] this stream is paid for out of the appropriation for the improvement [illegible] the Ohio River, and it therefore appears under that heading. The o[illegible]ject to be attained is to permit Ohio River steamboats to ascend [illegible] Coolville, 5 miles above the mouth, during high and medium stages [illegible] the Ohio, taking advantage of the backwater.

This work was under the immediate supervision of Lieut. Cassius [illegible] Gillette, Corps of Engineers, U. S. Army, until April 12, 1892. Sin[illegible] that time Mr. Edmund Moeser, assistant engineer, has had immedia[illegible] supervision of the work.

OPERATIONS DURING THE FISCAL YEAR.

(EXTRACT FROM REPORT OF MR. EDMUND MOESER.)

The work of improving navigation on this stream between its mouth and Co[illegible]ville, 5 miles above, by removing rocks and snags from the channel, was contin[illegible] during the months of July and August and closed September 1, 1891, as everyth[illegible] had been done for which there was any necessity.

The following is a summary of the work done:

Stone removed	cubic yards..	[illegible]
Logs removed	number..	[illegible]
[illegible] removed	do....	[illegible]
[illegible] trimmed	do....	[illegible]

WORK OF OHIO RIVER DREDGES DURING THE CALENDAR YEAR O[illegible] 1891.

This work has been under the immediate charge of Mr. E. J. Carpe[illegible]ter, assistant engineer.

OPERATIONS.

(EXTRACT FROM REPORT OF MR. E. J. CARPENTER.)

The dredges remained in winter quarters at the mouth of the Muskingum Riv[illegible] [illegible] March [illegible] 1891 when the *Oswego* was sent to the Monongahela River to work [illegible] [illegible] No. [illegible] and No. [illegible]. She remained there until April 5, when she returned to Pitt[illegible] [illegible] and was laid up, until joined by the *Ohio* and the rest of the fleet for the [illegible] [illegible] on April 1[illegible].

[illegible] late date at which the appropriation for 1890 became available, on[illegible] [illegible] had been made as were absolutely indispensable to fit the boats for te[illegible] [illegible]. The repairs for the season of 1891 were therefore extraordinari[illegible] [illegible] the following unusual items, viz:

[illegible] three new steel spuds; new tin roof for the cabin; new and larg[illegible] [illegible] for the main engines; a change from positive to frictio[illegible] [illegible] spud; improved gearing for hoisting the forward spu[illegible] [illegible] the capstan engines.

[illegible] packing for the capstan engines.

[illegible] steel dipper pole; new crank shaft and fittings for the ma[illegible] [illegible] the main engines and capstan engines; friction clutch f[illegible] [illegible] for hoisting the forward spuds by hand; a con[illegible] [illegible] iron roof over the whole of the boat.

[illegible] towboats were burned at the Pittsburg wharf, two [illegible] burning her sides and roof so badly as to necessita[illegible] [illegible] for them. The destruction of one dredge, and po[illegible] [illegible] avoided only by prompt and intelligent action of t[illegible]

[illegible] and bolt fitting machine, a metal shaper, an emer[illegible] [illegible] inch by 6-inch vertical engine added to the co[illegible] [illegible] did not much increase the total expenditure for the se[illegible] [illegible] reduced machine shop bills by an amount almo[illegible]

[illegible] 1881 were worn out and so rotten that they could not b[illegible] [illegible] condemned and plans were prepared from whic[illegible] [illegible] each, $3,537 being the price paid th[illegible]

channel a sunken coal flat, which the owners afterwards raised and removed.
tta Dike, 171 miles below Pittsburg.—After the dam across the West Virginia l at the head of Marietta Island was rebuilt, it was found that the increased of water on the Ohio side caused a dangerous cross current over the lower he riprap dike at the foot of the island, particularly during a rise of the gum. About 500 feet of the lower end of the old dike was therefore removed redges, which at the same time dug off a part of the gravel bar at the dike. tion made July 17 to 24 and July 27 to 30: loose rock, 4808 cubic yards, gravel, cubic yards. The dredges also removed 171 piles, 1 coal-boat wreck, and 10 l snags weighing 26.1 tons.
tta, Ohio, 170½ miles below Pittsburg.—During a rise of the river, which stopped ons at Marietta Dike, the dredges were employed to remove the shore bar at lroad incline just above the Fourth Street Wharf at Marietta. Material l from this bar was dumped at the foot of the island to stop leaks at the new ien in process of construction. Excavation made July 25 to 29: hard clay and 3,393 cubic yards.
of Blennerhassett Island, 185 miles below Pittsburg.—July 30 the dredges stoppped raveling to tear up and remove from the channel one wreck of coal barge.
of Blennerhassett Island, 188½ miles below Pittsburg.—A bar consisting of pud-one and hard gravel, on the Ohio shore above the location of the old dike, dged off. The removal of this bar, which deflected the current toward the d below the island, has materially facilitated the passage of tows in both ns, and by permitting the current to follow the axis of the river will tend open a good low-water channel. Excavation made July 31 to August 20: g stone, 5,703 cubic yards; hard gravel, 17,107 cubic yards. There was also l from the channel 1 snag weighing 3.1 tons.
of Blennerhassett Island, 188¾ miles below Pittsburg.—The dredges completed the l of the old dike on the Ohio shore, on which they had been previously em-in 1889 and 1890, until stopped by high water. Excavation made July 31 to 3: loose rock 1851.0 cubic yards.
Bar, 212½ miles below Pittsburg.—While traveling the dredges removed from nnel at this place, August 20, 1 snag weighing 12 tons.
ts Ripple, 240½ miles below Pittsburg.—A wrecked coal barge was broken up oved from the channel at this place August 21.
Indian Creek, above New Richmond, Ohio, 445½ miles below Pittsburg.—During ter, which prevented the dredges from working at Nine Mile Bar, they re-the creek bar at this point, which had been dredged off in 1880, but had again it into the river. The work straightened the channel and widened it 145 feet. tion made August 25 to September 16: gravel, etc., 16,119.1 cubic yards; emoved, 1 coal flat; snag removed, 1, weighing 2.5 tons.
Mile Creek Bar, 451½ miles below Pittsburg.—Ninemile and Tenmile creeks, on o side, come together a short distance from the river, and formerly ran parallel

[illegible] to follow more nearly the line of th[illegible] [illegible] to complete the [illegible] [illegible] channel. Excavation [illegible] [illegible] gravel, etc., 19,851.[illegible]

[illegible] Flattery.—A cut about 40 [illegible] [illegible] was made from the deep water bel[illegible] [illegible] a distance of about 1,600 feet. [illegible] on the Ke[illegible] [illegible] this bar, which, however, [illegible] [illegible] of the dredging was to break [illegible] [illegible] and thus had the riv[illegible] [illegible] Excavation made Septemb[illegible] [illegible] cubic yards.

[illegible]—During the low-water sea[illegible] [illegible] and as the dredges wer[illegible] [illegible] a channel by cutting thro[illegible] [illegible] was made, which [illegible] [illegible] Excavation made September [illegible] [illegible] cubic yards.

[illegible]—The construction of the [illegible] [illegible] Kentucky side of the river, wh[illegible] [illegible] a number of obstructions, [illegible] [illegible] however, [illegible] [illegible] was left for the dredges, whi[illegible] [illegible] Excavation made November 11 to Nove[illegible] [illegible] November 15: 1 steamboat [illegible] [illegible] the dredges removed [illegible] [illegible] the mouth of the Kentucky [illegible] [illegible]

[illegible] dredging has been done in 18[illegible], the bed[illegible] [illegible] River.

[illegible] River dredging statement for 18[illegible].

[illegible]

	Time at work.	
[illegible]	[illegible]	Traveling [illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	High water [illegible]
[illegible]	[illegible]	Sundays [illegible]
[illegible]	[illegible]	Waiting in Licking River [illegible]
[illegible]	[illegible]	Total days lost, etc [illegible]

[illegible]

[illegible]

[illegible] per day of work	cubic yards..	[illegible]
[illegible] during the season	do....	[illegible]
[illegible] per day of work	do....	[illegible]
[illegible] during the season	do....	[illegible]
[illegible]	do....	[illegible]
[illegible]	tons..	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	$1,[illegible]
[illegible]	[illegible]	[illegible] season	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	5,[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible] season	1[illegible]
[illegible]	[illegible]	Per day of work	1[illegible]
[illegible]	[illegible]	For the season	14,[illegible]
[illegible] days on work	[illegible]		

DREDGES OUT OF COMMISSION.

		Days.
linary		143
al repairs		80
tal		223

COST.

in ordinary	\$2,036.48	
etc	120.00	
otal in ordinary		\$2,156.48
during annual repairs	5,002.86	
repairs (shop bills, materials, etc.)	4,639.78	
otal cost of repairs		9,642.64
otal out of commission		11,799.12
day in ordinary (including superintendent's pay)		15.08

COST OF WORK, INCLUDING ALL EXPENDITURES IN 1891.

g gravel, sand, etc	\$15,324.99
g loose rock, pudding stone, etc	8,757.13
g logs, piles, and snags	875.71
g wrecks	1,313.57
otal expenditures in 1891	26,271.40

COST PER UNIT.

c yard of gravel, etc., excavated	\$0.188
c yard of loose rock and pudding stone	.377
in commission	101.92
of work	291.90

Location and description of work.

Place.	Miles below Pittsburg.	Date, 1891.	Days of work.	Snags and logs removed.	Tons weight.	Piles removed.	Wrecks removed.
and Lock at lower guiding crib	5½	July	3				
others Islands	160	....do	¼				1
oot of Marietta Island	171	....do	4½				
	171	....do	4¼				
	171	....do	1¾	10	26.1	171	1
(Ohio) Bar, outside of Fourth Street g.	170¾	....do	2				
Blennerhassett Island	185	....do	½				1
lennerhassett Island:							
ike on Ohio shore	188¾	July-Aug	2½				
n Ohio shore, above old dike	188¼	....do	10	1	3.1		
	188¼	....do	8				
'	212½	August	¼	1	12		
Tipple	240½	....do	1				1
lian Creek Bar (New Richmond, Ohio)	445½	Aug.-Sept	13				
	445½	....do	1	1	2.5		1
e Bar, at head	451½	Sept.-Oct	¾	11	9		
s Bar (Ohio) Chute, at head	452	....do	10				
s (Ohio) Creek Bar	451½	Oct.-Nov	12				
	451½	....do	10				
le Bar	453	Sept.-Oct	3				
ar	471½	November	2				1
al			90	24	52.7	171	6

[illegible]

illis Island, 40 cubic yards of rock.
ne Island, 80 cubic yards of rock and some snags.
bbs Island, wreck of coal boat.

ENCROACHMENTS.

any places along the banks of the river where na ined of encroachments, examinations were made, were stopped from depositing waste material in the firm, who have been engaged in the business of c e bed of the river, have been in the habit of leavin el, the refuse of their digging operations, lying in t vicinity of Brunot Island. In November their operat gerous to navigation that it was necessary to hav ated. When the case came to trial the members ny pleaded guilty. The court imposed a fine of ts, on the principals, and suspended sentence n yés.

rmation has been received at various times that cert he Ohio River were dumping material into the rive Investigations have been made, and wherever th into the river interfered with navigation, or wa n the channel of the river, the matter has been l States district attorney for his action.

HARBOR LINES.

er the provisions of section 12 of the river and harbor ac 19, 1890, three boards of engineer officers were convened by the f Engineers, under the authority of the Secretary of War, to con- and report upon the subject of harbor lines at Pittsburg, Pa., ing, W. Va., and Cincinnati, Ohio. These boards had meetings commended the making of careful surveys and maps of the three ies, and the officer in charge of the Ohio River improvement re- instructions to have the work done and paid for from the appro- n for the Ohio River. The field work has been finished and a part of the work on the maps, but this latter work was suspended ount of the lack of funds for completion.

BRIDGES OVER THE OHIO RIVER.

ing the past fiscal year this office has had supervision of the n of the following bridges, viz:

lge of Wheeling Bridge Company, at Wheeling, W. Va., 90 miles Pittsburg. This bridge was completed in October, 1891, in full ance with the plans approved by the Secretary of War.

lge of West Virginia and Ironton Railroad Company, at Kenova, ., 313 miles below Pittsburg. It is believed that this bridge en completed within the last few days, but this office has not en notified of its completion by the builders of the bridge.

lge of the Central Bridge Company, between Newport and Cin- 466 miles below Pittsburg. This bridge was completed in r, 1891, in full accordance with the plans approved by the of War.

STAGES OF THE OHIO RIVER DURING 1891-'92.

The following are the records of the gauges at Pittsburg, Cinci and Evansville, which may be taken to represent the navigable tion of the Upper, Middle, and Lower Ohio.

Gauge of Davis Island Dam, near Pittsburg.—When the dam is u water readings must be obtained from the gauge at the lower end lock. On this gauge 3 feet 2 inches corresponds to a navigable of 3 feet, and 6 feet corresponds to the same depth in the river.

Davis Island Dam.	Depth in channel.			Gauge rea	
	Under 3 feet.	3 feet and over.	6 feet and over.	Highest.	L
1891.	Days.	Days.	Days.	Feet.	
July	0	31	15	11.9	
August	0	31	12	10.7	
September	10	20	4	6.8	
October	25	6	0	3.8	
November	12	18	7	12.8	
December	0	31	29	15.10	
1892.					
January	0	31	22	21.4	
February	0	29	27	13.1	
March	0	31	29	14.9	
April	0	30	28	12.7	
May	0	31	29	12.7	
June	0	30	22	15.3	
Total	47	319	224	....	....

Cincinnati gauge.—The zero of this gauge is about 2 feet below water; readings of about 4 feet correspond to about 3 feet in the cha and those of 7 feet to about 6 feet in the channel.

Cincinnati.	Depth in channel.			Gauge readi	
	Under 3 feet.	3 feet and over.	6 feet and over.	Highest.	Lo
1891.	Days.	Days.	Days.	Feet.	F
July	0	31	31	15.2	
August	0	31	31	20.1	
September	0	30	27	17.8	
October	0	31	9	6.2	
November	0	30	15	24.6	
December	0	31	31	27.2	
1892.					
January	0	31	31	41.6	
February	0	29	29	29.6	
March	0	31	31	34.5	
April	0	30	30	42.8	
May	0	31	31	22.2	
June	0	30	30	21.8	
Total	0	366	326	....	....

ille gauge.—The zero of this gauge is at the low-water line. of 2 feet correspond to about 3 feet in the channel, and read- feet correspond to about 6 feet in the channel.

Evansville.	Depth in channel.			Gauge readings.	
	Under 3 feet.	3 feet and over.	6 feet and over.	Highest.	Lowest.
1891.	Days.	Days.	Days.	Feet.	Feet.
	0	31	31	16.0	6.8
	0	31	31	9.4	6.6
r	0	30	21	13.5	3.9
	0	31	0	3.7	2.1
r	0	30	7	15.9	2.0
r	0	31	31	18.9	9.3
1892.					
	0	31	31	33.4	12.0
	0	29	29	25.9	12.9
	0	31	31	29.8	17.0
	0	30	30	38.2	20.6
	0	31	31	34.6	16.0
	0	30	30	24.1	12.1
tal		366	303		

OPERATION OF DRAWS IN HIGH BRIDGES.

ere are no low drawbridges on the Ohio River; the general Ohio r bridge law requires that all bridges shall have a height of at 40 feet above high water, and, since large steamboats require more 40 feet, it is also provided that all bridges below the Cincinnati ension Bridge shall have a draw for use in high water, unless they a clearance of at least 53 feet above high water. There are three -water draws on the Ohio River, but the draw in the Ohio Falls ge, at Louisville, is exceptionally located, and no record of its ation is kept.

eports from the two other draws have been received. Owing to the rable stage of water in the river these draws were not operated ng the fiscal year.

STOPPAGE OF NAVIGATION BY ICE.

ie past winter was a very mild one, and assuming, as heretofore, the condition of affairs at Cincinnati is a fair average for the whole r, I have to report that the navigation of the Ohio River was not ;ted by ice during the past fiscal year.

LOSSES BY COLLISION WITH BRIDGES.

he following tables show the losses sustained by the commerce of Ohio River during the past fiscal year by collision with the piers of ges crossing the Ohio River.

KENOVA BRIDGE.*

Date.	Owner.	Steamboat.	Loss.	Amount.
	Previously reported			$8,700.00
28, 1892	S. S. Crump & Co	J. C. Risher	4 coal boats	10,000.00
	Total			18,700.00

*Unfinished.

COVINGTON AND CINCINNATI RAILROAD BRIDGE.*

Date.	Owner.	Steamboat.	Loss.	Amou[nt]
	Previously reported			$43,15[illegible]
May 22, 1892	W. H. Brown Sons	Charles Brown	Barge damaged	15[illegible]
	Total			43,30[illegible]

HENDERSON BRIDGE.†

Date.	Owner.	Steamboat.	Loss.	Amount.
	Previously reported			$18,4[illegible]
Dec. 7, 1891	W. H. Brown Sons	Alice Brown	1 coal boat	2,0[illegible]
	Total			20,5[illegible]

CAIRO BRIDGE.*

Date.	Owner.	Steamboat.	Loss.	Amount.
	Previously reported			$9,2[illegible]
Jan. 26, 1892	S. S. Crump & Co	Smoky City	1 coal boat, 1 barge, 1 flat.	4,3[illegible]
Feb. 18, 1892	W. H. Brown Sons	Mariner	1 barge	2,45
	Total			15,99[illegible]

Losses by collision with Ohio River bridges to June 30, 1892.

Beaver Bridge	$56,040.00
Steubenville Bridge	90,308.00
Wheeling and Martins Ferry Bridge	9,800.00
Bellaire Bridge	126,576.00
Parkersburg Bridge	72,677.00
Point Pleasant Bridge	9,600.00
Kenova Bridge	18,700.00
Newport and Cincinnati Railroad Bridge	11,107.00
Covington and Cincinnati railroad Bridge	$13,300
Cincinnati Southern Railroad Bridge	9,812
Ohio Falls Bridge	80,350
Kentucky and Indiana Bridge	27,767
Cairo Bridge	15,996
Henderson Bridge	20,520
Total	625,553

ESTIMATE.

The following estimate made by my predecessor, Lieut. Col. Willi[am] E. Merrill, in his last annual report, of the amount of money that shou[ld] be appropriated to a river of the magnitude of the Ohio and with [so] large and valuable a commerce, is repeated:

Low dams and dikes	$600,[illegible]
Davis Island Dam	11,[illegible]
Rock bar at mouth of Licking River	20,[illegible]
Dredging	20,[illegible]
[illegible]	20,[illegible]
[illegible] and contingencies	35,[illegible]
[illegible]	706,[illegible]

[illegible] $11,[illegible] [illegible] Davis Island Dam is compos[ed] [illegible] Davis Island and $8,000 for exten[illegible] [illegible] the lock. Experience, aft[er] [illegible] were required to ma[illegible] [illegible] estimated for, and it becam[e] [illegible] Davis Island. They we[re] [illegible] by the laboring force du[ring] [illegible] buildings are no long[er] [illegible] below the lock is urgent [illegible] stages of the river the [illegible] sometimes lost befo[re] [illegible] the river.

[illegible] 1888.

Money statement.

1, balance unexpended		$317, 057. 10
perty		243. 71
		317, 300. 81
892, amount expended during fiscal year		259, 114. 37
92, balance unexpended		58, 186. 44
92, outstanding liabilities	$8, 159. 99	
92, amount covered by uncompleted contracts	16, 331. 13	
		24, 491. 12
92, balance available		33, 695. 32
ppropriated by act approved July 13, 1892		360, 000. 00
vailable for fiscal year ending June 30, 1893		393, 695. 32
t that can be profitably expended in fiscal year ending June 30, 1894		500, 000. 00

tted in compliance with requirements of sections 2 of river and
or acts of 1866 and 1867.

---

of proposals for riprapping levee at Shawneetown, Ill., opened September 1, 1891.

Name and address of bidder.	Price per cubic yard.	Aggregate.
es Short, St. Charles, Mo	$1.50	$6, 900. 00
k Kirk, Madison, Ind	1.95	8, 970. 00
tucky Stone Ballast and Construction Company, Frankfort, Ky	2.15	9, 890. 00
. Harsha & Co., Shawneetown, Ill	2.48	11, 408. 00

act awarded to James Short and executed under date of September 23, 1891.

---

of contracts for improving Ohio River made during the fiscal year ending June 30, 1892.

tractor.	Work of improvement.	Date of contract.	To expire.
ort	Riprapping southern levee at Shawneetown, Ill.	Sept. 23, 1891	April 19, 1892

OHIO RIVER COMMERCE.

nection with the commercial statistics, which are given farther on in this it is deemed pertinent, interesting, and valuable to give the following extracts e last annual report of the superintendent of the Cincinnati Chamber of rce:

records for 1889–'90 showed a large gain in river business over previous years e a period, and this increase was maintained during 1890–'91 in both freight ssenger traffic. It is to be noted that this enlargement of volume of river ce was due more to an increased movement of manufactures than of proere being some deficiencies in crops in the valley region. Southern products, ng sugar, molasses, cotton, etc., contributed a liberal volume of freight.

revival of river commerce necessitated enlargement of transportation facilid during the year two steamers were rebuilt for the Cincinnati, Portsmouth meroy trade, two for the Cincinnati and Louisville Mail Line, and one new built and one purchased for the Memphis and Cincinnati Packet Company; ree lines being practically under one management.

h the additions mentioned, the equipment in these lines was better than preduring a period of six years, embracing seventeen boats, with a capacity of ons, and representing about half of the tonnage engaged in the Cincinnati There were daily departures (excepting Sundays) to Pomeroy, Portsmouth, a, and Louisville, and intermediate points, and two departures weekly to is.

"The Pittsburg and Cincinnati Packet Company, with an equipment of six stea ers, made daily departures, except Wednesdays. The tonnage in this trade w 3,370 tons, and was fully employed. * * *

"The Southern Transportation line had five steamers in service, with a tonnage 5,606 tons, making three departures every two weeks. The line had a good busine up to the close of the season. The traffic of this line largely represents reshipmen of goods from Pittsburg and lower Ohio business; also the movement of sugar, m lasses, etc., from the South, these products showing the largest volume in any ye since 1882. * * *

"The lines mentioned embrace the most important part of river transportation i terests at Cincinnati. The Kanawha Packet Line made weekly trips to Charlesto The Chilo Packet made daily trips. There were tri-weekly departures to Peter burg.

"The year's business has been so satisfactory, following two years of improving r turns for river transportation interests, that expectations have been greatly e couraged, and a further revival in river commerce is confidently looked for. T large increase in passenger traffic the past two years has occasioned decided impro ments to be made in the building of new steamers for the accommodation and co fort of the traveling public. The equipment in the Cincinnati trade now compar favorably with river navigati ... here.

"With 1890-'91 there has be ... ee years of little interruption to t movement of steamers in the C ... from low water, the record in th respect being quite exceptional. D ... ime there has been continuous co munication by the largest ste ... meroy and Louisville, and with b short interruptions in the Pitt ... is trades. The lowest stage of wat recorded at Cincinnati during ... t 5 inches. There have been no i terruptions to steamers from ic ... , 1888, at this port and below, a only slight delays in the uppe ... hest stage of water recorded at Ci cinnati during the year was 5 ... n February 25, which occasioned few days' interruption to traffi ... d with serious damage to proper or loss of river transportation." *

Coal ship ... ttsburg, Pa.

[Furnished by ... m Evans.]

Months.	To Cincinnati.					To Louisville.				
	Trips.	Coal boats.	Coal barges.	Fuel flats.	Tons.	Trips.	Coal boats.	Coal barges.	Fuel flats.	Tons
January	7	92	92	....	43,362	13	63	77	2	93,
February	2	2	7	2	39,873	1	....	12	....	39,
March	10	....	121	5	43,552	10	88	23	10	237,
April	16	5	204	....	105,093	18	82	133	9	142,
May	....	....	....	....	....	....	....	....	....	....
June	65	55	669	1	359,547	71	287	623	37	575,
July	20	12	233	....	123,906	21	36	154	14	151,
August	12	2	144	1	70,611	12	15	173	7	71,
September	....	....	....	....	....	....	....	....	....	....
October	....	....	....	....	....	....	....	....	....	....
November	24	32	252	10	153,018	40	214	221	21	321,
December	20	50	163	7	126,743	25	149	111	8	195,
Total	176	250	1885	26	1,065,755	211	934	1527	108	1,828,
Grand total	....	....	....	....	....	....	....	....	....	2,893,

Comparative table showing coal shipments from Pittsburg during the eight years endi December 31, 1891.

Year.	To Cincinnati.	To Louisville.	Total.
1884	946,124	1,160,292	2,106,
1885	1,733,104	1,114,008	2,847,
1886	1,262,702	2,220,530	3,483,
1887	788,690	1,367,012	2,155,
1888	1,950,882	2,223,494	[illegible]
1889	1,149,892	1,439,747	[illegible]
1890	1,324,641	2,095,716	[illegible]
1891	1,065,705	1,828,047	[illegible]

Commerce passing Davis Island Dam in 1891.

essels.	Ascending.				Descending.				Total freight.
	Through lock.	Freight.	Through pass.	Freight.	Through lock.	Freight.	Through pass.	Freight.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*	*Tons.*
	141	15,560	415	46,680	140	15,630	423	46,890	124,760
ats							4	1,200	1,200
	406		1,278		303		1,380		
ges	15		43		3		62	58,900	58,900
	102		443		21	16,000	1,398	1,273,976	1,289,976
	879	2,800	3,052	8,160	128	68,096	3,660	1,947,120	2,026,176
	495	1,300	1,127	4,500	367	55,784	1,600	243,200	304,784
					25	17,300	59	52,109	69,409
ons	33		54		50		70		
l	2,071	19,660	6,412	59,340	1,037	172,810	8,656	3,623,395	3,875,205

River commerce of Cincinnati for the year ending August 31, 1891.

rticles.	Receipts.	Shipments.	Total.
	Tons.	*Tons.*	*Tons.*
		74	74
er		1,617	1,617
	2,075	175	2,250
		14	14
	36	2	38
	133	67	200
		10	10
shoes	18	500	518
	248	733	981
n		3	3
	109	21	130
		31	31
	1,744	1,924	3,668
	4,395	106	4,501
	8,388	3,490	11,878
	2	66	68
	410	400	810
	57	1,347	1,404
	674	392	1,066
	584	972	1,556
	3	708	711
	13,345	557	13,902
	622	588	1,210
	748	29	777
	65	5	70
	7	944	951
	614	3,768	4,382
	85	59	144
	1,611	67	1,678
		1,021	1,021
dow	192	85	277
	4,354	3,541	7,895
	299	219	518
	2,510	2,988	5,498
	3,046	516	3,562
	315	106	421
	7,788	58	7,846
ict	16	2,657	2,673
		8	8
	878	668	1,546
	14,150	10,266	24,416
	4,272	2,465	6,737
	361		361

Articles.	Receipts.	Shipments.	Total.
	Tons.	*Tons.*	*Tons.*
Lead:			
Pig		6	6
White		295	295
Leather	299	92	391
Lemons		48	48
Lime	795	730	1,525
Lumber	6,620	2,120	8,740
Malt	22	46	68
Manufactures		180	180
Merchandise	28,175	24,782	52,957
Molasses	7,207	4,094	11,301
Nails	33,478	18,908	52,386
Oats	5	320	325
Oil	1,186	1,290	2,476
Onions	61	158	219
Oranges	3	183	186
Peanuts	1,815	541	2,356
Petroleum	865	1,412	2,277
Potatoes	951	882	1,833
Rice	204	138	342
Rope	879	1,327	2,206
Rosin	5	99	104
Rye	309	62	371
Salt	16,028	8,147	24,175
Seed, clover and timothy	93	867	960
Sheep	1,196	65	1,261
Shot		256	256
Soap	23	666	689
Sorghum	987	13	1,000
Spices		7	7
Starch	285	202	487
Stearine	19	6	25
Sugar	1,026	2,693	3,719
Tallow	590	15	605
Tea		8	8
Tobacco	19,309	2,765	22,074
Turpentine	2	18	20
Vegetables, green	443	128	571
Vinegar		1,260	1,260
Wheat	4,334	825	5,159
Whisky	8,861	6,483	15,344
Wines and liquors	190	366	556
Wool	91	11	152
Yarn, cotton	446	66	446

Recapitulation.

	Tons.
	210,956
its	125,831
otal	336,787

Commerce passing Davis Island Dam in 1891.

...els.	Ascending.				Descending.				Total freight.
	Through lock.	Freight.	Through pass.	Freight.	Through lock.	Freight.	Through pass.	Freight.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*	*Tons.*
	141	15,560	415	46,680	140	15,630	423	46,890	124,760
...s							4	1,200	1,200
	406		1,278		303		1,380		
...s	15		43		3		62	58,900	58,900
	102		443		21	16,000	1,398	1,273,976	1,289,976
	879	2,800	3,052	8,160	128	68,096	3,660	1,947,120	2,026,176
	495	1,300	1,127	4,500	367	55,784	1,600	243,200	304,784
					25	17,300	59	52,109	69,409
...ts	33		54		50		70		
	2,071	19,660	6,412	59,340	1,037	172,810	8,656	3,623,395	3,875,205

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...icles.	Receipts.	Shipments.	Total.
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	2,075	175	2,250
		14	14
	36	2	38
	133	67	200
		10	10
...oes	18	500	518
	248	733	981
		3	3
	109	21	130
		31	31
	1,744	1,924	3,668
	4,395	106	4,501
	8,388	3,490	11,878
	2	66	68
	410	400	810
	57	1,347	1,404
	674	392	1,066
	584	972	1,556
	3	708	711
	13,345	557	13,902
	622	588	1,210
	748	29	777
	65	5	70
	7	944	951
	614	3,768	4,382
	85	59	144
	1,611	67	1,678
		1,021	1,021
...ow	192	85	277
	4,354	3,541	7,895
	299	219	518
	2,510	2,988	5,498
	3,046	516	3,562
	315	106	421
	7,788	58	7,846
...d	16	2,657	2,673
		8	8
	878	668	1,546
	14,150	10,266	24,416
	4,272	2,465	6,737
	361		361

Articles.	Receipts.	Shipments.	Total.
	Tons.	*Tons.*	*Tons.*
Lead:			
Pig		6	6
White		295	295
Leather	299	92	391
Lemons		48	48
Lime	795	730	1,525
Lumber	6,620	2,120	8,740
Malt	22	46	68
Manufactures		180	180
Merchandise	28,175	24,782	52,957
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Nails	33,478	18,908	52,386
Oats	5	320	325
Oil	1,186	1,290	2,476
Onions	61	158	219
Oranges	3	183	186
Peanuts	1,815	541	2,356
Petroleum	865	1,412	2,277
Potatoes	951	882	1,833
Rice	204	138	342
Rope	879	1,327	2,206
Rosin	5	99	104
Rye	309	62	371
Salt	16,028	8,147	24,175
Seed, clover and timothy	93	867	960
Sheep	1,196	65	1,261
Shot		256	256
Soap	23	666	689
Sorghum	987	13	1,000
Spices		7	7
Starch	285	202	487
Stearine	19	6	25
Sugar	1,026	2,693	3,719
Tallow	590	15	605
Tea		8	8
Tobacco	19,309	2,765	22,074
Turpentine	2	18	20
Vegetables, green	443	128	571
Vinegar		1,260	1,260
Wheat	4,334	825	5,159
Whisky	8,861	6,483	15,344
Wines and liquors	190	366	556
Wool	91	11	152
Yarn, cotton	446	66	446

Rec...

	Tons.
	210,956
...ts	125,831
	336,787

Arrivals and departures of steamboats at the port of Cincinnati, Ohio.

Ports.	1885-'86.		1886-'87.		1887-'88.		1888-'89.		1889-'90.		1890-
	Arrivals.	Departures.	Arrivals.	Departures.	Arrivals.	Departures.	Arrivals.	Departures.	Arrivals.	Departures.	Arrivals.
New Orleans	63	66	34	38	35	37	51	51	38	37	31
Pittsburg	103	103	69	70	156	153	237	237	197	194	208
Other ports	2,323	2,314	2,169	2,173	1,389	1,385	2,233	2,234	2,022	2,021	1,995
Total	2,489	2,483	2,272	2,281	1,580	1,575	2,521	2,522	2,257	2,252	2,234

Schedule of rates on flour per barrel by rail and river from Cincinnati for six years ing August 31, 1891.

Destination.	1886.		1887.		1888.	
	By rail.	By river.	By rail.	By river.	By rail.	By ri
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cen*
Pittsburg	26 to 31	15 to 20	24 to 31	15	22 to 24	
Louisville	15	15	15	15	15	
New Orleans	44	35 to 39	44 to 49	35	40 to 49	

Destination.	1889.		1890.		1891.	
	By rail.	By river.	By rail.	By river.	By rail.	By ri
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cen*
Pittsburg	23	15	23 to 24	15	24	
Louisville	15	15	15	15	15	
New Orleans	54	35	49 to 54	35	49	

Comparative statement of commerce passing the falls of the Ohio River by canal an river.

Years.	Canal.		Open river.		Total.	
	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Ton
1882	3,988	935,628	2,305	668,866	6,293	1,60
1883	5,231	1,349,115	1,484	483,281	6,715	1,83
1884	3,485	785,192	1,548	484,124	5,033	1,26
1885	5,678	1,443,181	822	262,862	6,500	1,70
1886	4,964	1,240,112	1,796	577,547	6,760	1,81
1887	4,069	867,807	2,297	1,204,518	6,366	2,07
1888	6,963	1,915,365	2,252	1,162,305	9,215	3,07
1889	5,534	1,404,573	1,984	957,829	7,518	2,36
1890	4,386	998,062	3,828	1,717,158	8,214	2,71
1891	4,739	1,302,471	2,137	1,062,428	6,876	2,36

Commerce of Ohio River in 1891.

f boat or company	Between what points on the Ohio River.	Distance on Ohio River.	Number of months in commission.	Freight.	Number of passengers.
		Miles.		*Tons.*	
ents from Pittsburg..	Pittsburg to Cairo	965	9	2,893,752	....
River Navigation Co .	......do	965	8	24,104	....
n and St. Louis Tow-	......do	965	12	166,896	....
mery & Co	......do	965	10	223,740	....
et Co	Pittsburg to Louisville	599	10	139,106	....
Hawk	......do	599	6	58,880	....
Hudson	Pittsburg to Cincinnati	467	9	30,157	9,157
Keystone State	......do	467	9	29,221	8,300
Scotia	......do	467	8	14,880	5,920
Andes	......do	467	6	13,250	3,382
C. W. Batchelor	......do	467	8	14,850	3,300
Congo	......do	467	8	17,846	6,282
Louise	Pittsburg to Portsmouth	354	4	1,692	842
Lizzie Bay	Pittsburg to Gallipolis	267	10	12,600	5,500
New Courrier	Pittsburg to Parkersburg	183	10	2,813	11,025
Ben Hur	......do	183	7	7,801	9,511
H. K. Bedford	Pittsburg to Wheeling	90	10½	7,500	4,559
Leni Leoti	Pittsburg to McKees Rocks	3½	12	735	79,382
Venice	......do	3½	10	470	63,192
Venus	......do	3½	12	820	86,357
Olivette	East Liverpool to Steubenville	23	6	1,900	5,843
R. E. Phillips	Wheeling to Bellaire	4	10	3,000	50,000
Liberty	Wheeling to Clarington	28	12	14,100	8,156
Eliza H	Wheeling to Parkersburg	93	12	36,608	....
Sand and Gravel Co ..	Wheeling to Cincinnati	376	12	65,500	....
T. N. Barnsdall	Raven Rock to Marietta	23	10	2,600	9,600
T. M. Bayne	Marietta to Parkersburg	13	10	2,945	15,560
Bob Ballard	Marietta to Gallipolis	96	3½	2,980	1,325
Matt F. Allen	......do	96	1	675	500
Mary E	Parkersburg and vicinity	......	3	5,022	....
Jessie	Parkersburg to Louisville	415	12	5,760	....
Valley Belle	Ravenswood to Middleport	34	8	8,320	6,241
....	Ravenswood to Warsaw	304	12	29,021	....
Capitol City	Letart to Gallipolis	33	10	9,000	4,500
Coal Co	Syracuse to Cincinnati	224	12	35,947	....
ett & Son	Pomeroy to Cairo	718	10	377,000	....
Cincinnati & Louisville line.	Pomeroy to Louisville	351	8	160,000	....
ta Freestone Co	Pomeroy to Cincinnati	219	12	20,100	....
oal Co	......do	219	12	20,000	....
and Pomeroy Packet	......do	219	10	132,289	51,329
llins	......do	219	8	133,250	....
r Bros	Point Pleasant to Louisville*	336	10	80,000	....
awha Towboat Co	Point Pleasant to Cairo	703	6	28,800	....
dd & Co	Point Pleasant to Cincinnati	203	12	31,104	....
and Ohio Transporta-	......do	203	10	181,336	....
an Towboat Co	......do	203	10	287,500	....
Henry M. Stanley	......do	203	10	15,620	10,200
all	Gallipolis to Louisville	332	12	18,700	....
Ida Smith	Crown City to Ironton	37	7	1,120	3,920
B. T. Enos	Proctorville to Portsmouth	53	10	7,500	6,000
F. J. O'Connell	Guyandotte to Coal Grove	18	10	35,000	....
Chevalier	Huntington to Ironton	19	12	100	17,306
Coal and Iron Rwy. Co.	Ashland to Portsmouth	33	10	54,640	....
Mink No. 2	Ashland to Cincinnati	147	10	10,000	....
Reliance	Portsmouth to Rome	27	11	3,000	8,535
Silver Wave	Vanceburg to Maysville	30	11	3,500	16,500
llins	Manchester to Cincinnati	72	12	65,196	....
M. P. Wells	Maysville to Augusta	20	10	1,500	18,000
p	Charleston Bar to Covington	55	10	14,000	....
Tacoma	Chilo to Cincinnati	35	10½	13,800	18,768
Pauline	Blairsville to Desiccating Factory	24	12	150,000	....
Island Co	Coney Island Landing to Cincinnati.	10	3	525	287,521
lle & Son	Dayton to Cincinnati	3	8	20,000	....
Bellevue	Dayton to Cincinnati	3	12	....	309,329
Levi J. Workum	Cincinnati to Petersburg	25	12	9,540	886
ting	Cincinnati and vicinity	......	12	20,418	....
Line Co.†	Cincinnati to Louisville	132	12	158,510	127,266
B. F. Young	Cincinnati to Paducah	455	1	800	....

at to Portsmouth ten months.

ats from Cincinnati to Madison, one boat from Warsaw to Madison, and two boats from to Louisville.

Commerce of Ohio River in 1891—Continued.

Name of boat or company.	Between what points on the Ohio River.	Distance on Ohio River.	Number of months in commission.	Freight.	[illegible]
		Miles.		Tons.	
Memphis and Cincinnati Pk. Co.	Cincinnati to Cairo	490	10	73,902	
Steamboat U. P. Schenck	do	490	6½	9,925	
Steamboat State of Missouri	do	490	5	11,000	
Steamboat State of Kansas	do	490	1	1,900	
Steamboat New Mary Houston	do	490	7	14,700	
Steamboat Guiding Star	do	490	5	11,750	
Steamboat Golden Rule* (estimated).	do	490	7	14,000	
Steamboat Falls City	Carrollton to Louisville	56	12	21,654	
Steamboat City of Clarksville	do	56	10	5,220	
Steamboat Bellaire	Madison to Louisville	47	8	4,500	
Louisville and Evansville Mail Co.	Louisville to Henderson	197	12	105,853	
Steamboat Judelle	Can[illegible]nsboro	32	12	6,360	
Steamboat Royal	[illegible]enderson	40	8	2,673	
John Ingle & Co	[illegible]er to Evansville	8	12	350,000	
Steamboat T. C. Woodward	[illegible]	8	10	700	
Steamboat Fannie	[illegible]	8	1	175	
Steamboat Frank Stein	Ev[illegible]enderson	12	12	2,100	
Steamboat John S. Hopkins	Ev[illegible]aducah	137	12	17,000	
Steamboat Joe Fowler	[illegible]	137	12	16,400	
Steamboat W. F. Nisbet	[illegible]	137	12	25,508	
Steamboat D. A. Brooks	[illegible]ro	180	12	33,216	
Steamboat City of Metropolis	[illegible]opolis	9	12	3,250	
Steamboat Gus Fowler	[illegible]	45	12	67,000	
Steamboat Leslia Brown	[illegible]	45	4½	520	
Steamboat City of Sheffield	do	45	10	20,670	
Steamboat City of Savannah	do	45	12	21,600	
Steamboat City of Paducah	do	45	6	10,678	
Southern Transportation and Lumber Co.	Brooklyn to Cairo	42	1	62	...
Sea Lion Towboat Co	Catlettsburg to Louisville	284	10	485,150	...
Total		......	......	7,276,516	1,

* Boat burnt with books and papers.

Tonnage from which no report can be obtained (estimated).

	T
Logs, lumber, and railroad ties towed and rafted	1,00
Flatboats: corn, oats, hay, apples, potatoes, cabbage, cider, tan bark, hoop poles, etc	5
Trading boats: glass and stone ware, dry goods, groceries, oil, hides, pelts, oil barrels, scrap iron, old rope, etc	1
Total	1,06

D D 2.

OPERATING SNAG BOATS ON OHIO RIVER.

The river and harbor act of September 19, 1890, contained th lowing item:

SEC. 13. That for the purpose of securing the uninterrupted work of oper snag boats on the Ohio River, and removing snags, wrecks, and other obstructi said river, the Secretary of War, upon the application of the Chief of Engine hereby authorized to draw his warrant or requisition from time to time upon th retary of the Treasury for such sums as may be necessary to do such work, r exceed in the aggregate for each year the sum of twenty-five thousand dollars: *vided, however,* That an itemized statement of said expense shall accompany th nual Report of the Chief of Engineers.

e purpose of the above law was frustrated during the latter part e calendar year 1891 and the first half of the calendar year 1892, to the fact that, in addition to the usual annual repairs, a battery ew boilers and some betterments to the snag boat *E. A. Woodruff* umed two-thirds of the money allowed for operating expenses of oat for a whole year.

e above-mentioned work was contracted for in May, 1891, and was ave been completed and paid for out of the funds available for the l year ending June 30, 1891, but in consequence of unavoidable ys in the delivery of material to the contractors, these several jobs e not completed until the latter part of August, 1891, necessitating ments for the work which, including pay of crew and amounting to 773.70, had to be taken from funds available for the fiscal year end- June 30, 1892, which left only $9,226.30 to pay the current expenses he snag boat and the outside expenditures for the year.

fter deducting the outside expenditures and the cost of taking care he snag boat during the winter months from the balance on hand, considering the monthly expenses of the snag boat in commission, came evident that the boat could not be kept in commission later n November 30, 1891. The snag boat was therefore ordered put in ter quarters, in the mouth of the Kentucky River, not later than ember 1, 1891, where she was compelled to remain until the appro- ation for the next fiscal year should become available.

n submitting the annual report of the Ohio River snag boat *E. A. odruff*, it has been deemed best to continue the practice of report- the operations of the boat by calendar years, as by this means the ort of each season's work is presented by itself, while if the report nade for the fiscal year it must necessarily include parts of two sea- s' work, which is less satisfactory. It is evidently necessary, how- r, in view of the limit to annual expenditures, to report the latter fiscal years. The present report of operations is for the calendar r 1891, and the report of expenditures covers the fiscal year from y 1, 1891, to June 30, 1892.

he work of the United States snag boat *E. A. Woodruff* has been ler the supervision of Capt. W. H. Christian.

OPERATIONS.

(EXTRACT FROM THE REPORT OF CAPTAIN W. H. CHRISTIAN.)

ter undergoing her annual repairs at Cincinnati, the United States snag boat *A. Woodruff* began her season's work on the Ohio River on the 8th day of Septem- , 1891; she descended the river as far as Cullum Bar and removed part of a steam- t and three coal-barge wrecks and seven snags from the new channel made on the tucky side of the river by the dike recently built at that point. On the 11th of tober she ascended the river as far as Wheeling, W. Va., and then, being pre- ted by low water and a falling river from proceeding to Pittsburg, worked her down stream to Flint Island, 681 miles below Pittsburg, arriving at that place November 22. Returning she ran up stream to winter quarters in the mouth of Kentucky River, where she went out of commission on the 27th of November.

uring the short working season the *Woodruff* removed 173 snags, 9 steamboat cks, 24 coal boats, barges, and flats, 1 brick boat, 1 model barge, 1 ferry-boat , 11 rocks, 1 mass of pudding stone, 3 large pieces of iron wreckage of the Chesa- ke and Ohio Railway bridge at Cincinnati. Considerable time was spent in drag- g with hook and chain over wrecks nearly covered with earth and in breaking crust of sand and gravel bars to assist scouring. Total distance traveled during season was 1,396 miles.

mong the most dangerous obstructions removed may be mentioned two large s at the foot of Eightmile Island; two in front of Proctorville, Ohio; three in t of upper end of Ironton, Ohio; the steamboat *Nail City* in front of Catlettsburg, Ky.; steamboat [illegible] in front of upper end of [illegible], Ohio; [illegible] R. at the foot of Brush Creek Island; one large stump from the new [illegible] [illegible] Bar; a model barge at Flint Island; one large snag from channel [illegible] upper end of Greenupsburg, Ky., which had sunk two boats and damaged [illegible] one snag from channel at [illegible] Bar, which sunk steamboat [illegible].

REMOVAL OF SNAGS, WRECKS, AND OTHER OBSTRUCTIONS [illegible] OHIO RIVER.

In addition to the work done by the snag boat *E. A. Wo*[illegible] large number of rocks that obstructed the navigation of [illegible] River, near Catlettsburg, Ky., were removed by a gang of m[illegible] for that purpose.

A steam dredge was also hired, and worked fourteen and [illegible] days at Cullums Ripple, removing obstructions from the channel [illegible] river at that place.

Itemized statement of expenses for operating snag boats on the Ohio River, and [illegible] snags, wrecks, and other obstructions in said river.

EXPENSES OF U. S. SNAG BOAT E. A. WOODRUFF.

Month.	Pay of crew.	Subsistence.	Fuel.	Miscellaneous supplies.	Tools and implements.	General repairs.	Contingent expenses.
July, [illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	
August, [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
September, [illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
October, [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
November, [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.00		[illegible]
December, [illegible]	[illegible]	[illegible]					
January, [illegible]	[illegible]	[illegible]					
February, [illegible]	[illegible]	[illegible]					[illegible]
March, [illegible]	[illegible]	[illegible]					2.10
April, [illegible]	[illegible]	[illegible]					2.10
May, [illegible]	[illegible]	[illegible]		[illegible]			[illegible]
June, [illegible]	[illegible]						
Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	151.04

Other expenditures.

Removing snags, wrecks, and other obstructions from Ohio River near Catlettsburg, Ky.	[illegible]
Removing snags, wrecks, and other obstructions from Ohio River at Cullums Bar.	300.00
Outstanding liabilities July 1, [illegible] paid during fiscal year	1,267.15
Total expenditures for removal of snags, wrecks and other obstructions	[illegible]

D D 3.

OPERATING AND CARE OF DAVIS ISLAND DAM, OHIO RIVER, N[illegible] PITTSBURG, PENNSYLVANIA.

[illegible] has been under the immediate supervision of Mr. Wil[illegible] M[illegible] assistant engineer.

[illegible] statement of the amount and date of all allotm[illegible]

[illegible]	[illegible]	May [illegible]	$2,0[illegible]
[illegible]	[illegible]	[illegible]	14,7[illegible]
[illegible]	[illegible]	[illegible]	14,8[illegible]
[illegible]	[illegible]	[illegible]	10,3[illegible]
[illegible]	[illegible]		
[illegible]	[illegible]	Total	112,4[illegible]
[illegible]	[illegible]		

the close of the last fiscal year the dam was up, having been raised ne 30, 1891. The maneuvers during the year were as follows:

Lowered the dam, July 8.
Raised the dam, July 15.
Lowered the dam, July 24.
Raised the dam, August 10.
Lowered the dam, August 24.
Raised the dam, September 2.
Lowered the dam, November 24.
Raised the dam, June 30.

the end of the year the dam was up.

OPERATIONS DURING THE FISCAL YEAR.

(EXTRACT FROM THE REPORT OF MR. WILLIAM MARTIN.)

k.—The lower rail, in the recess of the lower lock gate, which showed evidence akening at the close of the last fiscal year, came off entirely in September, and month of October, when the stage of water was at its lowest, it was renewed new rail of heavier section. To do this required closing the recess by a coffer-and pumping out the inclosure.

e old rail fit into a rabbet in a 3½-inch timber which rested on the masonry. n this rail, which was three-quarter by 6 inches, came off, the lock gate wheels nto and through the timber and were soon running on the stone masonry, which g 3½ inches lower than the track level strained the gate and made it run very . A new steel rail, 3 by 11 inches, was substituted for the old rail and the 3½-inch timber, and was raised above the rough masonry surface one-quarter of an inch edges, thus bringing the new rail to the proper level.

ring the period of putting in the new rail, between the 12th and 19th of Octo-he stage of water was so low that the boats could not run, so no interference vigation was caused by having the lock closed for the period stated. At 12:50 , on the morning of the 13th of September, the passenger steamer *Courier* de-ing ran into the lock under full head and, crashing into the lower lock gate, e the upper chord of the gate truss, the top rail, one of the vertical posts, and large oak timber to which the lock gate chain is attached. The captain and t of the boat were arrested and the boat libeled. At the hearing before the ted States Commissioners the officers of the boat were charged with wilful care-ness, but for lack of sufficient testimony to prove the charge they were dismissed. libel against the boat has not yet been disposed of.

rvice pump.—The contract for building a new service pump to replace the old , for use in supplying water for the tanks for operating the lock-filling and dis-rging valves, was let August 8 to The Hall Steam Pump Company, of Allegheny y, Pa. The design of the pump was prepared in this office, and dated May 19, l.

he old pump was of the vertical piston class, and was poorly adapted to the work ad to perform, having to work against a head of 65 feet. The new pump is of plunger class, of more substantial build, and better adapted to the work. It is pleted but not yet erected, as the high water interfered before the work was com-ted.

rift chute.—The drift chute constructed through the lower wall of the lower back recess performs a great service in freeing the recess of all drift which is natu-y drawn into it by the operation of the lock-discharging valves. By its use the t is quickly passed below the lock and out of the way. I hope next year to have milar plan carried out in respect to the recess of the upper gate, as at the latter e the greatest annoyance is experienced from this cause.

one in land wall inclosure.—About 25 cubic yards of large stone, left over from construction of the bear-trap piers and which had been stored in the land lock l inclosure, were removed and deposited in the river bed below the bear trap, adding to the protection of the river bed at this point.

vable dam.—On the evening of the 8th of August, 1891, we began to raise the . Fourteen wickets next to the river wall were raised, when operations were pended until the next morning. On the outer wicket a red signal light was ed to warn navigators. The towboat *Nellie Walton*, ascending at 10:15 p. m., h a tow of empty barges, ran into these wickets and knocked four of them down. examination showed that four wicket boxes, three cross heads, three quoins, and wicket-box bolts were broken and the horses badly bent. The excuse the officers the boat gave was that they did not see the signal light. This accident delayed raising of the dam, as the repairs of the damage done required two days' time.

[illegible]

In October the river was at a very low stage and many of the levels of th bed were retaken on dry land, the stage of the water permitting the wading river. These levels being very accurate were substituted for the soundings sented by the map of March 24 above mentioned.

The land necessary for the construction of the lock and abutment was o by purchase after condemnation. The tract on the north side of the river, construction of the lock and its approaches, containing six acres, was pu from Mr. James McTaggart; that on the south side, containing 3.46 acres, be to the Beaver County Infirmary, and was controlled by a board of directors board was created by act of assembly of March 29, 1851, and by its terms no ity is given the board to sell any of the property acquired for the purposes act. Accordingly a board of appraisers was appointed by the court for the p of condemning the necessary land. By the appraisers report $166⅔ per ac agreed upon, being the same price per acre as paid to Mr. McTaggart for the the north side of the river. At this price the total cost to the United States land needed for the lock and dam was $1,576.67. This has been paid and t vested in the United States.

The reference of the sill of the Beaver Dam, as fixed by the diagram of the of the Ohio River from Davis to Montgomerys Island, dated February 24, 655.871 feet above mean tide.

Borings to determine the character of the foundation were made on the site location. No rock was encountered except at a few points, the strata in a being from two to three feet in thickness. The material passed through con clay, gravel, and sand, sandstone, a dark shale resembling coal, and some indi of quicksand.

The preliminary work of construction was begun with a small force on the June, 1892, by clearing and cross-sectioning the land of the site and erectin gauges for hydrographic purposes.

It is expected that the construction of the lock will be well advanced duri present season.

Money statement.

July 1, 1891, balance unexpended	$248
June 30, 1892, amount expended during fiscal year	5
July 1, 1892, balance unexpended	243
July 1, 1892, outstanding liabilities	
July 1, 1892, balance available	243
Amount appropriated by act approved July 13, 1892	100
Amount available for fiscal year ending June 30, 1893	343
Amount (estimated) required for completion of existing project	550
Amount that can be profitably expended in fiscal year ending June 30, 1894	250

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

D D 5.

IMPROVEMENT OF MONONGAHELA RIVER, WEST VIRGINIA AND SYLVANIA.

Statement of the amount and date of all appropriations.

June 10, 1872	$25,000	March 3, 1881	
March 3, 1873	66,000	August 2, 1882	
June 23, 1874	25,000	July 5, 1884	
March 3, 1875	22,000	August 5, 1886	
June 18, 1878	25,000	August 11, 1888	
March 3, 1879	24,000		
June 14, 1880	25,000	Total	

The following table shows the commerce that passed through United States
No. 9 during 1891:

Month.	Ascending.		Descendin	
	Passengers.	Freight.	Passengers.	Fre
		Tons.		To
January	368	451.70	320	
February	363	235.12	307	
March	393	379.30	400	
April	357	397.16	349	
May	431	397.60	393	3,
June	618	525.25	609	
July	1,599	690.85	1,361	
August	1,991	474.00	1,733	
September	890	458.20	863	
October	600	706.95	541	
November	478	488.40	427	
December	389	388.80	359	
Total	8,477	5,593.33	7,662	2,

Taking the average of the totals given in the above tables we find that the
merce during 1891 on the 14 miles of the Monongahela River which is controll
the United States is as follows:

Tons of freight 1
Passengers.. 1

The following table compiled from the annual reports of the Monongahela N
gation Company shows the commercial movement on the lower part of this rive
the past eight years.

Articles.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	T
Brick	1,467	1,325	8,907	5,279	4,504	6,333	7,856	
Cattle and horses	108	374	386	501	565	729	648	
Classified freight	13,890	13,683	13,086	16,486	17,450	18,334	23,169	
Coal and coke	3,104,860	3,265,078	4,297,768	2,998,690	4,400,996	3,084,175	4,486,322	4,2
Fire clay	2,140	3,463	3,295	2,383	3,476	5,982	5,021	
Hogs	254	138	83	259	379	266	340	
Iron:								
Ore	20,840	16,486	17,823	17,683	8,079	3,371	2,335	....
In pigs	17	11	5	7	10	15	5	
Lumber	10,714	9,622	10,231	11,144	13,778	10,095	11,615	
Oil	9	1,073	....	55	....	....	....	....
Pipe	....	595	....	2,285	....	....	2,394	....
Posts	5	256	437	258	489	700	1,089	
Posts pit	35,072	32,166	18,392	30,472	22,432	18,707	29,336	
Railroad ties	1,256	135	161	30	555	3,165	232	
Sand	37,345	51,771	59,229	89,230	63,085	73,590	105,600	
Sheep	170	134	108	233	193	164	60	
Staves	....	9	9	....	7	26	140	
Steel rails	23,844	22,428	45,795	57,490	10,688	32,177	34,609	
Stone	56,116	7,612	4,621	910	3,636	9,580	811	
Timber	47,064	46,172	52,608	53,561	84,191	54,696	43,970	
Whisky	254	198	164	49	88	134	180	
Wood	....	230	196	....	184	....	58	....
Total	3,355,425	3,472,959	4,533,484	3,287,005	4,634,785	3,322,239	4,755,790	4,5
Passengers	26,871	24,608	26,885	50,584	44,714	45,811	31,828	

D D 6.

OPERATING AND CARE OF LOCKS AND DAMS NOS. 8 AND 9, MO GAHELA RIVER.

The Monongahela River, from Morgantown, W. Va., to its mout
Pittsburg, is canalized by nine locks and dams, of which the first se
counting from Pittsburg, are the property of the Monongahela Na

mpany, and the eighth and ninth are the property of the United The eighth dam is 88.15 miles above Pittsburg, and Morgan-he head of the slackwater, is 102.16 miles from the same. It herefore, be stated that 14 miles of this river is under the direct l of the United States and 88 miles is under a private corpora-

following is a statement of date and amount of all allotments s work:

5, 1884	$1,000
ber 1, 1884	4,000
ber 3, 1884	4,500
ber 20, 1884	500
1885	100
, 1885	1,000
, 1886	1,200
l, 1887	1,100
1887	11,000
, 1888	6,270
r 27, 1888	3,000
, 1889	1,480
r 7, 1889	1,500
ber 8, 1889	1,200
, 1890	12,300
1891	24,250
ber 25, 1889, from appropriation for examinations, surveys, and con-ncies of rivers and harbors	4,000
	78,400

only stoppage to navigation throughout the year was on account and high water during a few days in midwinter.

s work has been under the immediate supervision of Mr. Philip , assistant engineer, and the information relating to the opera-of the year is contained in his report.

OPERATIONS DURING THE FISCAL YEAR.

(EXTRACT FROM REPORT OF MR. PHILIP GOLAY.)

in the spring of 1890 the aprons of both dams were injured by floods, but on t of continued high water it was impossible to repair them during that year. st year has been a little more favorable for such work, and repairs were made dams.

LOCK AND DAM NO. 8, MOUTH OF DUNKARD CREEK.

ir of dam.—The injury sustained by Dam No. 8 was confined to the middle . Two sections of the dam, one 64 feet long next to the lock, and one 58 feet xt to the abutment, showed no signs of injury. On the intervening section, long, the damage, beginning with the lifting of a small portion of the apron g, increased with subsequent rises of the river until it extended across the ting the sheeting together with all the purlins except the one on the up-side which was held in place by the sheet piling spiked to it. Also a few of the apron substructure were carried away.

tional anchorage was given to the toe of the apron of the uninjured parts; of the middle part, the apron sheeting was removed and the apron repaired ilt up 20 inches higher. The apron sheeting was then replaced, and, together e adjacent course of sheeting, was securely bolted down. On account of the te at which the low-water season came and its short duration, further repairs ot be made; and the work of replacing and bolting down the upper courses ting and purlins beneath was postponed until a more favorable time. The f the dam was thus left, and still remains, elevated to such a height as to ool No. 8, during low water, to stand about 1 foot above normal pool level. close of repairs, and as a protection to the apron of the dam against the re-ry current, 976 cubic yards of riprap stone were piled against the lower face lam up to the sheeting of the apron. Upon recent examination, these stones ersons encroaching on the river have had the effect of causing almost an spension of encroachments in general. Notwithstanding this, however, a vigilance is necessary in order to maintain a permanent obedience to the

Estimate for fiscal year ending June 30, 1893.

g spoil bank to destroy a dangerous eddy and to back Dam No. 9...
g material below lock to back Dam No. 8........................
and wages...
g expenses ....
el, light, and stationery...................................
ig snags and other obstructions............................ 1,
. 8, repairs, etc.:
res in turbine races ....
tering turbine races ....
k protection below lock.....................................
uilding storage shed ....
ting lock gates and buildings...............................
eral repairs to operating machinery.........................
. 9, repairs, etc.:
uilding lock-keeper's dwellings, carried away by flood, 1888......
on apron of dam...
athing guide wall ....
ing dam ....
uilding storage shed ....
tingencies ....

otal ....

statement of expenses incurred in operating and care of lo Monongahela River during the fiscal year ending June 3

	Operating expenses.				Repairs.				Tools and appliances.	Grand total.
	Salaries.	Supplies.	Miscellaneous expenses.	Total.	Hire of boats and barges.	Labor.	Material.	Total.		
..	$565.04	....	$11.00	$576.04	....	....	$488.91	$488.91	....	$1,064.95
..	622.91	$21.00	84.80	728.71	$416.00	$538.67	595.34	1,550.01	$858.42	3,137.14
r..	540.00	31.65	31.40	603.05	410.00	1,830.42	1,279.51	3,519.93	113.60	4,236.58
..	395.00	13.17	20.89	420.06	322.00	2,881.57	2,649.98	5,853.55	174.77	6,457.38
..	552.95	....	32.45	585.40	....	333.34	1,484.34	1,817.68	29.98	2,433.06
..	488.50	....	....	488.50	....	....	....	....	....	488.50
..	496.15	....	8.00	504.15	....	....	....	....	....	504.15
..	486.80	....	28.32	515.12	....	....	....	....	....	515.12
..	415.00	1.55	16.00	432.55	10.00	....	....	10.00	....	442.55
..	488.50	2.10	17.04	507.64	....	....	.47	.47	....	508.11
..	673.90	4.78	....	678.68	....	....	45.62	45.62	11.00	735.30
..	723.78	1.60	....	725.38	....	....	251.21	251.21	2.90	979.49
..	6,448.53	75.85	249.90	6,774.28	1,158.00	5,584.00	6,795.38	13,537.38	1,190.67	21,502.33

ercial statistics are attached to the report for the improvment of Monongaer.

D D 7.

URCHASE OF LOCK AND DAM NO. 7, MONONGAHELA RIVER.

close of the last fiscal year the case of the United States *vs.* ıgahela Navigation Company, in the matter of the condemck and Dam No. 7, was set to be heard on appeal at the No- of the circuit court of the United States for the western nia.

The harbor …
Mr. J. W. Ar…
his report:

Money statement.

91, balance unexpended	$167,000.00
92, balance unexpended	167,000.00

D D 9.

IMPROVEMENT OF CHEAT RIVER, WEST VIRGINIA.

ver and harbor act of September 19, 1890, contained an appro- of $13,000 for the improvement of Cheat River. This is the propriation ever made for this river.

bject of the improvement was to make this river navigable for gs, so as to bring out the immense supplies of timber found in in forests on the Cheat River and its tributaries. In its natural n it was impossible to bring down rafts, and a large percentage ose logs was stranded among the rocks and left there to decay. ough part of the river commences about 3 miles below Rowles- d terminates at Beaver Hole, 16 miles above the mouth, where r emerges from Laurel Ridge. The total length of difficult 30 miles.

riginal project for the improvement of the river was the removal rock obstructions as interfered with the free passage of logs on foot stage of water. At the suggestion of lumbermen and nterested in the improvement of this river, an additional proj- adopted of making a low-water channel from near Rowlesburg e river in which logs could be floated on a rise of from 2 to 3

work has been under the immediate supervision of Mr. Philip Assistant Engineer.

REPORT OF OPERATIONS FOR THE FISCAL YEAR.

(EXTRACT FROM REPORT OF MR. PHILIP GOLAY.)

was begun in November, 1890, suspended in January, 1891, on account of ther, resumed in the following April, and closed January 9, 1892, at which amount of the appropriation ($13,000) was found to be exhausted.

the latter part of September, 1891, the work was prosecuted with a view ing such rock obstructions as interfered with the passage of loose logs when from 6 to 8 feet occur. To this end 10,058 cubic yards of rock obstruction sted and the river was put in fair condition as far down as Green Island, 20½ ow Rowlesburg.

the month of September, 1891, lumbermen urged that a low-water channel termed it, be made. About this time, also, Col. Merrill paid a visit to the hela River and Morgantown office, and after discussing the subject with parties interested in the improvement of Cheat River, he directed that the he lumbermen be adopted. Accordingly about the latter part of September, force of workmen with tools and material were sent again to the upper end ublesome part of the river, about 2 miles below Rowlesburg, and working ream, blasted in the low-water channel 3,789 cubic yards of rock, clearing nel so that logs can be driven on from 2 to 3 feet rises down to a point 8 low Rowlesburg. The total number of cubic yards of rock obstruction nd removed, or leveled down, is 13,847.

itional sum could be advantageously expended in removing more rock ob- 3,000 cubic yards between Pringle Run and Green Island, mostly in low- el, and 7,000 cubic yards of channel and shore rocks, between Green Island sland, making a total of 10,000 cubic yards of rock obstruction yet be blasted. Guide cribs should also be constructed at the heads of [illegible] For the building of these guide [illegible] the additional sum of [illegible] needed [illegible] Cheat River property was transp[illegible] ample storage room.

[illegible] statement.

[illegible]	$7,[illegible]
[illegible] year	7,[illegible]
[illegible]	[illegible]
[illegible] ending June 30, 1894	20,[illegible]

[illegible] sections 2 of river and

[illegible] year ending December 31, 1891.

[illegible]	[illegible]	Received [illegible] at mouth of river.	Passed on to points below.	Total [illegible]
		Tons.	Tons.	Tons.
[illegible]	[illegible]	[illegible]	142.78	[illegible]
[illegible]	[illegible]	[illegible]	305.56	1,[illegible]
[illegible]	[illegible]	[illegible]	180.28	[illegible]
[illegible]	[illegible]	[illegible]	1,846.94	7,[illegible]
[illegible]	[illegible]	[illegible]	1,509.17	6,[illegible]
[illegible]	[illegible]	[illegible]	2,011.94	8,[illegible]
[illegible]	[illegible]	[illegible]	1,204.17	4,[illegible]
[illegible]	[illegible]	[illegible]	1,875.00	7,[illegible]
[illegible]	[illegible]	[illegible]	1,247.06	4,[illegible]
[illegible]	[illegible]	[illegible]	665.51	12,[illegible]

[illegible] PENNSYLVANIA.

[illegible] date of all appropri[illegible]

[illegible]	$30,0[illegible]
[illegible]	25,0[illegible]
[illegible]	20,0[illegible]
[illegible]	180,0[illegible]

[illegible] this river was the re[illegible] [illegible] construction of low [illegible] [illegible] contract the water [illegible] [illegible] on this project

[illegible] year $18,599.88 [illegible] Mr. J. W

[illegible] YEAR.

[illegible] improve[illegible] [illegible] located at [illegible] supple, was

LOW DAMS AND DIKES.

hute at Corydon, Pa., 209 miles above Pittsburg.—During the past winter an ge damaged part of the mill dam across the river at Corydon, thereby injuring f the sheeting of the log chute, which is built at the lower side of it. It is t the repairs can readily be made at a cost not exceeding $70.

at Cornplanter Island, 204 miles above Pittsburg.—This dam, which at the close ast fiscal year had been nearly finished, was completed. Its length is 334 feet, t base 18 feet, and height above low water 3 feet. An abutment for the pro- of the roots of the dam was built at each end to the height of the bank.

otal quantities of material used in the construction of the dam and abutments follows:

aber	feet, B. M.	34,636
k lumber	do	23,632
lts	pounds	2,991
	cubic yards	895
tion made	do	240

ost of labor and materials in the entire work was $2,503.05.

dam was designed to confine the water theretofore wasting down the island hereby reducing the navigable depth of the water on the very shallow bar pposite to the channel on the right. No actual soundings were made, but the tions and experience of timber and lumbermen show beyond a doubt that there n an increase of more than a foot in the depth of the water at a 3-foot stage. tors speak in terms of highest praise of this improvement, and point to the t since its completion the shipments from above that point have doubled. n at present is in good condition.

at Hickory, 157 miles above Pittsburg.—The dam designed to improve Hickory was originally located across the left or main channel, at the head of Greens the intention having been to make the right chute the channel for naviga- When everything was in readiness for commencing its construction serious ob- were offered by some local timber men, who claimed that the erection of a dam the left chute at the head of Greens Island would greatly impair the useful- their timber landings on that side of the river opposite the foot of the island. iate the possibility of damaging the landings a survey above and below the Greens Island was made, and the location of the dam changed to a point mile farther down, and so as to cross the right chute at the head of the lower The dam here was designed to confine the water below a 3-foot stage, about ourths of which drifted into the right chute at this point, into the left or l channel, and to cut out the channel bar opposite. Work was commeneed onstruction about August 1, and the structure completed on October 14. The built on a sharp curve, running from the right bank around the head of the Its length is 730 feet, width at base 18 feet, and height from 6 to 7 feet; the on of a 3-foot stage of water. An abutment 40 feet long at the root and one ead of the island 50 feet long were built, and the outer side of the island otected with heavy riprap stone. The structure is reported as being in good on.

e construction of this work the following quantities of material were expended,

mber	feet, B. M.	68,526
k lumber	do	56,684
olts	pounds	8,022
	do	285
	cubic yards	2,170
tion made	do	180

ost of material and labor was $5,623.49.

improvement also has been productive of excellent results, and whereas y Ripple had always been dreaded on account of its shallowness, caused by ter spreading over so much territory, now, according to the reports of navi- the difficulties and dangers heretofore existing have entirely disappeared.

at Pithole, 143 miles above Pittsburg.—The construction of this dam had been nced at the close of the last fiscal year. Under favorable conditions the work shed along rapidly and the structure finished in September. It extends from bank down to the high bar, formerly Pithole Island, a distance of 1,132 feet. th at base is 18 feet, and its height the level of a 3-foot stage. An abutment long and 10 feet high was built at the root to protect the bank.

object of this improvement was to stop the waste of water down the left which almost equaled the flow down the right, and thus increase the navi- epth of the water in the channel. This has been accomplished, fully a foot in depth having been added to the channel at a 3-foot stage. No damage has occurred to this work since its completion.

The following is a statement of the quantities of material expended in the construction of the dam and abutment:

Oak lumber	feet, B. M.	104,554
Hemlock lumber	do	84,090
Drift bolts	pounds	11,300
Spikes	do	325
Stone	cubic yards	2,490
Excavation made	do	860

The cost of materials and labor was $8,075.76.

Dike at Red Bank, 64 miles above Pittsburg.—Although one of the most extensive ice gorges seen in many years in the Allegheny swept over this dike in February of the past winter, yet the damage to it is slight, not exceeding the displacement of a few squares of paving. It is estimated that $40 will make the repairs.

Dam at Nicholson Island, 37 miles above Pittsburg.—This work was put in good repair in the season of 1891 by replacing about a square of paving which had washed out. During the past winter the Parker ice gorge damaged some of the paving. The necessary repairs, it is estimated, can be made for $30.

Dam at Sixmile Island.—This structure has remained in good condition.

REMOVAL OF OBSTRUCTIONS.

Removal of bar at foot of Pithole Ripple.—This work was commenced but not carried to completion, owing to the lateness of the season; 500 cubic yards of rock were removed.

Removal of rock and other obstructions below Kittanning.—A number of dangerous rocks and snags had made their appearance on the lower portion of the river, and in October a small force was put to work removing them. The party operated from Kittanning to Pittsburg, a distance of 45 miles, making the following removals of obstructions, viz:

Locality.	Rock.	Snags.
	Cu. yds.	
Kittanning	40	
Cogleys Island	50	
Head of Ross Island	125	3
Nicholsons Island	205	
White Rock	10	
Murphys Island		6
Tarentum Island	50	
Bull Creek	75	1
Logans Landing	6	
Fourteenmile Island	60	1
Total	621	11

ENCROACHMENTS.

At the close of the last fiscal year most of the leading parties encroaching on the navigable capacity of the river had been restrained, either by injunction, or by stipulations in which they agreed to stop depositing waste material over the banks, pending the establishment of harbor lines. During the year, however, navigators had frequent occasion to report parties engaged in filling material into the stream. These cases were promptly investigated, and the guilty parties were notified to stop their unlawful practices, which in every case they did, thus obviating the necessity of taking legal action.

Navigators have heretofore frequently experienced great inconvenience on account of huge piles of coarse gravel formed in the harbor by parties digging sand from the river bed, and last season the operations of one company became so objectionable that an information was made against them and their employés. At the hearing they were indicted and held for trial at court. Subsequently they removed the piles of gravel. Members and employés of a dredge company were prosecuted for obstructing the channel at the Union Bridge. After being indicted they removed all the material put in. These cases have not yet been tried.

The removal of large quantities of rocks, snags, and other obstructions from the bed of the river, and the erection of low dams and dikes, shutting off duplicate chutes and contracting the channel where spread over large areas, have resulted in great good to the general trade, and much more work of the same nature remains to be done for the relief and safety of navigation. The most important improvement that can be made on the Allegheny, however, and which should receive serious consideration, is the extension of slack water, at least as far up as Soda Works, 20 miles above Pittsburg. This part of the Allegheny Valley is rapidly building up with mills and industrial establishments of other kinds, which demand and deserve facilities for cheap and permanent transportation.

Money statement.

July 1, 1891, balance unexpended	$18,599.88
June 30, 1892, amount expended during fiscal year	16,977.73
July 1, 1892, balance unexpended	1,622.15
July 1, 1892, outstanding liabilities	163.00
July 1, 1892, balance available	1,459.15
Amount appropriated by act approved July 13, 1892	25,000.00
Amount available for fiscal year ending June 30, 1893	26,459.15
Amount that can be profitably expended in fiscal year ending June 30, 1894 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	25,000.00

COMMERCE.

It has never been possible to procure complete statistics of the commerce of the Allegheny River, owing to its scattered condition and the fact that there is no record of it kept anywhere. It is, therefore, impossible to state whether there has or has not been an increase in the tonnage over that of the previous year. The local harbor tonnage exceeds that of 1890 by 361,023 tons, most of which is attributable to an increase in the trade.

The following is a statement of the principal commercial movements on the river during the calendar year 1891:

Articles.	Quantity.	Articles.	Quantity.
	Tons.		*Tons.*
Barges	2,700	Lath	286
Bark	2,624	Manure	800
Barrels	900	Nitroglycerin	12
Boat bottoms	29,412	Piles	1,896
Brace poles	813	Pit posts	6,223
Cattle and horses	926	Rough lumber	105,959
Check posts	1,510	Sand	84,439
Coal	1,400	Sheep	30
Curbstone	406	Shingles	270
Fire clay	2,700	Stone	36,947
General freight	2,625	Timber	105,245
Gravel	12,453		
Hay	150	Total	400,726

Passengers carried, 5,650.

In addition to the above, the following is a statement of the principal commercial movements in the Allegheny Harbor at Pittsburg:

Articles.	Quantiy.	Articles.	Quantity.
	Tons.		*Tons.*
Cars, loaded	362,342	Oil	11,040
Cars, empty	77,916	Railroad ties	14,825
Clinker	1,500	Sand	172,040
Coal	189,282	Staves	9,376
Gas pipe	5,610	Vegetables	360
Gravel	33,845		
Fire brick	1,059	Total	896,095
Manure	16,870		

Passengers carried, 59,000.

D D 11.

DAM AT HERR ISLAND, ALLEGHENY RIVER, NEAR PITTSBURG, PENNSYLVANIA.

The following is a statement of the amount and date of all appropriations for this work:

August 5, 1886	$37,50
August 11, 1888	35,00
September 19, 1890	35,00
Total	107,50

The land required on both banks of the river was purchased. The authorities of Allegheny City, to whom the land on the right bank belonged, sold it for the nominal consideration of $1, on condition that the dam should be a movable one. A petition to the same effect was likewise received from the authorities of the city of Pittsburg, from the Pittsburg Chamber of Commerce, and from the Engineers' Society of Western Pennsylvania. In all these petitions the reason alleged for desiring that the dam be a movable one was the fear that the height of floods in the Allegheny River would be increased by a fixed dam.

The question of the proposed change was referred to the Secretary of War by the Chief of Engineers, and on September 29, 1890, it was ordered that the dam at Herr Island be made a movable one. This change in design necessitated a corresponding change in the estimated cost of the work; the estimate for the present design is $600,000.

It was supposed that after this action there would be no further cause for delay, but a number of riparian owners on the left or Pittsburg side of the river, to whom no allowance for damages had been made, for the reason that the proposed lock was to be outside of the high-water line, brought suit in the circuit court of the United States for compensation. The case was placed in the hands of the United States attorney for the western district of Pennsylvania, where it still remains.

The Davis Island Dam pool gives permanent navigation on about 2 miles of the lower portion of the Allegheny, and during the calendar year 1891 the local commercial movements on that part of the river amounted to more than 830,000 tons.

The legal questions which stand in the way of the commencement of this important work should be settled, and it is hoped that some action will be taken at an early day by those having the matter in charge.

This work has been under the immediate supervision of Mr. J. W. Arras, Assistant Engineer.

Money statement.

July 1, 1891, balance unexpended	$70,648.23
June 30, 1892, amount expended during fiscal year	1,951.38
July 1, 1892, balance unexpended	68,696.85
Amount appropriated by act approved July 13, 1892	40,000.00
Amount available for fiscal year ending June 30, 1893	108,696.85
Amount (estimated) required for completion of existing project	484,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	200,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

D D 12.

ICE HARBOR AT MOUTH OF MUSKINGUM RIVER, OHIO.

The ice harbor is the lower pool of the Muskingum River, which has n created by the slack-water dam at Marietta, and the object of the k under consideration is to build a passway through this dam, of size as will permit Ohio River packets and coal fleets to take ge from ice in this pool. The passway in question consists of a lock, which, owing to the local conditions controlling the only ble site, was built with independent axes of entrance and exit, ngle between these axes being 11° 15′. This involved the neces- f widening the lock chamber at both ends so as to permit boats nge direction while in the lock. The plan of the lock chamber refore somewhat like an hourglass, the lock being narrowest in iddle. The maximum rectangle which can be passed through the has a length of 365 feet and a width of 56 feet. The work has n progress since 1880, but has been kept back by inadequate priations and the occasional absence of any appropriation. The is now nearly finished and is in use.

e following is a statement of the amount and date of all appropri- s for the work:

h 3, 1879	$30,000	August 5, 1886	$37,500
14, 1880	50,000	August 11, 1888	60,000
h 3, 1881	30,000	September 19, 1890	30,000
st 2, 1882	40,000		
5, 1884	50,000	Total	327,500

his work was under the immediate supervision of Lieut. Cassius E. ette, Corps of Engineers, U. S. Army, until April 20, 1892. Since time Mr. Edmund Moeser, Assistant Engineer, has had immediate rvision of the work.

OPERATIONS DURING THE FISCAL YEAR.

(EXTRACT FROM REPORT OF MR. EDMUND MOESER.)

the beginning of the year the masonry of the river wall was complete; the l wall was complete with the exception of 155 feet, which was 12 feet above the er miter sill. Work was carried on without interruption; the masonry of the l wall was finished, being about 1,100 yards, the hollow quoins set, and the r gates built and placed in position.

contract was made with the Griffith and Wedge Company, Zanesville, Ohio, for iron work, consisting of mud valves, turbine culvert valves, head gates for mill , machinery for operating lower gates, and all machinery for operating valves. under-water iron work was all placed as soon as finished, so that the lock was ly for use December 1, 1891.

wo thousand two hundred and eighty-seven cubic yards of mud was taken from lock chamber and filled into the old mill race on the lock lot.

he lock will not be available for Ohio River boats until a draw is placed in the timore and Ohio Southwestern Railroad Bridge just below it. No move has been le by the railroad company towards changing the bridge.

Money statement.

y 1, 1891, balance unexpended	$20,114.29
e 30, 1892, amount expended during fiscal year	20,063.51
y 1, 1892, balance unexpended	50.78

... proposals for ...

Name and address of bidder.										
The Griffith & Wedge Co., Zanesville, Ohio	6.50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.35
... Bros. & Co., ... Ohio	4 1[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
The Blandy Machine ..., Zanesville, Ohio	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.40
... Nat. Steam Pump ..., Pittsburg, Pa	9.50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.35
... & ... Greenwald ..., ... Ohio	13.00	7.00	13.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
... Sons ...	10.73	9.80	14.66	2.60	7.559.25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
...	.[illegible]	10.50	11.50	.56	8.221.43	.13	15.50	.38	.56	

... extra charge for patterns, $25.

... & Wedge Co., and executed August 29, 1891.

... constructing *Ice Harbor Lock at mouth of* ... *fiscal year ending June 30, 1892.*

... Improvement.	Date.	To exp...
... work for Ice Harbor Lock	Aug. 29, 1891	Dec. 1

... to the report for operating and care of ... River.

D D 13.

...HARBOR LOCK AT MOUTH OF MUS... RIVER, OHIO.

... December 10, 1891, for the ope...

... supervision of Lieut. Cassius ... Army, until April 20, 1892. S... assistant engineer, has had immed...

... 1, 1891.

OPERATIONS FOR THE FISCAL YEAR.

(EXTRACT FROM THE REPORT OF MR. EDMUND MOESER.)

xpenditures were for lock-keepers and assistant, materials for repair of gates, labor in placing machinery for operating gates and for dredging entrance to lock d removing pieces of coffers.

tailed statement of expenses incurred during the fiscal year ending June 30, 1892, out f the appropriation for operating and care of canals and other works of navigation, in perating and keeping in repair the Muskingum Ice Harbor Lock, Ohio.

Month.	Salaries lock-keeper and assistant.	Labor.	Supplies.	Miscellaneous.	Dredging.		Total.
					Salaries.	Towboat.	
mber		$62.25					$62.25
ary		14.70					14.70
uary			$25.00				25.00
h		24.45	2.00				26.45
[illegible]	$55.00						55.00
[illegible]	105.00		14.38	$4.80	$157.65	$180.00	461.83
[illegible]	105.00	102.75					207.75
Total	265.00	204.15	41.38	4.80	157.65	180.00	852.98

ommercial statistics are attached to the report for operating and care of locks dams on the Muskingum River.

D D 14.

IMPROVEMENT OF MUSKINGUM RIVER, OHIO.

his report is limited to work carried on under the appropriation of gust 11, 1888, for the construction of a lock at Taylorsville and the nstruction of the lock at Zanesville, Ohio, of $102,000.

his work was under the immediate supervision of Lieut. Cassius E. ette, Corps of Engineers, U. S. Army, until April 20, 1892. Since t time Mr. Edmund Moeser, assistant engineer, has had immediate ervision of the work.

OPERATIONS FOR THE FISCAL YEAR.

(EXTRACT FROM THE REPORT OF MR. EDMUND MOESER.)

e work of opening out the channel below new Lock No. 9 was completed. There w a well-defined channel running from the lower end of the new lock on the side of the river, downstream, and finally across the river to near the mouth of Creek, 2,000 feet below new Lock No. 9. The excavation extended over a dis- of 800 feet. The bottom of this excavation is on a level 2 feet below the top e lower miter sill of the lock. The remainder of the distance to Salt Creek will ire some dredging.

ring the year 13,443 cubic yards of rock and 10,062 cubic yards of earth were ex- ted, at a cost of 80 cents per yard for rock excavation and 31½ cents per yard for excavation.

e coping of the new lock was repointed, balanced counter weights were added e machinery for operating the cylindrical valves, and the lower gates were ed but are not yet placed.

e balance of the money expended at this place during the year was for plant aterial which are on hand and which are to be used in the construction of a ing crib at the head of the new lock.

the appropriation relating to the re

the vicinity to ascertain the fe
lock in another location.
very dilapidated condition, but
the gates.

for operating and care of locks

Money statement.

	$35, 301.
year	19, 783.
	15, 517.
	370.
	15, 147.

AMS ON MUSKINGUM RIVE

amount and date of all appropri

allotted	$155, 200. 0
1891, allotted.	39, 980. 0
1891, allotted.	1, 200. 0
1891, allotted	12, 241. 5
Total	1, 043, 989. 5

work. The reconstruction
beginning of the fiscal year,
locks Nos. 2 and 5 was com-

completed, and minor repairs
and 10.
sills, where the bottom would
placed at equal depths below
uniform, so that all locks
time, and errors in width and
of the sills at a uniform
the navigable depth of the
be maintained. By raising
high-water line has been

rupted by the closing of
with the opening of

of Lieut. Cassius E. Gil-
20. Since that time
ad immediate super-

...race, leading to the mill below the Ice Harbor Lock, was excavated back of ... wall of the lock and the material thus excavated used in filling the old ...

...all amount of stone fill and about 100 feet of gravel backing is all that is re... to complete this dam.

...and Dam No. 2, Devols.—The repairs at this place were limited to such work as ... be done without making it last longer than the work at other points and thereby ... the opening of through navigation. The project for reconstruction included ...moval of the old foundation timbers under floor of lock chamber, as the lock ... to be founded on rock, making the lower miter sill of stone, and the inser... of mud valves in walls at lower gate recess. After the cofferdams were finished ...watered, investigation developed the fact that the lock was not on rock, but ... on a tough red clay overlying a red rock. Owing to the lateness of the season ...ge of plan was necessary; the lower miter sill was built of timber and the mud ... were omitted. The lock was closed for repairs July 20, 1891, and reopened to ...ation January 22, 1892.

...e following was the work accomplished: Built new upper and lower gates and ... sills; six slide valves were placed in the two lower gates. Put in upper miter ... with filling culverts. Inserted cylindrical filling valves in head of old lock ... Raised 117 feet of lock wall 3.2 feet, to make guard of lock standard height. ... general repairs to face of old lock walls and stopped all leaks with concrete. ... out mud and filled spaces between old foundation timbers with concrete. ... timber floor of lock chamber. A crib breakwater, 9 feet by 9 feet by 180 feet, ... on the bank below the lock in order to break the eddy caused by dam and wall.

...de repairs to dam. The lower apron of the dam had raised, letting out the ... filling; the apron was forced back into place and fastened down with anchor ... 18 feet long. The bolts penetrate the rock underlying the soft foundation of ... for a distance of 6 and 7 feet. The dam was refilled with stone where neces... and the lower apron was sheeted with new timber for a distance of 480 feet. ... complete the repairs at this place the following work remains to be done: To ...ete raising of lock walls, to build a small guiding crib below the river wall, ... iron cover plates over cylindrical valve machinery, and to put in place lock ... and new gate-operating machines. About 170 yards of masonry remains to ...ld.

...k and Dam No. 3, Lowell.—This lock has been open to navigation throughout ... year. The section of needle dam across the head of the lock was operated ... necessary, and the lower end of the canal kept in good navigable condition. ... has not as yet been an opportunity of testing the practicability of keeping ... upper end of the canal clear by this method, but a recent sudden flood in Cats ..., which empties into the canal near the upper end, has put out into the canal ...vy bar of sand and gravel, and a test is to be made on this bar as soon as the

... No. 9 were finished.

Dam No. 8, Eagleport.—At the close of last year the repairs on this lock ...pleted, but the cofferdams had not yet been removed. These were not ... out until the work on the dam was completed, and the lock was not ...ation until November. A dry masonry wall was built connecting the ... the land wall with the high ground, and new gate-operating machines ... in position on the lock walls.

The new dam was pushed as rapidly as the materials could be delivered. ...ly rebuilt, with the exception of a short piece put in last season. The ... new dam was raised 4 feet higher than that of the old dam, in order to ... normal conditions for which new Locks Nos. 8 and 9 were designed. The ... of this dam is expected to cause a deposit at the foot of the dam, and by ... hole immediately below the dam add to its stability.

...y abutment was built at the right end of the dam, and the embankment ... it with the high ground, was raised to the height of the new abutment ...stream slope paved.

Dam No. 9, Taylorsville.—As the new lock at Taylorsville can not be made ...til a draw is placed in the county bridge just below it, all navigation at ... has been through the old lateral canal and lock. In anticipation of the ... the new lock nothing was done to the canal, and the time required for ... of boats at this place has not been shortened.

... at this place must be raised 2 feet to produce the normal conditions for ... Lock No. 9 was designed. If this were done it would be of immediate bene... boats running through the canal and would avoid the necessity of dredg... season. The old dam was extensively repaired and is in good condition.

Dam No. 10, Zanesville.—Minor repairs were made to the dam.

... has been in operation throughout the year. Considerable trouble and ex... incurred by the large amount of mud which accumulates in the chamber ... the gates, rendering them difficult of operation. The middle and upper ... very poor condition. They should be rebuilt at an early day.

BOATS.

...e Malta was in commission seven months. She did good service in removing ...t Locks Nos. 2, 5, 6, 7, and 8, in digging out the canal at McConnelsville ...mpletion of Lock No. 7, and in dredging channel and removing snags and ...arious points between Marietta and Eagleport.

... for new dump scows have been prepared and the timbers for building ...ought and stored at McConnelsville.

...nment steamer Vega was engaged in general towing between Locks Nos.

...g for the dredge was done by the hired steamboat Lizzie Cassel.

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ber was
depth of 2 feet

embankment ju
of the abutment
wall next the ab
Extensive repairs w
dam has been re
and the entire
slope of 1 on 4. T
on that of for
on the floors p
timbers forming
dinal timbers are
discharge of water
the stone filling
To complete the
walls with concre
machines upon th
of the crest to t
Lock and Dam
was the work ye
the land wall a
dam and raise t
ished in August
operating mach
tion. Lock lad
be put in place
In the fall of
the rock below
The 150 feet
slope dam, the
mainder of th
A guiding c
as finished t
Lock and D
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1, 1891, t
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...ham, 10 Wallace, 132. It appears from the evidence that at ...ice of said notice the defendants had no funds with which to ...hange, and that under the statutes of Ohio, they, as commission... ...te levies for bridge purposes at their March or June sessions in ...lf of which would be collectible not before the 20th of December ...ing. It also appears from the evidence that the defendants ap... ...authorizing them to raise the funds with which to make the ...and that their application failed, and the defendants introduced ...to prove that the cost of the required change will exceed the sum ...h, however, is denied by witnesses for the Government. The de... ...the statutes of Ohio, can not expend in constructing, altering, or ...bridge a sum in excess of $10,000 without special authority from the ...or without submitting the same to a vote of the people of the county at ...election, and there was no general election after the service of notice, ...the spring election on the first Monday of April and the State election ...Tuesday after the first Monday of November. The first of these dates ...ly after the notice and the last was after the limit prescribed by the The defendants had no authority in the matter excepting as county com... ...s. They had no bridge fund to draw upon and no authority of law to incur ...ation excepting upon their individual responsibility. It would be mani... ...reasonable to expect them to proceed without the authority of local law ...out money, upon their own responsibility, to incur the expenses involved in the required changes, whether the cost would have been less or more than The notice was not reasonable, and, therefore, if upon no other ground, the ...ust be set aside.

...main question, and that which goes to the root of the matter, is whether ...has the power to confer upon the Secretary of War the authority attempted ...ferred by the act. In accordance with its terms, whenever he has good ...believe that a bridge is an unreasonable obstruction to navigation he is to ...e to the parties owning or controlling the same, after first giving them ...opportunity to be heard, to make such alterations as he may specify, and ...failure or refusal to make the same within a reasonable time they are to ...guilty of a misdemeanor, and the Secretary may direct the institution of ...roceedings. The power of the Secretary depends upon his having adjudged ...ridge is an obstruction and his adjudication is made final and conclusive. ...udicial power. The question is one of fact, or a mixed question of law ...and it can not be determined by a court without a jury unless the defend... ...nts. It was held in Grant *vs.* Raymond, 6 Peters, 242, Chief-Justice Mar... ...uncing the decision, that the Secretary of State of the United States is ...icer in whom, under the Constitution, judicial power can be vested. In ...the Secretary had gone through with the form of reissuing a patent for an ... It is true that there was not then any statute authorizing a reissue.

ent, original or reissued, is only prima facie evidence of an exclusive right in patentee, and it is open to all defenses, including, in the case of a reissued pate those involving an investigation into the question whether there was in fact such inadvertence, accident, or mistake as was requisite to authorize the reiss while here the Secretary of War finds and decides conclusively and finally wheth the bridge is an obstruction, what changes shall be made, and within what tim and the only questions left open to be tried in the criminal prosecution for misde meanor, which he is authorized to set on foot, are whether he has made the finding and decisions, ordered the changes, given the proper notices, and whether the de fendants have complied with his orders.

In this case the bridge was built about 1874 by the board of commissioners of Mu kingum County, by virtue of a grant from the State of Ohio under the act of the le islature of March 25, 1870. The Muskingum River is entirely within the State Ohio. Since 1838 and until the date hereinafter mentioned, it has been under th control of the State through its board of public works, which maintained a sy tem of slack-water navigation until the cession of the river and its improvemen by the State of Ohio to the Federal Government March 21, 1887. Since that time th General Government has caused to be constructed in a dam at the head of the rapi above said bridge, on its west side [illegible] the bridge, an artificial channel. has also raised the locks and dam[illegible] below, thus raising the level of th water above, some 4 feet. These [illegible]s and changes furnished the occasio alleged for requiring the proposed [illegible] the bridge. The right of the State Ohio to erect or authorize bridges [illegible]er which should not interfere with i navigation is conceded, and that su[illegible]ere lawful structures. But it is urge for the Government that they were [illegible]ject to the power of Congress at an time to act upon the subject of t[illegible]tion of the river, and to define wh structures should be regarded as in[illegible]ith that navigation, citing Gilman Philadelphia, 3 Wal., 731. There [illegible]ries of cases decided by the Suprem Court and cited in *United States* v. *Ke*[illegible] *Bridge* (45 Fed. Rep. at page 180), su taining the general proposition as[illegible]ed. But the question to be here d cided is whether Congress could de[illegible]t has undertaken to do, its authorit in the premises to the Secretary of [illegible] conclusion is that it could not. Th reasons for this conclusion are se[illegible]so fully set forth by Judge Shiras i *United States* v. *Keokuk and H. Bridg*[illegible]ove, that it is sufficient to refer to th case, and to express as I do my concu[illegible] the reasoning and conclusions of th opinion therein.

The verdict against the defendants will be set aside, and the judgment of the cou will be that sections 4 and 5 of the river and harbor act of September 19, 1890, upo which the information is based, are unconstitutional, and that the defendants g hence without day.

GEO. R. SAGE,
U. S. District Judge.

MAY 14, 1892.

Muskingum River leases for year ending April 30, 1892.

Location.	Lessee.	Dated.	Expires.
Dam 1, Marietta	Phœnix Mill Company	May 1, 1873	May 1, 190
Dam 2, Devol	Gates & Payne	May 1, 1889	May 1, 190
Dam 3, Lowell	Milton King	Nov. 1, 1889	Nov. 1, 190
Do	F. Wilking & Co	May 1, 1890	May 1, 191
Do	Rechsteiner Brothers	May 1, 1890	May 1, 191
Do	E. W. Sprague	Dec. 2, 1879	Dec. 15, 190
Do	George Rice	Sept. 1, 1889	Sept. 1, 190
Dam 4, Beverly	Robbins Brothers	May 1, 1889	May 1, 190
Do	Stull & Jumper	May 3, 1889	May 3, 190
Do	George S. Worstell	May 1, 1890	May 1, 191
Do	Mary L. Baldwin	May 1, 1890	May 1, 191
Do	D. T. Brown	May 1, 1890	May 1, 191
Do	Isaac D. Spooner	May 1, 1890	May 1, 191
Dam 6, Stockport	Joseph Newberry	May 1, 1889	May 1, 190
Dam 7, McConnelsville	E. M. Stanberry	Sept. 1839	
Dam 8, Duncans Falls	John Miller	Dec. 31, 1836	
Dam 9, Taylorsville	Frazier & Son	Dec. 31, 1836	
Dam 10, Zanesville	John T. Drone	May 1, 1890	May 1, 191
Do	Edward Johnson	May 1, 1890	May 1, 191
Do	do	May 1, 1889	May 1, 190
Do	Joseph Shaw	May 1, 1890	May 1, 191
Do	Muskingum Coffin Company	May 1, 1890	May 1, 191
Do	Gary & McLaughlin	May 1, 1890	May 1, 191
Do	Beaumont & Blankenbuhler	July 1, 1889	July 1, 1909
Symmes Creek	Sarah V. Plummer	Apr. 2, 1889	Apr. 2, 1894

Muskingum River leases for year ending April 30, 1892—Continued.

Lessee.	Subject.	Cubic feet of water per minute.	Annual rental.	Rebate allowed.	Rents collected.
Phœnix Mill Company	Water power.	3,000	$350.00	$257.73	$92.27
Gates & Payne	do	9,000	108.00	32.73	75.27
Milton King*	do	2,600	100.00		
F. Wilking & Co.	do	7,280	174.72		174.72
Bchsteiner Brothers	do	4,446	106.70		106.70
E. W. Sprague	Land		5.00		5.00
George Rice	do		6.00		6.00
Robbins Brothers	Water power	1,904	100.00	4.85	95.15
Stall & Jumper	do	5,293	127.03	6.16	120.88
George S. Worstell	do	5,600	114.24	5.54	108.70
Mary L. Baldwin	do	5,000	100.00	4.85	95.15
D. T. Brown	do	6,500	118.30	5.74	112.56
Isaac D. Spooner	do	4,000	100.00	4.85	95.15
Joseph Newberry	do	6,390	230.04	28.58	201.46
E. M. Stanberry†	do	(‡)			
John Miller†	do	(§)			
Frazier & Son†	do	(§)			
John T. Drone	do	7,560	453.60		453.60
Edward Johnson	do	6,029	361.74		361.74
Do	do	7,399	443.82		443.82
Joseph Shaw‖	do				
Muskingum Coffin Company	do	4,619	207.85		207.86
Gary & McLaughlin	do	4,794	186.97		186.96
Beaumont & Blankenbuhler	do	7,741	278.68		278.68
Sarah V. Plummer¶	Land				
Total					3,221.67

*Lessee insolvent. Water shut off.
†Perpetual free lease of water power.
‡Enough to propel 10 run of 4′ 5″ millstones.
§Enough to propel 15 run of 4½′ millstones.
‖Lease transferred to Muskingum Coffin Company, November 24, 1891.
¶Terms five years in advance.

Estimate for fiscal year ending June 30, 1893.

Lock and Dam No. 1	$1,100
Lock and Dam No. 2	2,270
Lock and Dam No. 3	450
Lock and Dam No. 4	2,145
Lock and Dam No. 5	2,470
Lock and Dam No. 6	1,340
Lock and Dam No. 7	1,615
Lock and Dam No. 8	1,845
Lock and Dam No. 9	7,000
Lock and Dam No. 10	1,000
Rent, fuel, gas, and water	300
Repairs to steamer *Vega*	500
Repairs to quarter boat	500
Operating steamer *Vega* eight months	3,000
Building two new dump scows	3,000
Dredging	9,600
Salaries and wages	12,288
Contingencies	5,000
Total	55,423

... original or reissued. ... grantee, and it is open ... involving an inve... inadvertence, accid... While here the Secretary ... bridge is an obstruc... the only questions ... ...ation, which he is au... decisions, ordered ... ...dants have complie...

In this case the bridg... ...ingum County, by vi... ...ature of March 25, ... Since 1838 and ... ...trol of the State ... ... of slack-water nav... the State of Ohio ... ...eral Government ... ... said bridge, on ... also raised the loc... ...ter above, some 4 ... ...ged for requiring ... to erect or auth... ...gation is conced... the Government ... to act upon ... ...tates should be ... ...delphia, 3 Wal... ...and cited in *U...* ... the general ... whether Co... premises to th... ...s for this co... ... States v. *Kea...* ...and to express ... therein.

... verdict again... ... that sections ... information ... without day.

May 14, 1892.

statement of expenses incurred on Muskingum River, etc.—**Continued.**

LOCK AND DAM No. 1.

Month.	Labor.	Material.	Supplies.	Boat and engine hire.	Total.
	$468.34	$2,248.91	$17.35	$265.56	$3,000.16
	2,452.02	1,814.12	96.42	104.76	4,467.32
	4,192.14	2,213.86	112.08	149.87	6,667.95
	6,480.43	3,179.77	475.45	165.49	10,301.14
	869.99	1,264.08	109.52	90.76	2,334.35
		.46			.46
		13.55			13.55
al	14,462.92	10,734.75	810.82	776.44	26,784.93

LOCK AND DAM No. 2.

Month.	Labor.	Material.	Supplies.	Boat and engine hire.	Total.
	$699.74	$970.69	$6.38	$3.00	$1,679.81
	3,090.01	619.31	42.61	45.00	3,796.93
	3,047.57	1,473.69	143.83	41.50	4,706.59
	2,969.24	1,974.32	42.90	92.83	5,079.29
	1,988.82	1,764.63	45.19	11.50	3,810.14
	1,018.33	480.82	18.40	10.98	1,528.53
	569.95	456.00			1,025.95
	44.30				44.30
	4.80			2.00	6.80
	3.90				3.90
	2.40				2.40
al	13,439.06	7,739.46	299.31	206.81	21,684.64

LOCK AND DAM No. 3.

Month.	Labor.	Material.	Supplies.	Boat and engine hire.	Total.
	$269.70	$657.17	$22.83	$57.00	$1,006.70
	1,305.00	360.26	1.00	38.00	1,704.26
er	2,357.46	1,740.82	7.60	50.00	4,155.88
	2,368.14	1,130.08	13.01	47.16	3,558.39
er	555.10	344.36		37.00	936.46
r		30.00		16.67	46.67
	3.60		.60		4.20
	3.15				3.15
tal	6,862.15	4,262.69	45.04	245.83	11,415.71

LOCK AND DAM No. 4.

Month.	Labor.	Material.	Supplies.	Boat and engine hire.	Total.
	$2,550.08	$1,334.64	$15.65	$174.16	$4,074.53
	2,390.11	26.45	1.85	30.00	2,448.41
er	1,655.92	128.64	.50	20.00	1,805.06
	479.57	19.70	.12	13.33	512.72
er		.35	4.50		4.85
er	56.30				56.30
	20.25				20.25
tal	7,152.23	1,509.78	22.62	237.49	8,922.12

LOCK AND DAM No. 5.

Month.	Labor.	Material.	Supplies.	Boat and engine hire.	Total.
		$44.50			$44.50
	$1,030.75	101.56	$3.76		1,136.07
ber	3,566.28	771.06	22.77	$85.00	4,445.11
	3,570.36	1,911.77	6.54	117.00	5,605.67
ber	4,182.65	1,019.21	217.36	85.00	5,504.22
	1,672.11	1,104.40	33.20	5.00	2,814.71
	886.83	56.09			942.92
	628.05	269.75	13.70		911.50
	1,029.21	384.68	21.39	8.00	1,443.28
	237.00			6.00	243.00
	16,803.24	5,663.02	318.72	306.00	23,090.98

Detailed statement of expenses incurred on Muskingum River under the appropriation for operating and care of canals and other works of navigation, for the fiscal year ending June 30, 1892.

GENERAL ADMINISTRATION.

Month.	Salaries.		Plant.	
	Office force.	Lock-keepers, bridge-tender and watchman.	First cost.	Repairs.
July	$530.00	$504.00	$517.16	$149.44
August	530.00	449.00	332.79	128.72
September	530.00	449.00	1,412.31	135.13
October	530.00	414.17	118.45	128.51
November		504.00	307.97	10.86
December		406.50	.95	
January	150.00	534.00	2.80	
February	410.00	579.00	107.28	
March	380.00	579.00	.50	2.20
April		524.00	2.10	.50
May		524.00		
June	380.00	449.00		
Total	3,440.00	5,915.67	2,802.31	553.36

Month.	Buildings.	Supplies.	Transportation.	Miscellaneous.	Total.
July	$74.08	$152.85	$127.01	$302.57	$2,337.11
August		30.73	11.25	72.53	1,553.02
September		42.34	10.25	127.71	2,708.74
October		49.40	10.80	128.66	1,370.99
November		5.54	13.15	109.18	959.70
December		8.58	.60	105.41	522.04
January		7.99	.50	41.28	736.57
February			14.60	110.68	1,221.56
March		34.18	.25	72.15	1,068.26
April		20.95	.25	50.51	596.31
May		1.00		33.18	558.18
June		1.20			830.20
Total	74.08	354.76	188.66	1,153.86	14,482.70

UNITED STATES DREDGE MALTA.

Month.	Salaries.	Equipment.	Supplies.	Repairs.	Towboat.	Total.
July	$532.10	$126.74	$185.51	$125.96	$1,220.00	$2,190.31
August	535.45	34.10	64.80	8.96	620.00	1,263.31
September	599.45	6.30	47.90		600.00	1,253.65
October	604.75		9.45	80.21	620.00	1,314.41
November	550.25		38.36	57.90	600.00	1,246.51
April	481.77		84.00		460.00	1,023.77
May	239.47		25.00		240.00	504.47
June	112.00		2.50			114.50
Total	3,655.24	167.14	457.52	273.03	4,360.00	8,912.93

UNITED STATES STEAMER VEGA.

Month.	Salaries.	Equipment.	Supplies.	Repairs.	Total.
July	$354.55		$52.44	$19.05	$426.04
August	355.00	$0.50	30.75	21.60	407.85
September	352.50	8.30	3.90		364.[illegible]
October	355.50		.54		35[illegible]
November	352.50		68.45	2.73	[illegible]
December			1.50	2.00	
January			1.10		
Total	1,770.05	8.80	158.68		

Detailed statement of expenses incurred on Muskingum River, etc.—Continued

LOCK AND DAM No. 6.

Month.	Labor.	Material.	Supplies.	Boat and engine hire.	T
July	$4,568.55	$3,405.89	$130.38	$244.00	$8
August	4,339.92	3,164.15	5.81	72.50	7
September	2,372.62	1,783.86	7.44	55.00	4
October	2,329.20	953.55	28.20		3
November	2,347.40	370.71	28.70	30.00	2
December	27.75	32.00			
January	14.70	348.26			
February	5.40				
March	4.95				
April	436.50	222.50			
May	18.70				
Total	16,465.69	10,280.92	200.53	401.50	27

LOCK AND DAM No. 7.

Month.	Labor.	Material.	Supplies.	Boat and engine hire.	T
July	$2,626.83	$3,492.54	$97.76	$69.25	$6
August	2,540.77	2,125.67	44.44	82.50	4
September	3,967.27	2,200.60		45.00	6
October	6,117.47	2,588.95	87.54	15.00	8
November	3,031.80	931.71	.67	17.00	3
December	939.95	665.95		20.00	1
January	149.94	347.76			
February	169.00				
March	102.50				
April	84.60	222.75			
May	49.05	8.36			
June	8.40				
Total	19,787.58	12,584.29	230.41	248.75	32,

LOCK AND DAM No. 8.

Month.	Labor.	Material.	Supplies.	Boat and engine hire.	T
July	$3,410.45	$3,209.29	$39.33	$201.67	$6,
August	3,469.30	3,177.85	54.13	87.25	6,
September	4,040.93	3,454.80		367.50	7,
October	3,749.10	2,278.10		498.05	6,
November	2,547.33	600.12		266.50	3,
December	318.52	220.75		31.00	
January	24.00	235.52			
February	32.57				
March	5.10	49.57			
June	2.55	1.56			
Total	17,599.85	13,227.55	93.46	1,451.97	32,

LOCK AND DAM No. 9.

Month.	Labor.	Material.	Supplies.	Boat and engine hire.	T
July		$2.00			
August		13.32			
September	$440.55	532.37			
October	914.77	433.16	$1.35		1,
November	40.50	2.20			
May		212.73			
Total	1,395.82	1,195.78	1.35		2,

LOCK AND DAM No. 10.

Month.	Labor.	Material.	Supplies.	Boat and engine hire.	T
July	$50.92	$3.00	$1.75	$147.00	$
August	401.02	13.46			
September	496.90	630.33			1,
October	159.15	221.33			
November	50.25	1.89	2.20		
December	1.40	10.72			
February	15.90				
March	22.95	1.00			
April	4.80				
June	28.95				
Total	1,232.24	881.73	3.95	147.00	2,

SUMMARY.

General administration	$14,482.70
United States dredge Malta	8,912.93
United States steamer Vega	1,982.91
Lock and Dam No. 1	26,784.93
Lock and Dam No. 2	21,684.64
Lock and Dam No. 3	11,415.71
Lock and Dam No. 4	8,922.12
Lock and Dam No. 5	23,090.98
Lock and Dam No. 6	$27,348.64
Lock and Dam No. 7	32,851.03
Lock and Dam No. 8	32,372.83
Lock and Dam No. 9	2,592.95
Lock and Dam No. 10	2,264.92
Total	214,707.29

Detailed statement and cost of dredging on the Muskingum River under the appropriation for operating and care of canals and other works of navigation, for the fiscal year ending June 30, 1892, to wit:

UNITED STATES DREDGE MALTA.

Date.	Locality.	Materials excavated.	Total cost.
July	Bear Creek	Gravel, ... at 18 cents	$1,005.30
	Luke Chute	Gravel, ... at 15 cents	1,185.00
August	Stones Ripple	Gravel, ... 18 cents	63.32
	Baldwins Ripple	Gravel, ... at 15 cents	1,200.00
September	Silver Heels	Gravel, ... at 17 cents	955.65
	....do	Stone, 1 ...	228.00
	....do	Snags, ...	70.00
October	Stockport	Gravel, ... ic yards, at 17 cents	1,249.41
	....do	Stone, 1 ...	30.00
	....do	Snags, ...	15.00
	....do	Piling, ...	20.00
November	....do	Cofferd...	100.00
	McConnelsville	Stone, 1 ...	20.00
	....do	Gravel, ... ds, at 24 cents	1,126.51
April	Eagleport	Piling, ...	35.00
	McConnelsville	Piling, ...	10.00
	....do	Gravel, ... ubic yards, at 9 cents	900.77
	....do	Cofferd...	80.00
May	Stockport	Cofferd...	40.00
	Luke Chute	Cofferdam, ... at $1	80.00
	....do	Gravel, sand, and mud, 480 cubic yards, at 15 cents	72.00
	....do	Wrecked barge, 1, at $20	20.00
	Devol	Gravel, sand, and mud, 1,600 cubic yards, at 11⅞ cents	190.00
	....do	Cofferdam, 40 linear feet, at $1	40.00
	Marietta	Gravel, sand, and mud, 316½ cubic yards, at 15 cents	47.47
	....do	Piling, 3 at $5	15.00
June			114.50
		Total	8,912.93

Commerce of Muskingum River during the fiscal year ending June 30, 1892.

LOCK NO. 1.

Month.	Steamboats.	Barges.	Miscellaneous.	Total.	Number of lockages.
December	2	2	6	10	10
February	1	11	13	25	25
March	5	8	7	20	20
April	58	17	66	141	141
May	54	10	31	95	95
June	81	13	41	135	115
Total	201	61	164	426	406

LOCK NO. 2.

	8	12	4	24	24
...ary	37	11	4	52	48
...h	54	8	6	68	66
...il	54	9	2	65	64
	69	17	5	91	91
	82	23	7	112	112
Total	304	80	28	412	405

uskingum River during the fiscal year ending June 30, 1892—Continued.

LOCK No. 8.

Month.	Steamboats.	Barges.	Miscellaneous.	Total.	Number of lockages.
	60	....	2	62	62
	26	....	1	27	27
	62	4	....	66	64
	11	....	....	11	11
	30	....	....	30	30
	85	6	4	95	90
	85	7	1	93	93
	77	1	4	82	82
	98	2	6	106	106
l	534	20	18	572	565

LOCK No. 9.

	....	1	7	8	7
	1	....	6	7	7
r	1	7	2	10	10
	50	14	2	66	66
r	52	1	3	56	56
	62	5	4	71	68
	13	....	....	13	13
	30	....	....	30	30
	86	2	2	90	88
	81	9	5	95	92
	78	11	....	89	85
	108	14	7	129	122
al	562	64	38	664	644

LOCK No. 10.

	54	....	....	54	54
	54	....	....	54	54
r	54	5	....	59	54
	54	3	1	58	56
r	48	4	2	54	49
r	64	3	....	67	64
	12	....	....	12	12
	48	....	....	48	48
	80	1	....	81	81
	76	....	....	76	76
	76	2	....	78	78
	101	3	....	104	104
tal	721	21	3	745	730

SUMMARY.

	Steamboats.	Barges.	Miscellaneous.	Total.	Number of lockages.
—					
	201	61	164	426	406
	304	80	28	412	405
	402	136	22	560	495
	239	188	21	448	334
	110	32	10	152	125
	102	28	14	144	136
	165	41	19	225	201
	534	20	18	572	565
	562	64	38	664	644
	721	21	3	745	730
	3,340	671	337	4,348	4,041

'ommerce of Muskingum River during the fiscal year ending June 30,

LOCK NO. 3.

Month.	Steam-boats.	Barges.	Mis lane
July	28	24	
August	32	30	
September	22	17	
October	11	7	
November	15	8	.....
December	....	....	
February	36	5	
March	54	9	.....
April	54	7	
May	65	13	
June	85	16	
Total	402	136	

LOCK NO. 4.

July	46	44	
August	28	20	
September	13	26	.....
October	14	29	.....
November	20	18	
December	....	3	....
February	12	4	
March	14	10	
April	20	9	
May	31	11	
June	41	14	
Total	239	188	

LOCK No. 5.

July	18	10
August	19	8
May	31	6
June	42	8
Total	110	3[illegible]

LOCK No. 6.

October	10
November	....
December	8
April	9
May	32
June	43
Total	102

LOCK No. 7.

	20

VER, IN-
ERATING
KY.

OF ENGI-
DING JUNE
RKS.

and Illinois.

OFFICE,
July 9, 1892.

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and on the im-
Indiana Chute,
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YDECKER,
of Engineers.

AT LOUISVILLE, KEN-

propriation are designed
Falls of the Ohio via the
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ely above the locks at the

List showing amount of principal items of freight and the number of passengers carried on the Muskingum River between July 1, 1891, and June 30, 1892.

Articles.	Amount.	Articles.	Amount.
Passengers .... number..	31,368	Wool .... tons..	7[illegible]
General merchandise .... tons..	6,000	Lumber .... do...	7,200
Coal .... do...	3,345	Brick .... do...	165[illegible]
Live stock .... do...	245	Hay .... do...	4,[illegible]
Oil .... do...	7,121	Salt .... do...	[illegible]
Wheat .... do...	621[illegible]	Potatoes .... do...	12[illegible]
Corn .... do...	1,174[illegible]		

The above statement of the commerce of the Muskingum River is complete, but is only for part of the fiscal year, as the locks were shut off for repairs and there was no through navigation until May 6, 1892.

lower end, in such manner as to form capacious basins, or harbors, at those points.

The project for the enlargement at the head of the canal was inaugurated in 1883, and modified in 1890, as recommended in the report of the Board of Engineers, dated January 28, 1890. The general width of the canal before enlargement was 90 feet; when the work is completed, as shown on the sketch submitted herewith, the width for a length of 2,400 feet will be from 210 to 325 feet; immediately to the eastward of this enlargement of the canal proper a basin about 800 feet wide and 2,200 feet long will be constructed, which will be closed by a bear-trap structure 800 feet long on the west and by a concrete dam 2,800 feet long on the north. The execution of this project requires, as its principal features, the excavation of about 325,670 cubic yards of solid rock and 270,000 cubic yards of earth; the construction of about 5,200 linear feet of new canal wall and masonry dams, containing in all about 26,000 cubic yards of masonry, and the removal of about 6,200 linear feet of old canal wall, dikes, and timber dams.

The work completed prior to June 30, 1891, comprised 124,027 cubic yards of rock excavation, 197,769 cubic yards earth excavation, and 10,307 cubic yards of masonry in new canal wall.

Operations for the past fiscal year were commenced July 21, 1891, when the river had fallen to a stage sufficiently low to permit the area of excavation to be cleared of water, by pumping and the erection of temporary dam, and the active work of excavation was begun July 26. It was continued until November 23, with a temporary suspension from August 28 to September 7 on account of high water. Up to August 28 the work was carried on by day only, but after resuming in September a night force was also organized, and was continued during the remainder of the working season. No masonry was laid on this portion of the work during the year, operations being limited to earth and rock excavation; but preparations for completing the new canal wall during the ensuing season were commenced June 15, 1892. The amounts excavated during the year were 15,299 cubic yards earth and 42,856 cubic yards rock, an average of 650 cubic yards daily during the working period. A considerable portion of the area remaining to be excavated has been drilled ready for blasting.

For blasting the rock in place 9,624 holes, aggregating 49,642 feet in length, and 18,362 block holes, aggregating 13,772 feet, for breaking the blasted rock, were drilled during the season; 29,567 pounds of dynamite and 875 pounds of black powder were used for blasting.

The total work done to June 30, 1892, is as follows: Earth excavation, 213,068 cubic yards; rock excavation, 166,882 cubic yards; masonry in canal wall, 10,307.5 cubic yards.

The principal items of work remaining to be done to complete the improvement is, approximately, as follows: Rock excavation, 158,787 cubic yards; earth excavation, 53,000 cubic yards; masonry, 16,000 cubic yards, and the removal of about 6,200 linear feet of old wall, dikes, and dams.

The other portion of the improvement, viz, the canal enlargement above the locks, has been carried on in accordance with the project authorized in the Annual Report of the Chief of Engineers for 1887, the purpose being to construct at that point a basin wherein boats may lie and tows may be properly formed, before or after passing the locks without interfering with navigation through the canal. The work approximately estimated as necessary to this end was the excavation of about 124,000 cubic yards of earth, 13,000 cubic yards of rock, the con struction of about 5,200 cubic yards of masonry wall, and the removal of 1,050 feet of old canal wall on the north side. The result will be a basin at the lower end of the canal 1,500 feet long, with a width varying from 210 to 250 feet.

At the close of the fiscal year ending June 30, 1891, there had been excavated 133,617 cubic yards of earth, 14,581 cubic yards of rock, and 1,908 cubic yards of masonry had been laid in the new wall.

Operations for the fiscal year just closed were commenced early in July, 1891, and carried on with but little interruption until November 20, when high water and cold weather caused a suspension for the winter; they were resumed May 14, 1892, and continued until June 7, when temporarily suspended because of lack of available funds. Progress was in the highest degree satisfactory, and for this fact great credit is due to the energy and skill of the assistant engineer, Mr. R. R. Jones, in immediate char[illegible]; for it was through his exceptional capacity that the work receiv[illegible] the full benefit of an unusually favorable season. He is entitled t[illegible] this official recognition of his valuable services.

The results accomplished du[illegible]g the year were 11,760 cubic yards of earth excavated, 3,364.6 cubic [illegible]ls of rock excavated, and 3,704.7 cubic yards of masonry placed in ne[illegible] wall, besides 195 cubic yards of temporary dry stone wall laid. I[illegible]ddition about 1,570 cubic yards of rock were removed from the old ca[illegible] wall.

But little work is required t[illegible] complete this portion of the improvement, being the removal of wh[illegible]emains of the old canal wall, the excavation of the underlying r[illegible] and the construction of a length of about 50 feet of the new canal [illegible]. It is anticipated that all this will readily be accomplished during the ensuing working season.

The amount expended under appropriations for improving the Falls of the Ohio River at Louisville, Ky., to June 30, 1892, was $619,079.43, of which sum $152,225.60 was expended during the past fiscal year, including liabilities outstanding July 1, 1892. The estimated cost of completing the improvements contemplated by the present project is $610,008.89.

The following statistics of traffic and commerce indicate the extensive river tonnage directly interested in the substantial and complete improvement of the Falls of the Ohio. They show a traffic of 7,939 boats passing this point during the past fiscal year, carrying 2,172,661 tons of freight. The annual average for the past eleven years is 7,025 boats, with about 2,500,000 tons of freight. Of coal alone the amount passing the falls to points below during the past six years has averaged 1,731,308 tons annually.

Statement of vessels passing Falls of the Ohio River via Louisville and Portland Canal and Indiana Chute, June 30, 1882, to June 30, 1892.

Kinds of vessels.	1882–'92.		1892.		Total for 11 years.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
Passenger boats	11,156	4,506,402	949	425,746	12,105	4,932,148
Tow boats	11,476	1,510,731	1,477	198,218	12,953	1,708,949
Government boats	1,107	76,536	143	12,522	1,250	89,058
[illegible]l boats and barges	43,287	14,202,133	5,162	1,811,723	48,449	16,013,856
[illegible]ll craft	2,251	....	201	....	2,452	....
[illegible]ts	54	....	7	....	61	....
[illegible]	69,331	20,295,802	7,939	2,448,209	77,270	22,744,011

[illegible] past 11 years: Boats, 7,025; tons, 2,067,638.

Statement of commerce passing the Falls of the Ohio River via Louisville and Port Canal and Indiana Chute, from June 30, 1887, to June 30, 1892.

Articles.	From 1887 to 1891.	From 1891 to 1892.	Total six ye
	Tons.	*Tons.*	*Ton*
Coal	8,672,543	1,715,308	10,38
Salt	63,091	8,532	7
Oil	44,823	2,839	4
Whisky	12,869	1,904	1
Tobacco	56,021	4,329	6
Cotton	66,193	10,068	7
Lumber	2,838,793	69,709	2,90
Corn and wheat	42,834	18,529	6
Iron ore	254,516	16,383	27
Iron	20,229	111,776	13
Steel rails	205,005	46,675	25
Produce	33,412	9,736	4
Hay and straw	118,457	6,375	12
Flour	8,639	1,013	[illegible]
Stock	42,347	5,890	4
Sugar and molasses	42,114	7,280	4
Staves and shingles	215,537	3,722	21
Peanuts	982	....	
Malt	695	....	
Cement	9,549	8,025	1
Miscellaneous	297,407	125,073	42
Total	13,046,056	2,172,661	15,21

Annual average during past six years, 2,536,453 tons.

Reports of R. R. Jones and G. W. Shaw, assistant engineers, c taining details of operations in their respective charges, are herew submitted.

Money statement.

July 1, 1891, balance unexpended	$193,14
June 30, 1892, amount expended during fiscal year	148,18
July 1, 1892, balance unexpended	44,96
July 1, 1892, outstanding liabilities	4,04
July 1, 1892, balance available	40,92
Amount appropriated by act approved July 13, 1892	60,00
Amount available for fiscal year ending June 30, 1893	**100,92**

Amount (estimated) required for completion of existing project 550,00
Amount that can be profitably expended in fiscal year ending June 30, 1894 300,00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

REPORT OF MR. R. R. JONES, ASSISTANT ENGINEER.

LOUISVILLE, KY., *June 30, 189*

COLONEL: I have the honor to submit the following report of operations for proving Falls of Ohio River at Louisville, Ky., enlarging canal basin at hea locks, for the fiscal year ending June 30, 1892:

IMPROVING FALLS OF OHIO RIVER, ENLARGEMENT OF BASIN.

Cofferdam at dry dock, pier, etc.—A cofferdam was constructed parallel to about 30 feet distant from the old pier, separating dry dock from canal. This d was 16 feet high and about 400 feet in length, and behind this protection the c struction of wall between dry dock and basin was carried on.

The excavation of material was carried on from the pit until November 20, the rial being removed on cars by the hoisting engine and incline and by carts. The ter were used only toward the close of the season's work for removal of part of outside bank, under the protection of which the work had been heretofore carried . The pit was allowed to fill November 20, and after that the regular canal dredges re employed, whenever the stage of water permitted, in the removal of old wall l the earth backing behind same.

Excavation.—The following material has been excavated from the commencement he work to the close of the present fiscal year: Earth, 141,593 cubic yards; rock, 744.6 cubic yards; total, 159,337.6 cubic yards.

f this total of 159,337.6 cubic yards there were excavated during the fiscal year: th, 11,760 cubic yards; rock, 3,364.6 cubic yards; total, 15,124.6 cubic yards.

he removal of what remains of the old canal wall will be done with dredges. The k under the wall will be blasted under water and also removed with dredges.

New canal wall.—The work of building new canal wall was carried on during the son of 1891 up to November 2, and was resumed May 14, 1892, and carried on at rvals whenever the stage of water permitted up to June 7, 1892.

uring the season of 1891 the work was conducted in the pit by means of derricks l traveling crane.

n 1892 the work was done by means of a derrick boat, as the old canal wall was that time partly removed.

he wall is now completed excepting the short curve joining the new wall to pier d of new locks. This will be done under the protection of a small cofferdam to constructed as soon as the water falls sufficiently.

he total quantity of masonry laid from the commencement of work to the close iscal year was:

	Cubic yards.
ncrete foundation	169.20
sonry	5,443.98
y wall	194.20
Total	5,807.38

)f the total quantity of masonry reported—viz, about 5,807.38—there was laid ring the fiscal year ending June 30, 1892:

	Cubic yards.
ncrete foundation	61.00
sonry	3,643.68
y wall	194.20
Total	3,898.88

The facilities for handling and laying stone, more particularly the traveler used construction of double wall between dry dock and basin, proved admirable. The ne used in construction of this wall weighed from 8,500 to 10,000 pounds, the aders being 10 feet long, and they were handled quickly and securely.

EXCAVATION FOR NEW CANAL WALL AT HEAD OF CANAL.

Much preparatory work was done in the way of laying railroad tracks, bridging e outlet to new portion of canal, and building earth embankments to protect the cavation.

Work was commenced June 15, 1892, the water then for the first time being low nough to permit the prosecution of the work described.

The material excavated was as follows:

	Cubic yards.
arth	1,424
oose rock	107
Total	1,531

This work was mostly done in the neighborhood of the Fourteenth Street Railroad bridge, and was for the purpose of connecting the end of the new canal wall as now uilt with the old canal wall, about 705 feet west and south of the north drawpiers of he bridge in question.

Very respectfully, your obedient servant,

R. R. JONES,
Assistant Engineer.

Lieut. Col. G. J. LYDECKER,
Corps of Engineers, U. S. A.

REPORT OF MR. G. W. SHAW, ASSISTANT ENGINEER.

LOUISVILLE, KY., *June 30, 18*

COLONEL: I have the honor to submit the following report of operations on proving falls of the Ohio River at Louisville, Ky., enlarging the head of the Lo ville and Portland Canal for the fiscal year ending June 30, 1892.

The work of enlarging the head of the Louisville and Portland Canal was be in 1885, and was let by contract in three sections. Section 1 was complete November, 1886, and the contracts for sections 2 and 3 expired December 31, The work has since been carried on with hired labor, and that of last season dire mainly to finishing sections 2 and 3. Work on section 4, an additional area n of section 3, was commenced during the last season. The material removed sisted principally of solid rock, ranging from 3 to 6 feet deep, the grade being of the canal bottom.

There was also removed a considerable quantity of earth, mud, and deposit w accumulates during high water.

The season of 1891–'92 was particularly favorable for work, excavation having carried on for ninety days. Preparations for beginning work were completed ear July, but high water interfered with pumping until July 21. Steam drills put in operation on the 26th and excavation commenced on the 27th of July. A in the river suspended general work from August 28 to September 7. Excava was resumed on the latter date and continued until November 23 at noon, at w time the river flooded the inclosure and work was suspended for the season.

It is estimated that the following quantities were excavated and removed du the season: Earth, mud, loose rock, etc., 15,299 cubic yards; solid rock (meas in place), 42,855.49 cubic yards.

Beginning with September 14 an additional force of men was employed at ni The inclosure was illuminated with gasoline torches and the excavated mat loaded into dump cars. It is estimated that the night force excavated and lo into cars 8,448 cubic yards of solid rock, which was removed by 632 trains, rying 11,882 cars, averaging about seven-tenths of a cubic yard per car, measur place.

Two 12-inch centrifugal pumps were used in pumping out the excavated area, leakage through the guiding dike and old canal wall was controlled by tempo earth dams, which carried the water around the edge of the inclosure into the r north of the improvement. The upper part of the guiding dike was repaired paved with stone taken from the excavated material.

The following statement shows approximately the work done to June 30, 1 Earth excavation, 213,068.06 cubic yards, of which 15,299 cubic yards were rem in the season 1891–'92; rock excavation, 166,882.40 cubic yards, of which 42,85 cubic yards were removed in season 1891–'92; masonry in new canal wall laid to of fiscal year, 10,307.56 cubic yards.

There remains to be done the following: Earth excavation, 53,000 cubic ya rock excavation, 158,787 cubic yards; masonry in canal wall, 6,013 cubic yards moving old canal wall, 7,500 cubic yards; removing part of dam and guiding d 2,900 linear feet; building concrete dam, 4,822 cubic yards; building bear-trap st ture, 800 linear feet; slope revetment and wall on south side of the canal b Tenth street, 2,300 cubic yards; and the construction of 4 guide piers or cribs a the north line of the improvement above Tenth street.

Herewith is submitted a sketch showing progress of work to June 30, 1892.

Very respectfully, your obedient servant,

GRANVILLE W. SHAW,
Assistant Engine

Lieut. Col. G. J. LYDECKER,
Corps of Engineers, U. S. A.

E E 2.

IMPROVEMENT OF INDIANA CHUTE, FALLS OF THE OHIO RIVER

The Indiana Chute is the main river channel over the Falls of Ohio; originally very crooked, filled with dangerous rocky points j jecting from the sides and bottom and with swift changing curre it was available for navigation by skilled pilots only when the river above a stage of about 11 feet on the gauge of the Louisville and P land Canal. Prior to 1890 some work had been done towards its provement by blasting out the most dangerous points whereby of navigation was increased, but the channel was not thereby available for heavy traffic at stages of water materially lower hat stated above. On the 28th of January, 1890, a project, hav- its object the radical improvement of the channel so as to make navigable at all stages above 8 feet on the canal gauge, was ended by a Board of Engineers after close study of the ques- d this project was approved by the Chief of Engineers, Jan- , 1890. (See Report of Chief of Engineers for 1890, pages 2217 It contemplates the better concentration in this channel of ssing the falls by the erection of guiding dikes and the ex- of rock within the limits of proposed channel to a designated he improved channel is designed to have a least width of 400 h a clear depth of not less than 8 feet at its lowest navigable The principal items of work in the execution of this project are vation of about 60,000 cubic yards of solid rock, the construc- bout 3,700 linear feet of stone dikes, and of a concrete wall long. The project contemplates, ultimately, some modifica- he present system of dams at the head of the falls when these e replaced by permanent structures, but the details of such tion have not yet been decided.

tions during the past year were limited to raising the old dike—575 feet long on the north side of the chute at its en- -2 feet, the first 50 feet constituting the pier head being raised gher, or 11 feet in all; the cross dam, connecting this dike with iana shore, was rebuilt above the water line, and some minor were made to the balance of the cross dam. About 72,900 feet f oak timber and 344 cubic yards stone filling were applied to pairs. The stage of water did not permit any rock excavation, e appliances available, until October 5, when the work was iced by hand-drilling; on the 9th the steam-drilling scow be- to the Louisville and Portland Canal was put on the work, and ons were continued until November 17, when a rise in the river ed a suspension for the season. The results accomplished during rt period were 3,163 holes, aggregating 6,474 linear feet, drilled l; 673 holes, aggregating 2,592 linear feet drilled by steam drills; g out in all about 1,474 cubic yards of rock, using for this pur- 825 pounds dynamite. This is the only work so far done in g out the present project, no suitable plant for the work in view been procured, while all operations have been restricted to short of dead low water, and to the primitive and expensive method l-drilling. It is proposed to procure proper machinery for carry- the work in the future, and make provision for operations during nary low water, at least.

relief which this improvement is designed to afford the heavy e—especially of coal—passing the falls, is a matter of high im- e. A coal tow in reaching this point frequently contains twelve n boats and barges carrying about 320,000 bushels (about 1,216 f coal, bound for points on the Ohio and Mississippi between here w Orleans; under existing conditions these tows, when unable to d the Indiana Chute, must be broken on arrival at this point, through the Louisville and Portland Canal and locks in sections, en again consolidated before continuing their journey to desti- ; all this imposes great delay and expense on this traffic, and not uently it happens that, when a rise in the river has brought nu- tows down to this point, the later arrivals after finally passing ks find the river too low to continue their journey, and are com- to lie over indefinitely, sometimes for an entire season. An im-

... gate such a condition of affairs is ... having been undertaken, it should be ... as possible.

... this report and the report in relation ... Canal show that during the past year ... the Falls of the Ohio, of which 1,232,998 tons ... incident to transit through the canal. With ... ment now under consideration it is highly ... most a very insignificant percentage, of the ... to any such delay, while general traffic ... relieved from the blockade frequently ... The total traffic through the canal ... boats, carrying 1,620,586 tons of ... via the Indiana Chute included 1,91... total passing by canal and river ... freight. The average for the past ... with 2,067,638 tons of freight.

... by the Board of Engineers ... available for the purpose was ... by the river and harbor act ... $25,000, a total to June 30, ... on the present project to ... amount estimated below for the ... on the idea that the river and ... will appropriate for the work ... appropriation be not made the ... increased in order that the ...

... given below, and the report ... charge of this improve-

...	$48,885.20
...	21,361.44
...	27,523.76
...	14.63
...	27,509.13
...	35,000.00
...	62,509.13
... project	57,249.53
... June 30, 1894	60,000.00
... of river and	

... ENGINEER.

... KY., *June 30, 1893.*

... of operations on im- ... year ending June 30,

... the guiding dike at the ... Right Hand Reef. Fifty ... to Ref. 51 to serve as a ... the dike, $524\frac{?}{?}$ feet, was

... storehouse at the locks, the

work of raising the dike began on September 21, 1891. In removing the old decking for the guide pier it was found that the timbers above low water were rotten, and new material was substituted. In the remainder of the dike the new timbers were placed on top of the old structure, care being taken to remove such as were found to be defective. Corrections in alignment were made and the new work filled with stone taken from the vicinity and from the excavation on Right Hand Reef. The upper end of the guide-pier was covered with three-eighths inch boiler iron as a protection against ice and drift. The work on the dike was completed on November 19.

Repairs to the cross dam and abutments consisted in replacing defective timbers and decking; in rebuilding the south abutment of the middle chute, and placing therein new clutches for the movable dam; in the construction of a crib abutment at the end of the dam, north of the Indiana Chute, and in rebuilding that portion of the cross dam immediately north of the Indiana Chute.

Excavation in the chute was directed to the right-hand reef and to some projections near the lower end of the guiding dike. On October 2, the river having fallen to a working stage, a breakwater was placed at the lower end of the guiding dike and hand drilling was begun on the 5th. On the 9th the drill boat belonging to the canal was placed in the chute near the lower end of the reef and the boiler utilized for drilling by steam. Steam drilling was continued until the 29th, at which time all the exposed portions of the reef had been drilled. Blasting on this part of the reef was commenced on October 11 and continued until November 17, on which date a rise in the river compelled a suspension of work for the season. Material removed from the reef was piled north of the line of improvement, and it is proposed to utilize part of it in the new wall which is to extend from the bridge eastwardly along the north line of improvement. During the season there were drilled 3,836 holes, ranging from 1 to 5 feet deep. It is estimated that 2,513 cubic yards of solid rock were blasted, of which 763 were removed. Tools and appliances were stored at the locks at the end of the season.

Very respectfully, your obedient servant,

GRANVILLE W. SHAW,
Assistant Engineer.

Lieut. Col. G. J. LYDECKER,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

Statement of vessels passing Falls of the Ohio River, via Indiana Chute, for fiscal year ending June 30, 1892.

Kind of vessel.	No.	Tonnage.
Passenger boats	344	177,286
Towboats	469	75,574
Square barges	1,024	582,572
Model barges	73	58,400
Total	1,910	893,832

Days navigable: Ascending, 51; descending, 285.

Statement of commerce passing Falls of the Ohio River, via Indiana Chute, for fiscal year ending June 30, 1892.

Articles.	Tons.	Articles.	Tons.
Coal	482,310	Iron	7,366
Salt	1,084	Miscellaneous	25,240
Oil	750	Produce	517
Whisky	315	Flour	169
cco	579	Sugar and molasses	519
n.	1,509	Hay and straw	710
er	2,521	Live stock	648
[illegible]	831	Staves and shingles	3,722
at.	236	Total	552,125
ore	3,517		
l rails	19,582		

ber of passengers, 7,248.

... promises ...
... assistance, an...
pushed to completion as so...

The statistics accompa... to the Louisville and Por... tons of coal pass... were subject to the delay... the completion of the im... probable that none, or ... coal traffic would be ... through the canal wo... tablished by the large... during the past year ... freight; that passing ... boats with 552,125 t... 7,939 boats, with 2,1... eleven years is annu...

The estimated co... was $138,610.97; ... $23,885.20, and th... approved Septem... 1892, of $48,885.2... June 30, 1892, w... year ending Jun... harbor bill nov... $35,000. If it s... estimate for 18... improvement n...

A statement ... of G. W. Shaw... ment, is appe...

July 1, 1891, ...
June 30, 1892, ...

July 1, 1892, ...
July 1, 1892, ...

July 1, 1892, ...
Amount app...

Amount av...

Amount ...
Amount ...
Submitted ...
... harbor ...

CONST...

...henever opportunity offered. Its object is to secure ... damage by striking against projecting points that ...ft in the lower courses of the canal wall and on the ...erlying rock. This work should be continued until all ...s have been removed.

NEW MACHINE SHOP.

...vening of February 12, 1892, the old frame building which ... the engine and boiler house and machine shop was totally ... by fire, the cause of which remains a complete mystery. ...struction, as a fireproof structure, was immediately under... ...d at the close of the fiscal year had been nearly completed. ...lls of the new structure are of stone masonry and the roof of ...ated iron. The destroyed building was surrounded by others ... inflammable character, viz: The blacksmith shop, carpenter shop, ... two storehouses, all of which were saved only by the greatest ex...on; had there been any wind they must have been completely de...oyed. These buildings should be reconstructed in masonry as op...tunity offers.

NEW WINDING ENGINE.

This engine was purchased and put in position in January, 1892, and ...operly housed in a small masonry building. It is used for handling ...s in their passage through the locks, and their lockages are very ...eatly facilitated and expedited thereby.

GENERAL REPAIRS.

Considerable repairs were made to the towboat; they included raising ...e pilot house four feet; extending the cabin forward, thereby adding ... much-needed room to the cabin accommodation; building a new ...heel, and placing new canvas deck and roof covering. New canvas

OPERATING AND CAR

The work of opera
ried on by a regular
manager, a lock mas
4 lock hands, 1 brid
general regulation
through the canal i
for the purpose of
two reliefs, one in
lock master, and th
periods of day and
assistant lock mas
only proper that h
to adopt this cour
During the past
closed 23 days b
the locks during
carrying 1,620,58
The care of th
der the immedia
of all improvem
operations duri
two new middle
boats, and buil
machine shop w
12, 1892. The

This service
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posits of mud
considerable
depth. The
was 86,825 c
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from the old
constructed
dam, under
material ha

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The usual statements of expenditures and commerce on the canal are given below, and the report of R. R. Jones, assistant engineer, charged with the care of the canal, is transmitted herewith.

Financial statement for operating and care of the Louisville and Portland Canal for the fiscal year ending June 30, 1892.

Receipts:	
Dockage	$165.42
Rent of land	285.00
Total	450.42
Expenditures:	
Office and general administration	5,976.52
Canal and locks	40,593.85
Dredging	18,499.58
Total	65,069.95
Rebuilding two mud scows	1,155.75
Trimming canal wall and rock below	1,573.76
Building new middle gates	5,153.66
New winding engine	1,026.14
Aggregate	73,979.26

Statement of expenditures for operating and care of Louisville and Portland Canal for the fiscal year ending June 30, 1892.

Office and general administration:	
Salaries	$4,910.03
Supplies	114.07
Miscellaneous	952.42
Total	5,976.52
Canal and locks:	
Labor	21,687.16
Supplies	3,400.64
Repairs and extra labor	15,506.05
Total	40,593.85
Dredging:	
Labor	10,445.67
Supplies	4,344.21
Repairs	3,709.70
Total	18,499.58
Grand total	65,069.95
Rebuilding two mud scows	1,155.75
Trimming canal wall and rock below	1,573.76
Building new middle gates	5,153.66
New winding engine	1,026.14
Aggregate	73,979.26

Abstracts of proposals for furnishing and delivering forage at the Louisville and Portland Canal received in response to the advertisement dated April 25, 1892, and opened May 26, 1892, by Lieut. Col. G. J. Lydecker, Corps of Engineers.

Articles.	Quantity (more or less).	(1) Bid of B. B. Connor.	(2) Bid of Geo. Becker & Co.*
timothy hay .... pounds..	10,000	† $0.80	† $0.80
black oats .... bushels..	300	.44	.40
ear corn .... do ...	100	.50	.55
wheat straw .... pounds..	100	†.40	†.40
middlings bran .... do ...	600	†.70	†.75
....	....	266.60	259.90

* Accepted. † Per hundredweight.

PROPOSED WORK I

In addition to the reg
operation of the canal, i
old locks, to revet the e
locks up to the ordinary
in the approach to the lo
to replace the old dred
the old unsafe bridges
Other items of propos
allotments, are contain.

In relation to the
time, I would state th
newly made earthen
canal by each recurri

The old dredge (No
and is kept in servic
work is very small.
is such that it can
ing, and to that en
draulic dredge to
connection I would
my letter of Apri
at the head of th
the canal, with a
suitable hydrauli

The estimate f
highway bridge
of which were re
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make some e
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year ending

Regular force
Extra labor
General rep
Miscellaneou
New guard
New bridges
Building or
Completing
Slope revetn
Rock excava
Draining ca
Extending
Contingencie

The unexpe
ties outst

The additio

NEW MIDDLE GATES.

...pleted during the season of 1891 and were allowed to remain ... high-water season occurred in the spring, when they were ... April 23, 1892. Since this time they have been floating in ... place at such a time as will least interfere with navigation.

...HORS AND GUY RODS, MIDDLE GATE COLUMNS.

...h secured the guy rods used to stay the suspension columns had ... from the masonry, in which they were embedded to a depth of ... system of anchorage has been put in, consisting of bars 3½ inches ...ing 20 feet down into the masonry of lock walls. These anchors, six ... (one more than the old system), were placed in holes drilled through ... the depth named, and cemented therein with English Portland ...

...nd of anchor bars have stout heads 2 inches larger in diameter than ...ar. The upper ends have carefully forged eyes through which pass ... 2½ inches diameter, with cross bars, connecting with the guys, which ...p of the column.

... system of anchorage was successfully completed without interfering ...e of the gates and hold perfectly firm and secure.

REPAIRS TO LOCK GATES.

...airs were made to the upper, middle, and lower gates of the new locks as oc... demanded. Nine cast-iron ...kets, or valves, were replaced and three bear... for same were put in place. The replacement of the latter was a very trouble... operation, involving the use of a partly submerged dock, in which the men ...ked. A number of the truss rods were also replaced when broken.

PAINTING.

The engine houses and portions of the gates and iron work were painted.

TRIMMING CANAL WALL.

This work was continued during the year whenever the water was sufficiently low. The season for such work is necessarily very short, as the most troublesome ledges are only exposed during a very low stage of water in the river, and then for but a brief period.

The manner of conducting this work was the same as in preceding years, viz, by stonecutters dressing the stone while working from flats.

BRIDGES.

Repairs were made to the flooring and stringers of bridge at new locks and temporary repairs to lower chord of bridge at old locks.

The bids received for construction of a new iron drawbridge at new locks having been unsatisfactory, all bids were rejected, and a new opening of bids will become necessary.

The old wooden drawbridge at old locks is in a very insecure condition, and the temporary repairs alluded to above will only suffice to carry the bridge along for a few months, within which time a new structure should be erected.

SHOPS AND OTHER BUILDINGS.

A fire, which occurred on the evening of February 12, destroyed the frame building used for boiler and engine house and machine shop. The origin of the fire was unknown. The city fire department and the regular canal force, with our own fire apparatus, succeeded in confining the fire to the building in which it originated. The building was entirely destroyed, and the shafting, pulleys, and machinery more or less injured. The work of rebuilding in stone was commenced within a short time after the fire, and the engine and boiler houses are now completed. The entire ...ucture will be in shape like two Ls joined together—the boiler and fuel rooms, 18 ...4, constituting one L; the machine shop, 26 by 50, another L, and the two united ... room, 14 by 18. The fuel rooms are rendered fireproof by brick arches ...en 7-inch iron I-beams. The exhaust fan, for conveying shavings from

Abstract of proposals for furnishing coal received in resp[illegible] April 25, 1892, and opened May 26, 1892, by Lieut. Col. [illegible] neers.

Kind of coal.	
Best Pittsburg coal	bushel[illegible]
Second pool Pittsburg coal	[illegible]
Ohio River or Kanawha coal	[illegible]
Anthracite egg coal	[illegible]
Anthracite nut coal	[illegible]
Total	[illegible]

* Accepted. †[illegible]

Abstract of proposals for removing old and er[illegible] Louisville and Portland Canal, received in res[illegible] 1892, and opened May 10, 1892, by Lieut. Col.

No.	Name of bidder.
1	Toledo Bridge Co.*
2	Wisconsin Bridge and Iron Co
3	Grant Wilkins
4	King Bridge Co

* Informalit[illegible]

All proposals recommended for rejection, pric[illegible]

REPORT OF MR. R. R. [illegible]

COLONEL: I have the honor to sub[illegible] care of the Louisville and Portland [illegible]

DRE[illegible]

The United States tow boat and [illegible] mud from the canal and approach[illegible] removal of the old canal wall an[illegible] locks. The stone was taken out [illegible] used for backing up the new wall.

UNITED STA[illegible]

The United States tow boat w[illegible] the cabin extended forward und[illegible] the cabin. This work included [illegible]

The dredges were repaired [illegible] as they became broken. The [illegible] Slight general repairs to mach[illegible]

[illegible] has been used [illegible] steam [illegible]

…NDIANA AND ILLINOIS.

…of late years been carried on …applicable to improvements …Ind. Excepting the construc-…nd Rapids, near Mount Carmel, …of the same nature. With the …his lock and dam, operations would …two appropriations in one for the …secure a navigable low-water chan-…cessary to excavate channels through …ncentrate the flow by properly located …wa… at some points, and to clear the

…TS BE… …ENNES.

…section… …e past year was on the …armel. …ginning of the year the …ing the… …l, had been about com-…en done o… …. During the past fiscal …mpleted, n… …ecured in positions, gates …e, earth filli… …d and graded behind the …tures auxili… …he work of construction re-…nains to put … …ck in working order besides …ering apparat… …or the gates.

…l preparations … building the west abutment of …and, the materia… having been delivered, the work commenced September 25 and completed November

…n the lock during the year comprised the laying of …of masonry; 4,676 cubic yards earth were hauled and …d the lock wall, and 1,554 cubic yards of mud and …from the lock chamber. The total masonry in the lock …rds, and the whole work is of a most substantial and …ruction. Work on the abutment of the dam comprised …20 cubic yards of earth, laying 655 cubic yards of masonry, …ng 1,100 cubic yards of earth against the abutment.

…n to this permanent work at Mount Carmel the snag boat …rd was employed up to December 1 in removing snags …t point and the mouth of the river, principally in the vicin-…ville, New Harmony, Little Chain, and Black's Cut-off. At …med points the accumulation of snags was such as to estab-…plete blockade. The crib dike at Little Chain was repaired …with stone; 429 snags, weighing in all 1,786 tons, were re-…he result of this work has been to materially improve the condition of this portion of the river; but there remains a …shoals, where, at low water, a navigable depth of only 15 …es exists. The worst place is at New Harmony, where, …truction of a dam which formerly closed the cut-off at that …annel depth has been reduced to 12 inches at low water, …ut 2½ feet, as was the case when the river was held to a … The reconstruction of the dam is of great importance,

planing mill to fuel room, is located directly above this
boiler and engine rooms is entirely of iron, both trusses

The roof of machine shop will have corrugated-iron
The floors throughout are of concrete. The stone used
was taken up by the dredges from old canal walls and

A new stationary engine was purchased, and also
furnishing power to the planing mill. This shafting
30 feet long.

REPAIRING MUD SCO

The timber and iron work has been purchased
old mud scows. These boats have been pulled
work of rebuilding commenced.

The fire, which disabled the engine used for
the dressing of lumber, but this cause of delay

Very respectfully, your obedient servant,

Lieut. Col. G. J. LYDECKER,
Corps of Engineers, U. S. A.

COMMERCIAL

Statement of vessels passed through the
year ending

Vessels.	
Passenger boats	[illegible]
Towboats	[illegible]
Government boats	[illegible]
Coal boats and barges	[illegible]
Small craft	[illegible]
Rafts	[illegible]
Total	[illegible]

Lockages, 3,600.

Statement of commerce passed throu
year

Articles.	
Coal	[illegible]
Salt	[illegible]
Oil	[illegible]
Whisky	[illegible]
Tobacco	[illegible]
Cotton	[illegible]
Lumber	[illegible]
Corn	[illegible]
Wheat	[illegible]
Miscellaneous	[illegible]

Total tons, 1,620,586.

...dely through the lock walls ...osing are of cast iron and of

..., each gate is opened and shut ...hat this will be amply sufficient.

	Cubic yards.
....	1,442
....	6,090
...ck........................	7,532
... lock........................	4,676
...er........................	1,554
...es........................	$7,870

...er miter sill were bolted down to the bed ... 5 feet long.

...of abutment was furnished by the Romona ...ut contracted for being delivered by Octo-

...uilding of storehouse for cement and tools had ...was all received the work of excavation for ...gor.

...ced in going to the bed rock on account of quick- ...he rock. A small cofferdam was found necessary, ...ereby increased. Work was begun September 25 ...891.

...asonry wall 10 feet thick at the bottom, 7 feet at the ... of wall at right angle to the dam proposed, line of ... the height of proposed dam, the face of remainder ... with quarry-face masonry.

...ts pertaining to the abutment:

	Cubic yards.
....	655
....	1,520
...behind abutment	1,100
... including inspection........................	$7,229.11
...g masonry, including excavation, supplies, fuel, ... cement	2,965.18
....	10,191.29
...ubic yard for laying stone, including all expenses	1.53

REMOVAL OF SNAGS.

...h the project the snag boat *Richard Ford* was employed in remov- ... of snags between Mount Carmel and the mouth of the river. ... snags were removed between Grayville and New Harmony, but ...number were removed at Little Chain and Black's Cut-Off, where ...gs had accumulated to such an extent as to shut off the channel ...hese places were almost entirely cleaned out. During some two ...river was at the very lowest stage the crew of the snag-boat was ...airing and building new cribs in the dike at Little Chain and remov- ...yards of loose rock which had rolled into the chute.

...at returned into winter quarters on December 1st, remaining at Mount ...June 25th, when she was sent to Vincennes to remove snags on the ...r above Vincennes.

...done by the snag-boat was as follows:

...snags removed and destroyed........................		429
...snags removed and destroyed........................	tons..	1,786
... days repairing cribs at Little Chain........................		10

CONDITION OF THE RIVER.

...moval of snags during last season has undoubtedly been of great benefit to ...gation, but nevertheless, the river, at very low water, is not practicable for ...wing over 15 to 18 inches of water, except in a few places where deep pools ...etween shoals.

Wabash River, below Vincennes, for fiscal year ending June 30, 1892.

Articles.	Tons.	Approximate value
....	35, 635	$659, 247. 50
... and rafted	25, 250	153, 200. 00
....	60, 885	$812, 447. 50

... statement of commerce, Wabash River, above and below Vincennes.

Years.	Tons.	Approximate value.
....	122, 729	$1, 817, 947. 00
....	58, 014	535, 006. 00
....	106, 513	1, 573, 698. 00
....	100, 443	641, 107. 00
....	103, 415	1, 162, 299. 00
....	122, 535	2, 037, 242. 40

IMPROVEMENTS ABOVE VINCENNES.

... the intention at the beginning of the year to clear a number ... from this section of the river, but it was found impracticable ... any suitable arrangements for doing the work. The snagging ... owned by the Government was totally unserviceable, and no ... plant for doing the work could be obtained from private parties ... factory terms; as a result no work was done.

...rds the close of the year the snag boat *Richard Ford*, which ... work on the lower river during the last season of operations, ... up to Vincennes, and will be kept at work above that point ... the ensuing season. In the meantime a new hull for the steamer ... is in process of construction and will be fitted for snagging ...; when completed it will be an easy matter, with the two boats, ... the entire river clear of snags with annual appropriations of ... $5,000 for the operation of each boat.

...des the removal of snags an additional expenditure of about ...00 would be of great benefit to navigation on this section; it is ...d for opening channels through the worst shoals, the construction ...ms for a proper concentration of flow, and for shore protection in ... localities.

...e commerce on this section for the past fiscal year is reported at ... tons of freight, valued at about $1,250,000.

...ansmit herewith report of O. L. Petitdidier, assistant engineer, ...commercial statistics gathered by him.

...ferring to the opinion expressed in the first part of this report, I ...d invite consideration to the propriety of making a single appro...ion of $60,000 for "improving the Wabash River, Indiana and ...is" for the year ending June 30, 1894, in lieu of separate appro...ions of $40,000 and $20,000 for improvements *below* Vincennes and ... Vincennes, respectively.

Money statement.

... 1891, balance unexpended	$5, 742. 26
...0, 1892, amount expended during fiscal year	974. 28
..., 1892, balance unexpended	4, 767. 98
..., 1892, outstanding liabilities	440. 00
..., 1892, balance available	4, 327. 98
...t appropriated by act approved July 13, 1892	5, 000. 00
...t available for fiscal year ending June 30, 1893	9, 327. 98

The worst impediment to navigation outside of the Grand mel is at New Harmony, where a cut-off, at one time shut off half of the water of the main river, which could formerly be na by boats drawing 24 to 30 inches of water, is now impassab stage by boats drawing 12 inches.

The portion of river thus deprived of navigation is 12 miles i

As the island which is now between the cut-off and the main r high water and is composed of a sandy soil of very loose natu possible to devise any sort of closing for the cut-off which woul season, and this in the present enlarged size of the cut-off woul

At Grayville Bend Cut-Off.—Where an examination was made levee built by the United States is still in good order, while th complished what was expected of them. At this place the ba and it is probable that some additional work of protection will long.

rand Rapids.—Near Mount Carmel, Ill., where the greate efit can of course be expected until the improvement, co completed.

n all in all, at very low water, navigation is suspended, n uilt by the United States are necessarily inefficient, but n the river seems either to diminish or the reefs seem to f low water, which grow longer as the drainage of the r fect.

PROJECT.

sent fiscal year it is contemplated to complete th emoval of snags. Should any new appropriati ble during the present fiscal year, it would be he timber for dam to be delivered during next im re could quarry during the present summer som one which will be needed for the dam. This stone co transported during the high water of 1893, and t d no delay would be experienced in the construc butment already built are useless until after com ith the commercial statistics of the river bel tics of the whole river, for the past six years. ase in the tonnage has taken place while the nearly doubled; this difference being due to greater pr total tonnage.

The increase of commerce is principally due to the high wat the last three months.

Very respectfully submitted.

Your obedient servant,

O. I

Lieut. Col. G. J. LYDECKER,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

List of steamboats and barges plying on Wabash River, below V year ending June 30, 1892.

Name.	Kind.	Tonnage of boat.	Tonnage of barge.	T to
Emma Cooper and 5 barges	Towboat			
Eugene and 5 barges	...do			
E. S. Ragon	Stern wheel			
J. P. Droulliard	...do			
John Fowler	...do			
Emma Evans and 4 barges	...do			
Rosedale and 3 barges	...do	147	385	
Alex Perry	...do			
D. A. Nesbit and 6 barges	Towboat		1,450	
Cumberland and 1 barge	Stern wheel	400	80	
Irene and 2 barges	Side wheel	60	60	
Peankishaw and 1 barge	Stern wheel	53	7	
Diana and 2 barges	...do	60	[illegible]	

Amount (estimated) required for completion of existing project....... $
Amount that can be profitably expended in fiscal year ending June 30, 1894
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

REPORT OF MR. O. L. PETITDIDIER, ASSISTANT ENGINEER.

MOUNT CARMEL, ILL., *June 3*

COLONEL: I have the honor to submit the following report upon the imp of the Wabash River above Vincennes during the fiscal year ending June

The plan of operations contemplated at beginning of fiscal year consist removal of numerous snags which were obstructing the channel between V and Terre Haute, a distance of 90 miles.

As the steamer *Osseo*, which had been used formerly in towing the snag become entirely unserviceable, an effort was made to secure the services boat to take its place, but owing to unacceptable restrictions put on by of towboat the offer could not be accepted.

It was determined to build a new hull and fit it up with machinery of and the snag scow, thus giving us a more manageable single snag boat and the necessity of employing a double crew as formerly.

In continuation of this plan the necessary timber was ordered early in th of 1892, and work was begun as soon as stage of water was such as to u low bank which was to be used as a shipyard.

The long-continued high water of the spring of 1892, lasting nearly thre having delayed the building of new hull until it was found that the new b be prevented from passing over the Grand Rapids near Mount Carmel b water set in, the snag boat *Richard Ford* was sent up to Vincennes, an date in readiness for the work of removing snags between Vincennes Haute.

Condition of river.—The condition of the river remains unchanged since report, the snags still forming at low water a very great obstruction to n

The commerce is still considerable, and, as will be seen by the commercial here appended, shows a very decided increase over the previous year. Th due to the long-continued high water of this spring, which has been very to navigation.

Project.—During the present fiscal year it is intended to resume snagg tions and push work vigorously until funds on hand are exhausted.

I forward herewith tabular statements showing amount of freight carri part of the river during the past fiscal year.

Very respectfully submitted.

Your obedient servant,

O. L. PETITDID
Assistant E

Lieut. Col. G. J. LYDECKER,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

Statement of commerce, Wabash River above Vincennes, for fiscal year ending Ju

Articles.	Tons.
Grain	55,204
Lumber	875
Stave bolts	[illegible]
Salt	378
Wood	126
Shingles	[illegible]
Merchandise	2,850
Stock	
Total	

Passengers, 17,404.

ximate
ine.

$181,000
71,145
137,950
256,330
93,150
174,000

ding June

g.

es.
gleton.

REPORT OF MR. O. L. PETITDIDIER, ASSISTANT ENGINEER

MOUNT CARMEL, ILL., J

COLONEL: I have the honor to present the following report of wor White River, Indiana, during the fiscal year ending June 30, 1892:

The work intended to be done at the beginning of the fiscal year co completion of improvement at Kellys Ripple and removal of snags from

Owing to the very low stage of water prevailing on the Wabash Riv whole summer, it was found impracticable to take the snag boat *Richa* which it had been intended to remove snags, up to White River, so t done was confined to completing the improvement at Kellys Ripple.

The work done at this place has consisted of the construction of a 350 feet long, 10 feet wide, and 5 feet high, from the head of the sout left bank of river; the widening of entrance of chute for a distance of rebuilding for a distance of 240 feet, of the north dike, which had s since its construction.

I append the following data in regard to the work done:

Linear feet of logs used ....
Linear feet of driftbolts used ....
Cubic yards of stone filling used ....
Approximate cost of work ....

Work was begun on July 16 and continued until its completion, Oct

The improvement, as completed, is now of great assistance to naviga

Condition of river.—With the exception of Kellys Ripple, where t ment has been completed, the condition of the river is no better than year; numerous snags render navigation difficult and dangerous, whi the caving and cutting of banks brings in fresh obstructions; such a pla Eddy, three-fourths of a mile above Deckers, where a row of piling wh driven to protect the bank is now by reason of successive erosion behind i dle of the channel, and the obstruction most complained of by steambo

The bridge at Rodgers is still unprovided with a draw, but no co been heard in regard to it, there being no navigation in this portion of

Project.—It is intended during the present year to resume the remo and obstructions as soon as practicable, and until the present funds exhausted.

Should any additional funds become available during the present fis work of snagging could be continued through the whole season.

I append commercial statistics for the present fiscal year, also compar tics for the five years previous. It will be seen that there has been quite in the commerce of the river; this has been mainly due to the favorable river during the last three months.

Very respectfully submitted.

Your obedient servant,

O. L. PETITD
Assistant

Lt. Col. G. J. LYDECKER,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

Statement of commerce, White River, Indiana, fiscal year ending June 30,

Articles.	Tons.
Grain	4,630
Logs and lumber, boated and rafted	18,500
Total	

Locks 7 and 8 were completed in 1892, as well as parts of the found tions of dams 7 and 8. When these two locks and dams are added the finished works there will be a very great gain in the availability f navigation at all seasons on the river.

Mr. A. M. Scott has continued to exercise the local charge in h usual efficient manner. His report, which is appended, treats in det of the operations of the year.

As the improvement of the river has progressed the commerce on notably the shipment of coal, has greatly increased.

The telephone line has been maintained between the central office Charleston and the locks, and it is used by night as well as by da being found indispensable for the proper oversight and direction of t operations, as well of construction and of maintenance.

A gauge-reader has been kept at Kanawha Falls, near which pla the Gauley joins the New to form the Kanawha River; and another Hinton, where the Greenbrier empties into the New River. The co pensation of these men is less than $10 a month each. They send the central office daily reports, by postal cards, of the stage of the riv at their respective stations and by telegraph when there is a rapid ris These reports are necessary as warnings to the central office in Charle ton, in order that such maneuvers of dams, etc., may be had in time the height and duration of the freshets may require.

For perfect security a similar station should be occupied at son point on the Upper Gauley, and perhaps also on the Elk.

The following are the amounts and dates of appropriations for i proving Great Kanawha River, West Virginia:

March 3, 1873	$25,000.00	August 2, 1882	$200,000.
June 23, 1874	25,000.00	July 5, 1884	200,000.
March 3, 1875	300,000.00	August 5, 1886	187,500.
August 14, 1876	270,000.00	August 11, 1888	350,000.
June 18, 1878	222,000.00	September 19, 1890	300,000.
March 3, 1879	150,000.00		
June 14, 1880	200,000.00	Total	2,629,500.
March 3, 1881	200,000.00		

UNITED STATES ENGINEER OFFICE,
Baltimore, Md., January 8, 1892.

GENERAL: The estimate for the project for the improvement of the Great Kanaw by the method of locks and movable dams was prepared in 1875, seventeen years a

Several circumstances seem to make the present a suitable time for its final re sion. A revised estimate is therefore submitted below. One reason why this not been done sooner was the hope that in the project for the Ohio it might be kno whether it was likely a dam would be built below the mouth of the Kanawha n enough to raise the water to such a distance as to influence the location of the da in the Kanawha near its mouth and thus perhaps save the expense of one site in Kanawha.

In a letter of September 26, 1891, from Col. Merrill he says: "I would theref advise you to make your location on the Great Kanawha River without regard what may be done on the Ohio."

The original estimate amounted to $4,000,000. The appropriations since ha amounted to $2,579,500.

This would leave a sum of $1,500,000 to be still provided if the original estim were adhered to, but reasons have arisen for changing it. In four or five years became apparent that the upper dam of the series estimated for would not be nec sary, as the commerce above the pool of No. 2 would not justify so large an expen ture as the occupation of Site 1 would have required.

When the original estimate was made it was necessarily founded on French dra ings and experience, as a movable dam of the Chanoine type had not been built America. The knowledge of the river since gained by our own experience and m detailed surveys than the hurried ones upon which the first estimates were based also been great. We have thus been enabled to rearrange the locations of the si to be occupied and to omit another of the twelve locks and dams originally provided for. For these considerations the estimate was reduced by $600,000 in 1878.

The amount asked for in the last Annual Report for completion of the work in the occupation of ten sites was $670,000. The following revised estimate was lately made with great care by Mr. A. M. Scott, the resident engineer at Charleston:

"COLONEL: In compliance with your instructions I have the honor to submit below an estimate for completing the Great Kanawha slack-water improvement to the mouth of the river:

For Lock and Dam No. 9, complete, not including inspection, engineering, office expenses, etc	$320,000
For Lock and Dam No. 10, complete, not including inspection, engineering, office expenses, etc	325,000
For Lock and Dam No. 11, complete, including purchase of site, not including inspection, engineering, office expenses, etc	485,000
Amount required to complete locks and dams Nos. 7 and 8, in addition to money now available	15,000
For additional lock houses at locks Nos. 2, 3, 4, 5, 6, 7, and 8, sixteen houses in all	12,000
Dredging in pools at heads of shoa[illegible]r [illegible]pproaches	30,000
	1,187,000
For inspection, engineering, genera[illegible]e expenses, and incidentals, 10 per cent	118,700
Total	1,305,700

"The cost of No. 11 over 9 or 10, [illegible]eit[illegible]er locks and dams on the river, is due partly to the greater width [illegible] 11 (being from 100 to 210 feet wider than at the other sites), but [illegible]epth of foundations. The bed rock at 11 and in that vicinity [illegible] low-water mark, and the foundations will average from 6 t[illegible] sills than at any of the other sites, increasing materially t[illegible]nasonry, concrete, excavation, and expenses of cofferdams.

"The estimate submitted is regarded as a 'full estimate,' and it is believed the actual cost of the completed work will be made to fall below it. It was thought advisable, however, to make the estimate large enough to cover considerable uncertainty, unavoidably connected with such works.

"COL. WM. P. CRAIGHILL,
"*Corps of Engineers.*"

The cost of what has been done is considerably greater than it would have been if the work had not been protracted through so many years instead of being entirely finished in three, as it might have been had money been available. The whole work could have been done in the same time as at each site, and three years is a full allowance of time for any site.

Moreover, the size of the locks has been increased by proper authority beyond what was originally proposed.

Work is nearly completed at sites 7 and 8. The completion of No. 8 marks an unusually important step in the improvement of this river, which has been a success from the commercial as well as the engineering point of view.

When the dam of No. 8 is finished, boats can at all times come as low as its pool for a harbor, and when there are often within reach of the back water of the Ohio in its freshets which may be in progress when the Kanawha is not.

Under such circumstances the coal, etc., from the Kanawha may at once pass over the unimproved lower part of that river and down the Ohio to a market at Cincinnati and the other great cities on the Ohio and Mississippi rivers and their dependencies by water and rail.

Moreover, should the backwater from the Ohio not come fully to the pool of Dam 8, it is thought it may at times be supplemented by using the water of pool 8 and others above it to flush the portion of the Kanawha below 8 sufficiently to enable boats to reach the Ohio at some stages when such movement would otherwise be impossible, when there would be a boating stage in the Ohio and not in the Kanawha.

APPENDIX F F.

IMPROVEMENT OF GREAT KANAWHA, ELK, AND GAULEY RIVERS, WEST VIRGINIA, AND OF NEW RIVER, VIRGINIA AND WEST VIRGINIA.

REPORT OF COL. WM. P. CRAIGHILL, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Great Kanawha River, West Virginia.
2. Operating and care of locks and dams on Great Kanawha River, West Virginia.
3. Elk River, West Virginia.
4. Gauley River, West Virginia.
5. New River, Virginia and West Virginia.

(For letter of transmittal see Appendix I.)

F F 1.

IMPROVEMENT OF GREAT KANAWHA RIVER, WEST VIRGINIA.

The object of the improvement has been to give a depth of not less than 6 feet all the year round throughout the whole river, 96 miles. The means are locks and dams. The locks are about 300 by 50 feet, above Charleston, and about 340 by 55 feet below. The following table shows the present condition:

No.	Distance in miles from Charleston.	Style of dam.	Completed in—	Remarks.
2	26 miles above	Fixed	1887	In operation.
3	21 miles above	do	1882	Do.
4	15 miles above	Movable	1880	Do.
5	9 miles above	do	1880	Do.
6	4 miles below	do	1886	Do.
7	14 miles below	do		Lock finished and dam under contract.
8	22½ miles below	do		Do.
9	32 miles below	do		Site purchased September, 1890.

Two more sites will require to be occupied below No. 9. Some dredg-g is also necessary in some of the pools, as well as the occasional moval of snags and rocks.

dam and foundations, is given on page 1918 to 1889 ... is, owing to a misprint, the ... stead of 311, the correct length, and is so ... 1890.

Reference may also be made here to the ... description of the lock and dam, finished ... photo-lithographed by the ...

The cost ... above referred to covers ... gates. It included cofferdamming, pu... work, ... all materials except the irons ... rnished by the United States and placed ... the prices and payments on this contra...

Grubbing and clearing site............
Crib logs in cofferdam, 53,903 linear f...
Sheathing in cofferdam, 34,870 feet, B. ...
Filling in cofferdam, 7,361 cubic yard ...
Excavation, common, including dredg...
Excavation, hard pan, 3,064 cubic y...
Excavation, rock, 11 cubic yards, at ...
Embankment, 11,031 cubic yards, at ...
Puddling, 223 cubic yards, at $1.50
Concrete, 600 cubic yards, at $5.....
Concrete below Ref. 530, 2,713 cubi...
Backing masonry, 5,224 cubic yard...
Rock face masonry, 2,017 cubic ya...
Pointed face masonry, 1,836 cubic ...
Cut stone, bush hammered corners
Sill, 219 ... cubic yards, at $18...
Quoins, 75... cubic yards, at $25
Coping, 377 ... cubic yards, at $25
Stone filling in cribs under pavi...
Riprap, hand-placed, 1,987 cubi...
Paving, 1,171 cubic yards, at $5
Timber in permanent constructio...
Bolt holes drilled in masonry, 1...

Amount ...

The ... built in or attache... fastenings, pivot plates, ladde... $1,0... The lock gates ... the contract and the gates built are ... $7,800 making the cost of the ... $1... 9,523.

Completion of masonry. ... described generally on pages ... 1891. ... are also fully s... ... Doc. No. 7 above ...

... the year ... ... to ... the four ...

... of com... ... so far ...

the service bridge and wicket irons, tres- irons, and wicket boxes for the navigation the other irons mentioned above, embracing and 38,500 pounds of cast iron.

and are meeting with delay about getting the account of the strike now prevailing in some delay will be but temporary.

showing the most of the castings and anchorage, of Chief of Engineers for 1891, pages 2416 and

COMPLETED WORKS.

in 1887. (Located 85 miles from the mouth of Charleston.)

regular operation during the year. Locking was by high water. The commerce through the lock

	bushels..	1,277,800
	tons..	16,020
merchandise, produce … steamboats…do….		5,506
	feet, B. M..	96,800
	number..	296
	do….	1,674
	do….	164
	do….	25,000
	do….	10,500
	do….	5,938
	do….	1,766

… did some damag… and made it necessary to … riprapping; 1,… …s of stone were used in …ding the riprap b… …ks; 850 yards of this were … from the old quar… …site, the rest being either … stages of water f… …below the dam. The work … lock hands, assiste… …red labor and teams. The … side now ext… …nstream 1,210 feet and on the … the crest of the da… .

…dam; finished in 1882. (Located 80 miles from the mouth of above Charleston.)

…d working order during the year. Locking was suspended … water. The commerce through the lock was as follows:

	bushels..	1,796,000
	tons..	16,020
merchandise, produce, etc., by steamboats..do….		7,148
	feet, B. M..	477,200
	number..	429
	do….	1,682
	do….	70
	do….	55,000
	do….	72,000
	do….	8,870
	do….	1,778

In addition to the ordinary repairs about the works, 530 cubic yards were used in repairing and extending the riprapping below the lock but 125 yards of this, which were taken from the bar below the dam, boated from the old quarry near the site. About 600 yards of old rip- … and 425 yards of earth moved in grading the banks. The work was regular lock hands assisted by some hired labor. The riprap on the side now extends downstream 910 feet and on the lock side 1,212 feet … of the dam.

…ing *valves*.—The working of the new valves put in last year (Report of Engineers for 1891, pages 2420, 2421) has been entirely satisfactory.

THE MOVABLE DAMS.

…d movable dams with their locks were in good working order during the year. As usual a good deal was done at each lock regular hands, in keeping the works in order. The most are mentioned below under that head. A brief account of he movable dams here follows:

DAM NO. 8.

Work on the contract for building the foundations and masonry of this mova dam (see Report of Chief of Engineers for 1891, page 2419) was directed mainly building the foundations for part of navigation pass, building the shore abutm and quarrying and cutting stone.

First cofferdam for pass.—The first section of cofferdam for the navigation p inclosing 150 feet of it next to the lock, was completed so that the pumps w started July 9, 1891. Excavation inside the cofferdam began July 13. The blast of ditches in the bed rock for the anchorage disks and anchor bolts of the wi sill and service bridge was begun July 20. These trenches are about 8 feet deep. rock was generally seamy and carried a good deal of water, and some difficulty met with in keeping the trenches pumped out. The placing of the disks and an rods in the trenches and concreting around them was begun August 15, but ow mainly to the small force employed by the contractor was not completed until 1st of October. The laying of masonry in the pass cofferdam was begun Oct 8. Operations inside the coffer were stopped November 13 by a rise in the river, nothing more was done on that part of the work last year. When stopped for ter the condition of the work on this first section was about as follows: The anc age was in and concreted around; the upper or bridge sill was set; the founda course under the outer downstream wall was about two-thirds set; the main creting between the top of the rock and bottom of timbers was nearly finished; bed sticks were all placed, and sixteen of the main longitudinal timbers wer The work inside this section of cofferdam should have been finished last season, would have been without difficulty if the contractor had made proper effort kept a reasonable force employed. He was carrying on the lock contract, how at the same time, and seemed unable, or rather unwilling, to keep men and plant ficient to carry on both works properly.

Shore abutment.—The shore abutment was built last season. Excavation for i gan August 13, 1891, and the last piece of coping was set September 25. Some culty was met with in making the excavation for the abutment. It is located back into the bank, and the last 12 or 13 feet in depth (except about 3 feet of gr on top of the rock) was fine sand, with a good deal of water running in it. The caved badly, and it was found advisable to put in curbing, and two rounds of ti and sheet piling were put in clear around the pit before the rock was reached. loose stone and earth filling back of the abutment—the stone being against the of the wall and leading to an opening in the lower wing—and the puddle ab upper wing were put in, and the bank riprapped immediately back of the a to a height 32 feet above low water. The bank in its unfinished condition s winter floods well and has suffered no damage of any importance. The gra riprapping of the bank on this side will be completed as soon as the retai below the abutment is placed.

Work this season.—Operations on and within the first section of the cof the pass have been a great deal hindered so far this season by high water on the cofferdam, which was considerably damaged during the winter, w May 4, 1892. The pumps were started May 12 and excavation inside beg day. About 1,675 cubic yards of material—sand, gravel, fine coal, etc.—w the work in the coffer dam, deposited by floods during the winter and cofferdam was flooded May 20 by a rise in the river and pumped out inside was resumed June 14, and has been in progress since then. Unl again by water the foundations inside this first section of coffer, incl ing of the fixed irons, wicket and trestle boxes, hurters, slides, sill be completed about July 15, when the end bulkhead will be built (as Dam 7), the cofferdam removed, and the building of the second sec

Materials prepared.—The contractor has nearly all of the dimen sills, corners, pier recess stone, etc., required for the work, and the rock and pointed face cut and on hand. He still lacks al of rock and pointed face, but the quarries are turning out w delay for stone. Considerable trouble has been and is ye suitable timber for the wicket sill, box seats, etc., for the small and there is likely to be no material delay on accou that the foundations and masonry of Dam No. 8 will be co working season.

IRON WORK FOR MOVABLE PARTS

Drawings for the movable parts of Dams 7 and 8 w ... trestles for Dams 4, 5, an ... Proposals for furnishing these irons were opene ... Fred J. Meyers ... with you dated June

	Total.
500	16,514,600
940	16,020
,400	2,311,580
.....	352,080
.....	50,500
134	3,014
1,580	2,571
75	117
......	1,125

...o worn and de-
...p and a new sill
... this connection
...ces of the weirs
... has been mostly
... by fastening the
...st-iron sills.
...n up and replaced
... this weir are now

...es from mouth of

...ainder of the time,
...he dam and the com-
...es:

Remarks.

Work.

... in
... July
... at
... August 22
... below
... Shoal. On October

Lock No. 4.—Movable dam, finished in 1880. Located 74 miles from the of the river and 16 miles above Charleston.

The dam was up 150 days during the year and down the remainder of the ti was down 12 days to make repairs and the rest of the time on account of i sufficient stages of water. The maneuvers of the dam and some of the pri items of commerce at No. 4 are given in the following tables:

Maneuvers of dam.	Date.	Time taken.	Men employed.	Remarks.
		h. m.		
Lowered	August 23	3 30	5	No difficulty.
Raised	September 14	8 00	5	Do.
Lowered	November 25	4 00	5	Some trouble with pier tripping bar
Raised	December 1, 2, and 3	15 00	5	Water rather too high at beginnin trouble with chains breaking n drift.
Lowered	December 5	3 00	5	No difficulty.
Raised	December 23 and 24	13 30	5	
Lowered	December 27	2 30	6	Lock bar failed after tripping 10 rest put down by hand without
Raised	May 16 and 17	16 30	6	Found tripping bar off guides; so spent repairing panels of wickets
Lowered	May 20	2 30	6	Some of the bar wickets lowered no particular difficulty.
Raised	June 15, 16, and 17	28 00	6	Found lock tripping bar bent and also some trouble with drift ets.

	Through the lock.	Through the naviga-tion pass.
Coal ... bushels	2,249,000	6,154,000
Coke ... tons	1,080	14,040
Lumber and logs ... feet B. M.	307,500	164,000
Coal barges ... number	502	1,1[illegible]
Steamboats ... do	784	1,6[illegible]
Other craft ... do	29	54
Number of lockages ... do		

Prominent repairs at No. 4.—Owing to trouble with the shortened trip the lock side, it was still further reduced in length last fall and 12 shunting hurters put in, leaving 14 of the wickets on that section to the bar. This short bar got off the guides and badly bent again had, on the whole, made so much trouble that it was decided to take which was done in June. It will not be put back. The remain hurters on the lock section will be replaced during low water this new pattern. There are still 13 wickets on the pier section operat bar.

New top timbers were put on three of the lock gates last win being badly decayed. These gates are now twelve years old. The occasional small repairs, to last several years yet.

Lock No. 5.—Movable dam, finished in 1880. Located 68 mil and 10 miles above Charleston.

The dam was kept up 162 days during the year. The man the most important items of commerce at No. 5 are given in th

Maneuvers of dam.	Date.	Time taken.	Men employed.	
		h. m.		
Lowered	August 23	3 00	5	No difficul
Raised	September 4 and 5	11 30	5	Two hou track.
Lowered	November 25	3 10	6	No diffi
Raised	December 2 and 3	14 30	6	About trip ing
Lowered	December 5	4 00	7	
Raised	December 23	10 00	7	
Lowered	December 27	3 00	6	
Raised	May 16	12 00	7	
Lowered	May 20	1 30		
Raised	June 14 and 15	18 30		

RIVER, WEST
· DAM NO. 7.

:o the Ohio 262
nation of New
Blue Ridge and
Great Kanawha

New and Gauley,
:t the Kanawha
· the foot of the
'he shore, is 95.25

profile, Plate 1.
.· river (95¼ miles ·
:he first 15 miles.
om the foot of the
et; from the foot
· 10¼ miles fall 24
:les, 16 feet; from
· most of the fall
:pples, the natural
the slope becomes
· reduced and finally

··wlders and gravel,
·ath. It is underlaid
· low low-water mark.
The banks are from
equent mixtures and

' of the river and 40
ded rise at Charleston
· e high-water line in
· fected by backwater
st 25 miles above, as
: the Ohio of February,
several miles above, as

· et.
7 has been found nowhere
· that site; except as to
· of the river, and of the
natural low water depth
; in many places, as shown
· originally but a few inches
·t a loaded canoe or skiff
· river, Plate 1, are taken in
ition, as described further on.
·oal. For fuller description
· e may be made to the ...
·ort for 1871, page 62; for 187·,
, Part 2, page 16·; for 1877, pages

he river for different stages with
· This gauge was established in
: by the United States. It is set to
the Great Kanawha below Charles-
· ordinary low water. The extreme
·s the zero.
· econd for the different gauge readings
· made at or near Charleston. All but
· of Elk River; the first ... made just
des the ... discharge of Elk. Gauge
low water, ... gauge 1,450 cubic feet per
... 2,942 cubic feet per second; gauge 3.90,
8,613; gauge 6.8· discharge 12,755; gauge
charge 28,798; gauge 11.40, discharge 47,120;
· ·2.60, discharge 118,291; gauge 31.60, discharge

te I (profile) only is reprinted herewith.

and estimate was for locks with "clear in- width and from 285 to 300 feet in length." wide in the clear and from 300 to 311 feet long was built, the first below Charleston, it was date the coal trade, particularly large-sized ll of the locks below Charleston 55 feet wide quoins. The coal barges are from 24 to 26 he locks are designed to pass four barges at

was begun, as before stated, in 1875. Progress etc., of each lock and dam are shown on the ant features and dimensions of each work, is

...sion.		Lock dimensions.		Location—miles from mouth.	Remarks.
...	Total.	Clear width.	Length between quoins.		
	Feet.	*Feet.*	*Feet.*		
...	524	50	308	85	Finished in 1887.
...	564	50	311	80	Finished in 1882.
310	458	50	300	73¾	Finished in 1880.
305	515	50	300	67¼	Do.
310	558	55	342	54¼	Finished in 1886.
316	564	55	342	44¼	To be finished in 1892.
302	540	55	342	36	Do.
300	*548	55	342	25¼	Not begun yet.
200	*538	55	342	18¾	Do.
120	*668	55	342	1¾	Do.

* Approximate.

nd dams.—The commercial effect of the locks and anawha, and the additional benefits to result from the mouth of the river are shown in some detail in neers for 1887, page 1921, etc., and by commercial s, and will be but briefly referred to here. leted in 1880; No. 3 in 1882; No. 6 in 1886, and No. by river for the year ending June, 1881, was 385,148 and in 1891 the river shipment was 1,030,454 tons. ines above the head of the Charleston pool (the site nd they were sending out altogether not to exceed now 17 mines above No. 5 shipping by river. The r last year was 546,020 tons. It is evident too that this part of the valley is but a small part of what it ke business is being increased and new mines opened

id about 900 barges engaged in the coal trade on the

ssenger traffic has increased and is still increasing carried about 41,000 tons of miscellaneous freight— . Last year they carried 64,000 tons. There are now of them being local boats, the others running from cinnati, Pittsburg, Gallipolis, or other points on the

THE MOVABLE DAMS.

Chanoine wicket type, operated from trestle-service hey are all like Dam No. 7, illustrated and described e completed and put in operation in 1880, and were ection with slack-water improvement built in Amer- 1886. Nos. 7 and 8 are now building; both are well pleted during the present season, 1892.
on the Great Kanawha, the number of, and time taken net with, number of days the dams are kept up, the ing, etc., each year, are fully described in the Annual ers.
dams on this river has on the whole been very sat- rapidly maneuvered (in these respects Dam No. 6 and

ran up to Cannelton, in good stages of water, generally "winding" through the upper shoals. After the railroad was built steamboats seldom went above the foot of Paint Creek Shoal (now the site of Lock 3), and in low or even medium stages there was but little done by river above the Charleston pool.

In reference to coal shipments from the upper river: Locks Nos. 4 and 5, the first built on the river, were completed and put in operation in 1880. At this time there were but two mines above the site of No. 5 shipping by river, and they were doing but little, shipping altogether not to exceed 8,000 tons per year. Several attempts had been made to ship coal from above the foot of Paint Creek Shoal, at Cannelton, Armstrong Creek, etc., but owing to the risks and uncertainties of navigation this had been entirely abandoned before the slack-water improvement began. The immediate practical effect on commerce of the building of locks and dams in this part of the river will be referred to farther on.

IMPROVEMENT BY LOCKS AND DAMS.

The first appropriation for the improvement of the river by locks and dams was made by Congress in March, 1875. Col. (then Major) William P. Craighill, the engineer officer in charge of the river, in a project for the expenditure of this appropriation, dated April 30, 1875 (Report of Chief of Engineers, 1875, page 90), says: "The system of locks and dams may be considered as affording the most reliable navigation at all seasons of the year; and, as the ordinary construction is open to the objection of delaying boats and breaking up tows, the adoption of movable dams seems the best expedient available." * * * "These will furnish an unobstructed navigation during such times as the river will give sufficient depth of water, which will be not less than six months in each year. The system has not been fairly tested in this country, but its long successful use in France would seem to supply the deficiency and justify its adoption under such favorable conditions as are found on the Kanawha."

* * * * * * *

"The profile represents approximately the position and height of the movable dams, the lifts of which vary from 6 to 8 feet up to Paint Creek Shoal. Above that point the fall is greater, and it may be better that the movable dam system be not applied to it, but that the rise be overcome by three locks of 15 feet lift each."

On this project a Board of Engineers, consisting of Lieut. Col. H. G. Wright and Majs. Craighill and Poe, made a report to the Chief of Engineers, under date of May 25, 1875 (Annual Report for 1875, page 94). The following is an extract from the report of the Board:

"To meet the necessities of such economical transportation a depth of at least 7 feet water should be secured at all times. This, as stated by Major Craighill in his report of April 30 last, may be obtained in three ways: By a system of locks and permanent dams; by a system of locks and movable dams, and by a combination of the two; that is, by locks and movable dams from the mouth of the river to a certain point, with locks and permanent dams above."

* * * * * * *

"They therefore recommend that movable dams be adopted from the mouth of the river to Paint Creek, the first permanent dam being at this point," etc.

This report was approved by the Chief of Engineers and the lock and dam at No. 5 and the lock at No. 4 were put under contract, and the work on them begun in the course of a few months.

The fixed dams, lifts, and number of.—The first project as stated above contemplated three fixed dams of 15 feet lift each above the foot of Paint Creek Shoal carrying the improvement to the foot of Kanawha Falls. It was afterwards deemed advisable to change the plan by reducing the lifts of the fixed dams to 12 feet, and Locks and Dams Nos. 2 and 3 have been so built, the No. 2 pool reaching to the foot of Loup Creek Shoal, as shown on the profile. This is nearly or quite to the upper line of the best coal deposit on the Great Kanawha (being about where the Lower Coal measures run out and the thick top sandstone of the Conglomerate series appears), and it is proposed not to continue the improvement further upstream until the locks and dams are all completed below. The reduction in the lifts will make two more fixed dams necessary if the slack water is carried to the foot of the falls, making four in all instead of three as first proposed. It may be added that the experience at Nos. 2 and 3, particularly in regard to the scour of the banks below the works, has fully justified the change of plan and shown that the height adopted (for maximum 12-foot lifts) is as great as either of these dams should have built.

Detailed drawings of Lock and Dam No. 2, uniform with those of No. 7, are now under way for publication by the department.

size of the locks.—The first project and estimate was [illegible] dimensions of about 48 to 50 feet in width and from [illegible] locks above Charleston are 50 feet wide in the clear [illegible] between quoins. Before Lock No. 6 was built, the [illegible] determined, in order to better accommodate the coal trade [illegible] boats in the lower river, to build all of the locks [illegible] the clear and 342 feet long between quoins. The coal barges [illegible] feet wide and about 130 feet long. The locks are designed [illegible] one or three barges and a towboat.

The building of the locks and dams was begun, as [illegible] made to date, relative locations, lifts, etc., of each lock [illegible] profile. This, with some other important features and [illegible] also given in the following table:

No. of lock and dam.	Style of dam.	Maximum lift.	Length of dam. Navigation pass.	Weir.	Total.	Lock dimensions. Clear width.	Length between quoins.
		Feet.	Feet.	Feet.	Feet.	Feet.	Feet.
2	Fixed	12			524	50	[illegible]
3	do	12			564	50	[illegible]
4	Movable	7	248	210	458	50	[illegible]
5	do	7	250	265	515	50	[illegible]
6	do	8¼	248	310	558	55	[illegible]
7	do	8	248	316	564	55	[illegible]
8	do	8½	248	292	540	55	[illegible]
9	do	6½	248	*300	*548	55	[illegible]
10	do	7½	248	*290	*538	55	[illegible]
11	do	10	248	*420	*668	55	[illegible]

* Approximate.

Commercial effects of the locks and dams.—The commer[illegible] dams first built on the Great Kanawha, and the [illegible] completing the improvement to the mouth of the river [illegible] the Report of the Chief of Engineers for 1887, page [illegible] statistics in later Annual Reports, and will be [illegible]

Dams Nos. 4 and 5 were completed in 1880; No[illegible] 2 in 1887. The shipment of coal by river for the year [illegible] tons. It has increased steadily, and in 1891 the r[illegible]

In 1880 there were but two mines above the [illegible] of Lock 5) shipping by river, and they were [illegible] 8,000 tons per year. There are now 17 mines a[illegible] output of these 17 mines by river last year was [illegible] the present output of coal from this part of the [illegible] will become, as the coal and coke business is [illegible] all the time.

There are now 21 towboats and about 900 barges [illegible] river.

The ordinary freight and passenger traffic [illegible] rapidly. In 1886 these boats carried about [illegible] merchandise, farm produce, etc. Last year the [illegible] nine packets in the trade, five of them being [illegible] Charleston and above, to Cincinnati, Pittsburg [illegible] Ohio.

THE MOVABLE DAM[illegible]

The movable dams are of the Chanoine wicket [illegible] bridges. In general features they are all like Dam [illegible] herein. Dams Nos. 4 and 5 were completed and [illegible] the first movable dams in connection with slack-water [illegible] ica. Dam 6 was completed in 1886. Nos. 7 and [illegible] along and will probably be completed during the [illegible]

The operation of these dams on the Great Kana[illegible] in the maneuvers, difficulties met with, number of [illegible] cost of operating and maintaining, etc., each year [illegible] Reports of the Chief of Engir[illegible]

The experience with mov[illegible] factory. They are easil[illegible]

[illegible] r- [illegible] ver [illegible] ds, [illegible] aces [illegible] aber [illegible] erior [illegible] ing," [illegible] ll be [illegible] p and [illegible] before [illegible] ckness, [illegible] joints, [illegible] exceed 8 [illegible] er-shaped [illegible] it was pro- [illegible] feet; sand, [illegible] of concrete [illegible] and laid in off- [illegible] n the back and [illegible] Communication [illegible] r wing. [illegible] by 1½-inch wedge [illegible] are shown on Pl. XI. [illegible] Line fastenings and [illegible] cated on Pl. XI; details those now under construction have considerable advantage over those first built the expense of operation and maintenance is but little if any more than with fixe dams, and they prove highly satisfactory to the river interests.

Advantages over fixed dams.—The movable dams are kept up whenever there is no water enough in the river for coal-boat navigation and down at other times. The advantages over the ordinary fixed dams for a commerce and river like the Gre Kanawha are decided, furnishing the benefits of the usual slack water without i most serious drawbacks. With fixed dams everything must pass through the lock with them navigation is entirely suspended, too, when the river is near or above th top of the lock walls. With movable dams the locks are only used when the di charge of the river is so small as to make them necessary. At all other times the are down, practically on the river bottom, out of the way, affording unobstructe open navigation. This is of great advantage to all classes of commerce, and is pa ticularly so with coal, transported as it is, and empty barges returned, in "fleets of large barges. More barges can, of course, be taken by a towboat, and much be ter time made by all kinds of craft in "open river," when there is water enough fo such navigation, than when the stage or discharge compels the use of the locks.

The movable dams being down in high water, there is comparatively little diff culty in protecting the banks about the works from scour. In this respect they hav considerable advantage, too, over the fixed dams.

Modifications, cost of operating, etc.—Experience with the dams has naturally sug gested improvements, and No. 6, the last one completed, has considerable advantage over those first built in strength and durability of construction, facilities for rapi maneuvering, and cost of operation and maintenance. Dams 7 and 8 have been sti further improved in some of their details.

No. 6 has been in operation over five years. The average cost of operating an maintaining the lock and dam has been $2,515 per year. This covers wages, sup plies, repairs, including considerable addition to the riprapping, and all expense connected with the work. The entire cost during the five years of repairs on th dam proper and on all of its apparatus, including paints, one of the principal item has been something less than $250, or an average of $50 per year.

This dam is put up by four or five men in from seven to twelve hours; the usual tim is about eight hours. It is lowered with the same force in about two hours. N material difficulty has ever been met with in any of the maneuvers at No. 6.

Four men are employed regularly at each work, the same as at the fixed dams. I raising and lowering the dams one or two extra men are often hired.

Maneuvering the dams.—The operation of raising and lowering the dams is gene ally understood, or will be inferred from the drawings, but may be briefly describe as follows: In raising the pass the bridge is first put up trestle by trestle (they a connected by chains as shown), beginning at the lock. As the trestles come up, an with them the aprons that make the walk, the rails forming the connections an winch track are placed. In raising the trestles the winch (Plate 10) is used b means of the small top crane and sheave. After the bridge is up the wickets a pulled up one by one with the winch and wicket chains until the props drop in the hurter seats. The wickets are not erected or "righted" as fast as pulled up b left "on the swing" (*en bascule*), that is, with the horse erect, the end of the prop the hurter seat and the wicket in a horizontal position at the top of the horse. this position the water passes freely under the wicket. If righted as fast as pull up, the head of water becomes so great that the last wickets can not be safely ha dled with the winch. After being put on the swing clear across, they are all ra idly righted; this is done with the drum and brake on the winch and wicket cha the butt of the wicket being held against the pressure of the water and let again the sill without shock. In lowering the pass the wickets are pulled upstream few inches with the winch by a simple line and grab connection at the top of t wicket. This carries the foot of the prop out of the seat into the descending cha nel of the hurter, when the grab is disengaged and the wicket falls. After t wickets are lowered the bridge is put down. The maneuvers briefly described abo refer particularly to the navigation pass. The weir is maneuvered on the sa general plan, but the weir wickets being smaller than those of the pass, they can raised or lowered, put on the swing, or righted with full head whenever desir The maneuver of the weir when the dam is up is governed by the stage or discha of the river, it being kept wholly or partly raised as required to regulate the surf of the pool. A pass wicket, for reasons given above, is never lowered or swu unless the whole dam is to go down.

Telephone line, equipments, etc.—Concert of action is necess dams and regulating the pools, and the different works are co and with the central office at Charleston by telephone. Th Kanawha Falls to give notice of floods, and daily com telegraph when necessary, is had with Hinton at th miles above the Falls.

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12, 700	
2, 350	
1, 300	
	140, 065
....	34, 012
....	343, 600

... section, which requires the ... expenses, I have the honor

... June 30, 1892, out of the general ap- ... and other works of navigation," in ... on the Great Kanawha River, West

...	$2,204.83	
...	1,172.61	
... etc.	110.88	
...	4.64	
		$3,492.96
...	2,225.06	
...	449.40	
...	118.60	
...	7.62	
		2,800.68
...	2,220.39	
... and extra labor.	623.09	
...	141.28	
...	5.96	
		2,990.72
...	2,242.66	
...) and extra labor.	811.53	
... etc	165.76	
...	6.29	
		3,226.24
...	2,278.06	
...rons) and extra labor.	728.09	
... tools, etc	128.42	
...	3.63	
		3,138.20
... expenses:		
...	3,485.31	
...	273.99	
...	9.10	
		3,768.40
... running expenses of steamboat:		
...	1,263.40	
...	829.77	
...	2.75	
		2,095.92
...	140.00	
...	140.38	
...rtation	6.41	
		286.79
... and reporters at Hinton and Ka-		
...	145.50	
...	4.96	
		150.46
...eneral work	53.59	
		53.59
...		22,003.96

[illegible] Bridge, W. Va., to foot of shoal or ledge, their [illegible] head and foot of same; also the quantity and [illegible] improving the channel in Gauley River, [illegible] in Fayette County, W. Va., 1891.

[illegible]	Number.	Distance.	Length.	Fall.	Loose rock.	Solid rock.	Total.	Blasts.	Holes.	Walls.	Bowlders.	Drilling.
		Miles.	*Feet.*	*Feet.*	*Cu.yds.*	*C.yds.*	*C.yds.*	*No.*	*No.*	*Feet.*	*No.*	*Feet.*
[illegible]			[illegible]		......	......		....	....	......	....	......
[illegible]			[illegible]		......	......		....	....	......	....	......
[illegible]			[illegible]		......	......		....	....	......	....	......
[illegible]			[illegible]	.4	24	......	24	....	....	50	....	......
[illegible]			[illegible]	[illegible]	12	......	12	....	....	......	....	......
[illegible]			[illegible]	[illegible]	10	......	10	....	....	......	....	......
[illegible]			[illegible]	[illegible]	15	......	15	....	....	30	....	......
[illegible]			[illegible]	.6	75	......	75	....	....	......	....	......
[illegible]			[illegible]	.9	108	4	112	3	3	168	....	4
[illegible]			[illegible]	[illegible]	2	......	2	....	....	......	....	......
[illegible]			[illegible]	[illegible]	105	1	106	....	....	246	....	......
[illegible]			[illegible]	[illegible]	90	2	92	1	1	96	....	2
[illegible]			[illegible]	[illegible]	118	......	118	6	6	196	....	5
[illegible]			[illegible]	[illegible]	20	......	20	....	....	84	....	......
[illegible]			[illegible]	[illegible]	18	......	18	....	....	130	....	......
[illegible]			[illegible]	[illegible]	83	6	89	4	4	894	....	8
[illegible]			[illegible]	.6	8	......	8	....	....	84	....	......
[illegible]			[illegible]	[illegible]	6	......	6	....	....	37	....	......
[illegible]			[illegible]	.9	69	......	69	....	....	265	....	......
[illegible]			[illegible]	6.5	135	5	140	3	3	54	....	5
[illegible]			[illegible]	2.5	43	......	43	....	....	579	....	......
[illegible]			[illegible]	1.1	18	2	20	1	1	178	....	2
[illegible]			745	3.6	218	12	230	10	10	1,400	....	9
[illegible]			300	2	9	......	9	....	....	200	....	......
[illegible]			[illegible]	2.5	112	......	112	....	....	253	....	......
[illegible]			[illegible]	4.1	124	......	124	....	....	1,388	....	......
[illegible]			204	1.1	123	24	147	21	21	348	10	24
[illegible]			600	9.1	......	310	310	70	66	......	30	138
[illegible]			900	8.7	17	......	17	....	....	200	....	......
[illegible]			500	.8	7	......	7	....	....	100	....	......
[illegible]			900	14.8	......	1,249	1,249	152	150	......	31	406
[illegible]		....	14,137	79.8	1,569	1,615	3,184	271	265	6,980	71	603

[illegible] STATISTICS FOR GAULEY RIVER, WEST VIRGINIA.

[illegible]	Saw logs.	Lumber.	Staves.	Tonnage of timber.	Produce, etc.	Total from Gauley.	Merchandise to Gauley.
	Feet.	*Feet.*			*Tons.*	*Tons.*	*Tons.*
[illegible]	[illegible]	2,5[illegible]	177,400	7,121	36	7,151	750
[illegible]	[illegible]	3,6[illegible]	274,200	9,491	78	9,569	1,322
[illegible]	[illegible]	4,472,500	....	9,676	90	9,766	1,985
[illegible]	[illegible]	4,7[illegible],300	100,000	10,347	89	10,436	1,964

[illegible] with four bateaux and four flatboats, drawing about [illegible] tons capacity each.

[illegible] *West Virginia, from July 1, 1891, to June 1, 1892—[illegible] months.*

[illegible]	feet..	5,249,200
[illegible]	do....	261,170
[illegible]	number..	1,200,000
[illegible]	do....	111,000
[illegible]	tons..	9,527
[illegible]	do....	103
[illegible]	do....	9,630
[illegible]	do....	3,083
[illegible]		

F F 5.

IMPROVEMENT OF NEW RIVER, VIRGINIA AND WEST VIRGINIA.

There has been no work on this river in the year ending June 30, 1892.

The following are the amounts and dates of appropriations for improving New River, Virginia and West Virginia:

August 14, 1876	$15,000	August 2, 1882	$12,000
June 18, 1878	15,000	August 5, 1886	10,000
March 3, 1879	12,000		
June 14, 1880	24,000	Total	112,000
March 3, 1881	24,000		

Money statement.

July 1, 1891, balance unexpended	$2,341.79
July 1, 1892, balance unexpended	2,341.79
Amount (estimated) required for completion of existing project	159,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

APPENDIX G G.

IMPROVEMENT OF CERTAIN RIVERS IN KENTUCKY AND WEST VIRGINIA.

REPORT OF MAJOR D. W. LOCKWOOD, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, July 8, 1892.

GENERAL: I have the honor to transmit herewith, in duplicate, the annual reports on the works under my charge at the close of the fiscal year ending June 30, 1892.

First Lieut. William L. Sibert, Corps of Engineers, has been on duty under the direction of this office throughout the year.

Very respectfully, your obedient servant,

D. W. LOCKWOOD,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

G G 1.

IMPROVEMENT OF TRADEWATER RIVER, KENTUCKY.

The Tradewater is a tributary of the Ohio and empties into it 79 miles below Evansville, Ind.

The project for the improvement, adopted in 1881, contemplated originally the removal of obstructions, such as bars, snags, etc., so as to

F F 3.

IMPROVEMENT OF ELK RIVER, WEST VIRGINIA.

Between July 1 and 11 a small party continued the work in progress June 30, 1891, at and near Jarretts and Porter shoals, which are, respectively, 12 and 7 miles from the mouth of the river. Twenty-three snags and sunken trees were taken out and cut up, and a number of leaning trees cut down or the projecting limbs removed. A towpath was also made high up along the bluff at Porter Shoal, and two ringboats were put in for use in winding boats through the shoal.

Some other work was done in July, August, and September below Clay Court-House, at Yankee Dam, Big Laurel, Big King, Little Spread, Queen, and Porter shoals, in building, repairing, and modifying chute walls and dikes and removing rocks.

In the stretch between the 34 and 38 miles above Sutton, which is itself 100 miles from the mouth of the river, a number of shoals were worked over which had been left in November, 1888. The principal operation was the removal by blasting of about 4,500 cubic yards of large rock to facilitate the movement of much lumber to market in the shape of oose logs. Above Sutton there is no boating or rafting of any conse-quence, but below there is a considerable movement of rafts and separate logs of valuable timber, railroad ties, and sawed lumber in rafts, all downstream, and of push-boats with merchandise upstream.

The operations of the United States on the river have greatly im-ved it for the kind of navigation on it. There are still several mill ıs which are unreasonable obstructions to navigation. They have ueen reported as such to the proper authorities in compliance with the law.

The following are the amounts and dates of apropriations for improving Elk River, West Virginia:

June 18, 1878	$5,000	August 11, 1888	$3,000
June 14, 1880	5,000	September 19, 1890	2,500
March 3, 1881	5,000		
August 2, 1882	2,000	Total	24,000
August 5, 1886	1,500		

Money statement.

July 1, 1891, balance unexpended	$2,754.31
June 30, 1892, amount expended during fiscal year	2,595.42
July 1, 1892, balance unexpended	158.89
Amount appropriated by act approved July 13, 1892	2,500.00
Amount available for fiscal year ending June 30, 1893	2,658.89
Amount that can be profitably expended in fiscal year ending June 30, 1894. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	5,000.00

REPORT OF MR. ADDISON M. SCOTT, RESIDENT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Charleston-Kanawha, W. Va., December 16, 1891.

COLONEL: I have the honor to submit the following report of operations sinc July 1 on the improvement of Elk River, West Virginia.

The work was stopped October 21 for want of funds, the appropriation being practically exhausted.

With the exception of a few days' work early in July, near the mouth of the river, at removing snags, etc. (in continuation of that reported for the year ending July 1, 1891), work was directed to blasting a channel for logs through the large loose rock on the shoals in the upper river near Webster, Court-House, and in building, repairing, and altering chute walls and dikes and removing rock between Clay Court-House and the mouth of the river.

REMOVING ROCK IN THE UPPER RIVER.

This work was begun September 1 with a hired force under Mr. W. A. Porter, overseer, 5 miles below Addison (Webster Court-House), where it was left November 24, 1888. (Report of Chief of Engineers for 1889, page 1956, etc.) The weather and stage of water were favorable and the work went on without interruption until stopped, October 21, as stated above. This, with the exception of some work at Mill Run and Canoe Tree Shoals, left unfinished, owing to high stages of water in 1888, brought the work up to Addison, being all that was contemplated this season in this part of the river with the funds at hand.

The names and location of the sho data connected with the work at each are given in the follow

The distances are given from Su rt-House) as in former table. Sutton is 100 miles from the mouth

Name of shoal.		ocks sted.	Holes drilled and blasts fired.	Rocks blasted and disposed of (approximate).
				Cubic yds.
Painter Lick Shoal	34	50	74	234
Miller Shoal	34½	59	144	1,129
Skidmore Shoal	34¾	17	31	272
Crisaline Shoal	35	23	35	241
Big Island Shoal	35¼	38	97	974
Cat Hole Shoal	35¾	18	20	151
Fadry Shoal	36	53	66	739
Upper Cat Hole Shoal	36¼	43	57	444
Phares Shoal	37	2	9	67
Fall Hole Shoal	37½	15	34	148
Shoal just below Addison	38	2	13	19
Total	....	320	580	4,418

There is a large quantity of fine timber on the Upper Elk, and all of the work done by the Government on this part of the stream has been to assist in driving and floating loose logs. Owing to the character of the stream above Sutton no rafting or push-boating is done above that point.

As in 1888, and described in the report referred to, the work in this part of the river consisted in blasting away the worst rocks on the shoals to make a narrow channel, generally about 25 feet wide, for logs to run in.

On most of the shoals worked on the passage could be made wider to advantage by more blasting, and in several places short dikes and dams would be useful in keeping logs out of bad lodging-places in pockets and behind islands.

WORK BELOW CLAY COURT-HOUSE.

This work was done by hired labor in July, August, and September. Mr. Leslie Frame, a pilot and lumberman of Braxton County, was the overseer on the most of this work. It consisted principally, as stated above, in building, repairing, and changing chute walls and dikes and removing rock on the most troublesome shoals. The names and location of the shoals and a brief description of what was done at each here follows:

Yankee Dam Shoal (46 miles from mouth of river and 7 miles below Clay Court-House).—Three riprap dikes were built, two at the head and one near the foot of shoal, to concentrate and direct the water in log and rafting stages. In addition, small bar or tow-head and a piece of an old dike were taken out on the right, near head of the shoal, the bar being reduced by horse scrapers.

About 554 cubic yards of stone were used in building the dikes, all of which were on the shoal, and mostly out of the rafting channel. Material moved and old dike, about 210 yards.

Big Laurel Shoal (37 miles from mouth of river).—Built a timber and stone da at head of shoal out from left shore, past head of island, 594 feet long, 7 feet wi on bottom, and about 3 feet high. Also repaired and strengthened an old dike on t right shore; 1,170 linear feet of round timber and about 415 cubic yards of new sto were used in the dam and dike.

Big King Shoal (31 miles from mouth of river).—Built a timber and stone dam head of shoal 255 feet long, 9 feet wide at base and 6 feet at top, and 5 feet hig from right bank to island. Material used in dam, 2,950 linear feet of round timb and about 255 cubic yards of stone.

Also moved an old riprap wall on left of channel and rebuilt it, lengthening bo ends, near left shore. This wall, as first located, proved to be a good deal in the wa of rafts and boats at certain stages of wacer, and was changed at the request several of the best pilots. About 365 cubic yards of stone were handled in movi and lengthening the wall.

Little Spread Shoal (27 miles from mouth of river).—Built a timber and stone dike o from the left shore to hold up the water on the shoal and keep rafts from runni into the bank. The dike is 440 feet long, 8 feet wide at base, 6 feet at top, and 4 fe high. In building it 3,555 linear feet of round timber and 327 cubic yards of sto were used.

Queen Shoal (25 miles from mouth of river).—Moved farther to left and rebuilt part of the old riprap wall on left to improve the channel for rafts and boats; mov and placed about 550 cubic yards of stone.

Porter Shoal (7 miles from mouth of river).—The work done here consisted in blas ing or breaking up with sledge sand removing a number of large rocks from along t left bank that were quite an obstruction to rafts and steamboats, particularly, t latter, in high stages of water. The rock disposed of aggregated about 140 cub yards.

REMOVING SNAGS, ETC.

The small party engaged in May and June in removing obstructions below Que Shoal, in the interest mainly of steamboat navigation, as described in the last Annu Report, continued operations until July 11, when it was disbanded. The work do by this party in July was at and near Jarretts and Porter shoals. Twenty-thr snags and sunken trees were taken out and cut up and a number of leaning trees c down or the projecting limbs removed. In addition, a "towpath" was made hig up along the bluff bank at Porter and two ringbolts put in for use in winding boa through the shoal.

Very respectfully, your obedient servant,

ADDISON M. SCOTT,
Resident Engineer.

Col. WILLIAM P. CRAIGHILL,
Corps of Engineers.

COMMERCIAL STATISTICS.

UNITED STATES ENGINEER OFFICE.
Charleston-Kanawha, W. Va., July 18, 1892.

Commercial statistics for Elk River, West Virginia.

Year ending June—	Saw logs and lumber.	Railroad ties, oak.	Oak staves.	Hoop poles.	Hickory spokes.	Oak tan-bark.	Tonnage timber products
	Feet, B. M.					*Cords.*	*Tons.*
1883	5,200,000	100,000	898,334				24,7
1884	5,975,000	125,000	1,122,500				30,7
1885	5,100,000	250,000	1,433,750				33,5
1886	15,361,000	250,000	1,845,000				68,5
1888	15,900,000	330,000	1,210,000				71,1
1889	15,750,000	295,000	1,600,000	500,000	350,000		70,2
1890	26,650,000	330,000	1,380,000	150,000	568,[illegible]	300	89,8
1891	27,995,000	412,500	800,000	125,000	[illegible]0,000	500	103,7
1892	44,400,000	380,000	1,405,000			240	139,8

The marked increase in the output of lumber will be noticed. The 44,400,000 feet of lumber is divided in kind about as follows: Poplar, 33,000,000; white oak, 6,000,000; hemlock, 1,500,000; the rest being mainly walnut and ash.

The amount of general merchandise and produce carried on the river is estimated at 10,000 tons, making the total for the year, with the timber products as above, 119,800 tons.

F F 4.

IMPROVEMENT OF GAULEY RIVER, WEST VIRGINIA.

The small amount of money available for this river was expended in July, August, and September, 1891. The unfinished channels made in 1890 through the shoals within 7 miles of Gauley Bridge were cleared of rocks and some new training walls were built for them. The channel for boats, 30 feet wide and [illegible] deep at low water, was completed to the foot of the Little Rough[illegible] miles.

A channel 30 feet wide was [illegible]ade through the Little Roughs by blasting out large bowlders, t[illegible] being to facilitate the downward movement of logs.

The formidable obstruction [illegible] as the Big Roughs was also attacked by blasting the large b[illegible]ich form it.

The total number of cubic y[illegible] removed was 3,184, and 6,980 linear feet of walls were built.

The work of the year has h[illegible] of causing the movement of much local freight by boats w[illegible] otherwise have been hauled by teams at greater cost to th[illegible]y.

The following letter explains itself:

UNITED STATES ENGINEER OFFICE,
Baltimore, Md., May 31, 1892.

GENERAL: In the money statement in the last annual report, under the head of Gauley River, West Virginia, the following is found: "Amount (estimated) required for completion of existing project, $4,000."

The project under which Congress has given two appropriations contained two heads, viz, the improvement from the mouth of the river to the Roughs for bateaux navigation, $10,000, and for the improvement of the Roughs, and above, $65,000; total, $75,000. See Annual Report for 1888, Part 3, page 1762. The appropriations up to this time have been, August 11, 1888, and September 19, 1890, each $3,000, amounting to $6,000.

Work was first begun on the portion below the Roughs, of which the cost was estimated to be $10,000, and when $4,000 was stated a year ago to be the balance estimated for completion of existing project it was understood to refer to that portion of the river. The statement should have read "Amount (estimated) required for completion of existing project below the Roughs, $4,000," and that it did not so read was my fault.

In preparing the Annual Report for the current fiscal year doubt now arises as to what amount should be stated as that "required for completion of existing project."

The original estimate was $75,000 for the two items as explained above, and I request authority to use this total in the money statement after deducting appropriations made prior to June 30, 1892.

Very respectfully, your obedient servant,

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

The following are the amounts and dates of appropriations for im[illegible]oving Gauley River, West Virginia:

[illegible]gust 11, 1888	$3,000.00
[illegible]tember 19, 1890	3,000.00
Total	6,000.00

Money statement.

July 1, 1891, balance unexpended	$2,938.9
July 30, 1892, amount expended during fiscal year	2,856.2
July 1, 1892, balance unexpended	82.6
Amount appropriated by act approved July 13, 1892	3,000.0
Amount available for fiscal year ending June 30, 1893	3,082.6
Amount (estimated) required for completion of existing project	66,000.0
Amount that can be profitably expended in fiscal year ending June 30, 1894	10,000.0

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

REPORT OF MR. WILLIAM PROCTOR SMITH, ASSISTANT ENGINEER.

BALTIMORE, MD., *November 16, 1891.*

COLONEL: I have the honor to report the following operations on the improvemen of Gauley River, West Virginia, for the season of 1891.

The river being very low in May it was thought advisable to start the work, an accordingly everything was made ready by the 1st of June, when rains set in whic kept the river up until the 29th, at which time work was begun and continued un til the 22d of September.

It was found that the channels made in 1890 needed clearing out and that addi tional wing walls were desirable; so work was begun on them, beginning at the Bi Creek, 1¼ miles above the mouth of the river, and extended to and through Mill Shoal 7¾ miles above the same point, from which were removed 712 cubic yards of loos sand and 12 cubic yards of solid rock, and 1,004 linear feet of main and wing wall were built.

Owing to the large amount of work absolutely required in this part of the river the project for the season could not be carried out in full.

The new work began at Humphreys Shoal, 1½ miles above the mouth of the Gauley and channels were made through the shoals left last season, as far as the head of Mil Shoal, 7¾ miles above the initial point; from which place to Sugar Creek, 6¾ miles fur ther up the river, the work was entirely new during the season.

The combined width of the shoals in the whole distance of the new work amount to 8,623 feet, covering a river space of 7¼ miles, from which were removed 857 cubi yards of loose and 1,603 cubic yards of solid rock, with which were built 5,976 linea feet of main and wing walls.

The wing walls were built of loose stone, borrowed from points near by, mixe with brush and gravel and sand when the latter could be procured.

The total amount of loose rock for the season was 1,569 cubic yards; of solid rock 1,615 cubic yards; in all, 3,184 cubic yards.

The walls vary in width from 3 feet to 10 feet, and in height from 1 foot to 5 feet and amount to 6,980 feet in length.

The combined widths of shoals amount to 14,137 feet, or nearly 2¾ miles.

The total fall over the shoals and ledges from the mouth of the river to the hea of the Big Roughs, 13.4 miles, is 79.8 feet, and the entire fall of the river betwee these points can be but little more, although the levels were not taken.

At Tritts Shoal, 9¾ miles above the mouth of the river, two channels were made one long and curved for extreme low water, the other short and straight for water a and above zero.

The bateau channel, 30 feet wide and 2 feet deep at zero or ordinary low water was completed to the foot of the Little Roughs, 12½ miles, on the 8th of August, an there the force was reorganized, put in camp, and set at work at that point, Littl Roughs, by blasting out the large bowlders for floating logs, through which was mad a channel 600 feet long and 30 feet wide, requiring the removal of 30 rocks, containin 310 cubic yards. The Little Roughs, as shown on the tracing of map accompanyin this report, is the beginning of the "Roughs" of Gauley, which extend from thi point up the river for a distance of 26 miles, as mentioned in your report Decembe 26, 1887, page 1761, Appendix D D 6 of the Annual Report of the Chief of Engineers U. S. Army, for 1888, and the shoal called Big Roughs, on the same map, is the fourth in this series.

This completed, the force was moved to Big Roughs, 1 mile up the river, a partia channel having to be made through Beaver Pond Shoal and Camp Shoal to admit th passage of the boats.

Guide cribs.—Constructed upper and lower guide cribs. Upper river crib is 200 feet long, 34 feet high, and 15 feet wide. Upper land crib is 100 feet long, 12 feet wide, and 10 feet high. Lower river guide crib is 110 feet long, 34 feet high, and its mean width is 13 feet. Lower land crib is 550 feet long; 250 feet of it is 34 feet high, and 300 feet of it is 15 feet high. Total cubic yards of crib work built, 12,497.

Repairs to lock.—Pumped out lock and repaired gates, placing four new arms in each lower gate. Cut down recess for lower gate in old land wall so as to make it vertical. Cut recesses in walls to receive gate castings when gates were opened. Lengthened ladders and cleaned out lock pit. Made more clearance under lower gates by picking off stone forming bottom of lock. Rebolted lower miter sills.

General work.—Drove 29 piles and capped same, forming fender along island above lock. Split up the necessary stone and paved 675 square yards of bank. Moved 1,600 cubic yards of earth in grading bank. Built up wing walls of lock so as to conform to grade of bank. Dredged off point above entrance to lock, and drove forty-five piles around this point for a fender.

Mr. B. O. Lermond, assistant engineer, was in local charge at this lock.

LOCK AND DAM NO. 4, GREEN RIVER.

Repairs to dam.—Removed old sheeting from dam; rebuilt an 80-foot section of lower slope and placed new sheeting on dam throughout. Replaced all missing stone in dam. Constructed and sunk a crib 90 feet long, 16 feet wide, and 22 feet deep, so as to form an apron below the dam next to the abutment and at the same time filling a hole washed out below dam, endangering same. The sheeting has been torn off this crib during the winter, evidently due to a head caused by leak under dam from above.

Guide cribs.—Constructed and repaired guide cribs above and below lock. Lower land guide crib is 275 feet long, average width 12 feet, and 30 feet high. Upper land crib is 140 feet long, 18 feet high, and 15 feet wide. Upper river crib rebuilt from water up, 220 feet long, 10 feet wide, and 10 feet high. Total cubic yards in guide cribs, 5,837.

General work.—Constructed retaining crib along mill race, 450 cubic yards. Split up and laid 408 square yards of paving. Repointed coping of land wall of lock. Placed new gate-operating apparatus in position. Dredged entrances to lock.

Mr. George N. Bratt was in local charge at this lock.

LOCK NO. 7, BARREN RIVER.

Graded bank, Quarried and laid 804 square yards of paving; cut, hauled, and set 1,465 square yards of sod. Set out shade trees and cleaned up premises. Placed 500 cubic yards of sawdust behind dam.

UNITED STATES DREDGE BOAT.

Work done.—Lock No. 1, Green River: Removed 5,621 cubic yards of material and 36 logs from lock pit and entrances to lock.

Lock No. 2, Green River: Removed 5,200 cubic yards of material from entrances to lock.

Lock No. 3, Green River: Removed 12,975 cubic yards of material in preparing foundations for guide cribs and in cleaning out lock entrances and pit. Tore up and removed 6,000 linear feet of old crib timber. Dredged and blasted off remains of old lock wall and cofferdam to low-water level. Dredged a channel across river so as to barge stone from ledge below dam.

Lock No. 4, Green River: Removed 2,920 cubic yards of material from entrances to lock.

General work.—Dredged off point at Boat Island, removing 1,000 cubic yards gravel. Dredged off bar at mouth of Green River, removing 1,000 cubic yards of material. Painted dredge.

UNITED STATES SNAG BOAT WM. PRESTON DIXON.

Removed 1,043 snags from channel of river; cut 252 trees and deadened 220. Pulled out and removed cofferdam at No. 1, Green River. Pulled one dump scow out on ways. Did all towing required on Green and Barren Rivers. Towed a dredge from Carmel, Ill., to Catlettsburg, Ky. Total miles run 8,773.

Very respectfully, your obedient servant,

WM. L. SIBERT,
First Lieutenant of Engineers.

D. W. LOCKWOOD,
Corps of Engineers, U. S. A.

Table showing the distances from Gauley Bridge, W. Va., to foot of shoal or ledge, their length, and difference of level between head and foot of same; also the quantity and quality of material excavated in making and improving the channel in Gauley River, West Virginia, from its mouth to Sugar Creek, in Fayette County, W. Va., 1891.

Name of shoal.	Number.	Distance.	Length.	Fall.	Loose rock.	Solid rock.	Total.	Blasts.	Holes.	Walls.	Bowlders.	Drilling.
		Miles.	*Feet.*	*Feet.*	*Cu. yds*	*C. yds.*	*C. yds*	*No.*	*No.*	*Feet.*	*No.*	*Feet.*
Junction of New and Gauley Rivers	1	......	200	......	......	......	......	....	....	......	....	......
Scrabble Creek ledges	2	¼	330	.8	......	......	......	....	....	......	....	......
Buck Ford Ledges	3	¾	339	1.2	......	......	......	....	....	......	....	......
Humphreys Shoal	4	1½	100	.4	24	......	24	....	....	50	....	......
Big Creek Shoal	5	1¾	846	3.2	12	......	12	....	....	......	....	......
Poal Shoal	6	2	283	.1	10	......	10	....	....	......	....	......
Winding Shoal	7	2¼	400	1	15	......	15	....	....	30	....	......
Kincaid Shoal	8	2½	525	1.6	75	......	75	....	....	......	....	......
Durden Shoal	9	2⅝	460	1.9	108	4	112	3	3	168	....	4
Durden Ripple	10	3	168	.2	2	......	2	....	....	......	....	......
Long Shoal	11	3½	976	2.8	105	1	106	....	....	246	....	......
Twenty-mile Creek Shoal	12	5	1,464	4.1	90	2	92	1	1	96	....	2
No. 1, above	13	5¾	205	1.2	118	......	118	6	6	196	....	5
No. 2, above	14	6¼	143	.2	20	......	20	....	....	84	....	......
No. 3, above	15	6½	100	.3	18	......	18	....	....	130	....	......
Foster Shoal	16	6¾	482	2.3	83	6	89	4	4	894	....	8
No. 1, above	17	7	42	.6	8	......	8	....	....	84	....	......
No. 2, above	18	7¼	37	.2	6	......	6	....	....	37	....	......
No. 3, above	19	7 5/16	265	.9	69	......	69	....	....	265	....	......
Mill Shoal	20	7½	1,075	6.5	135	5	140	3	3	54	....	5
Church Hollow Shoal	21	9¼	580	2.5	43	......	43	....	....	579	....	......
Simms Shoal	22	9½	178	1.1	18	2	20	1	1	178	....	2
Tritts Shoal	23	9¾	745	3.6	218	12	230	10	10	1,400	....	9
Ford Shoal	24	10	200	2	9	......	9	....	....	200	....	......
Laurel Shoal	25	10¼	200	2.5	112	......	112	....	....	253	....	......
Upper Shoal	26	10¾	690	4.1	124	......	124	....	....	1,388	....	......
Little Ledges	27	12⅓	204	1.1	123	24	147	21	21	348	10	24
Little Roughs	28	12½	600	9.1	......	310	310	70	66	......	30	138
Beaver Pond Shoal	29	12⅝	900	8.7	17	......	17	....	....	200	....	......
Camp Shoal	30	12⅞	500	.8	7	......	7	....	....	100	....	......
Big Roughs	31	13¼	900	14.8	......	1,249	1,249	152	150	......	31	406
Total	....	......	14,137	79.8	1,569	1,615	3,184	271	265	6,980	71	603

COMMERCIAL STATISTICS FOR GAULEY RIVER, WEST VIRGINIA.

Year ending June 30—	Saw logs.	Lumber.	Staves.	Tonnage of timber.	Produce, etc.	Total from Gauley.	Merchandise to Gauley.
	Feet.	*Feet.*			*Tons.*	*Tons.*	*Tons.*
1888	691,800	2,535,300	177,400	7,121	36	7,151	750
1889	890,400	3,615,000	274,200	9,491	78	9,569	1,322
1890	384,800	4,452,500	....	9,676	90	9,766	1,985
1891	384,700	4,701,300	100,000	10,347	89	10,436	1,964

This commerce is carried on with four bateaux and four flatboats, drawing about 18 inches of water and of 18 tons capacity each.

Commercial statistics for Gauley River, West Virginia, from July 1, 1891, to June 1, 1892—eleventh months.

Lumber	feet	5,249,200
Saw logs	do	261,170
Staves	number	1,200,000
Shingles	do	111,000
Total timber in	tons	9,527
Produce, etc	do	103
Total from Gauley	do	9,630
Total to Gauley	do	3,083

F F 5.

IMPROVEMENT OF NEW RIVER, VIRGINIA AND WEST VIRGINIA.

There has been no work on this river in the year ending June 30, 1892.

The following are the amounts and dates of appropriations for improving New River, Virginia and West Virginia:

August 14, 1876	$15,000	August 2, 1882	$12,000
June 18, 1878	15,000	August 5, 1886	10,000
March 3, 1879	12,000		
June 14, 1880	24,000	Total	112,000
March 3, 1881	24,000		

Money statement.

July 1, 1891, balance unexpended	$2,341.79
July 1, 1892, balance unexpended	2,341.79
Amount (estimated) required for completion of existing project	159,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

G G 4.

IMPROVEMENT OF KENTUCKY RIVER, KENTUCKY.

[Ken]tucky River is a tributary of the Ohio, and empties into it [at Carroll]ton, Ky., about midway between Cincinnati, Ohio, and Louis-[ville].

[The pre]sent project for the improvement of the river was adopted in [... the o]bject being to repair the five locks and dams built by the [State of K]entucky, and extend slackwater navigation for a draft of 6 [feet by th]e construction of additional locks and dams to Beattyville, a [distance o]f 261 miles from the mouth of the river.

WORK DONE DURING THE YEAR.

[Lock No]. 6.—Work on this lock was commenced April 27, 1891, by [excavatin]g for lock walls, and on December 2 the first boat was locked [through]. The cofferdam inclosing the lock site consisted in the main [of a row o]f piles joined by stringers and wale pieces, against which a [single ro]w of sheet piles was driven, the whole being backed inside [and out w]ith gravel put in position by dredges. The lower return [...] [ba]nk was left open at first, so that excavation of the incl[osed area could] be effected by the dredges. Afterwards the low[er return to th]e bank was constructed, the inclosed area pumped [out, and excavatio]n to the rock made by shoveling, wheeling out th[e material, and hoistin]g it out with derricks. Although the coffer was flo[oded several times duri]ng the season, it held well, leaked very little, and answered [its pur]pose.

[In the c]onstruction of the lock and abutment, the following quanti[ties of sto]ne, etc., were put in place:

	Cubic yards.	Cubic feet.
	439	25
	693	25
[...]tone	1,830	5
[...]one	1,557	26
	1,287	1
	3,099	20
[...]one	1,420	18
[...]prap	2,028	2
	1,483	26
	1,836	19

[The dim]ensions of the lock are as follows: Length of walls, 249 feet. [Length of] chamber between hollow quoins, 185 feet. Width of chamber, [... feet.] Lift, 14 feet 2½ inches.

[Nearly] all the stone was on hand when the work commenced.

[In the c]onstruction of the dam the lower step is a crib filled with [stone, ext]ending down to the rock and reaching from the abutment to [the river] wall of the lock. The portion of the dam extending upstream [from the] lower step is crib work, resting on 139 piles, and is also filled [with stone.] The upper breast of the dam is protected by a double row [of sheet pilin]g extending down to the rock, and will be backed with [...]

[In the cons]truction of the dam the following material was used: [...] [ti]mber, 291,217 feet, B. M., sheathing, 16,361 cubic [...] yards fascines, and 10,949 cubic yards sand, Submitted ... harbor ...

REPOR...

SIR: I hav...
River, Kent...
That por...
the banks ...
mouth to it...
No work ...
Work do...
the river; ...
ing trees; ...
river.
Very ...

Maj. D. ...
Corps ...

Cons...

Logs ...	
Lumber ...	
Timber, ...	
Total ...	

...nt of the river, and at the same time, when necessary, ... snagging and doing general work connected with oper... The present boat can not do the work.

APPROPRIATIONS.

...	$100,000
...	100,000
...	125,000
...82	225,000
...	250,000
...1886	187,500
... 1888	180,000
... 19, 1890	180,000
	1,347,500
...ived from Tabler & Cogar	500
	1,348,000

Money statement.

...891, balance unexpended	$151,816.59
..., 1892, amount expended during fiscal year	147,834.43
...1892, balance unexpended	3,...
...1892, outstanding liabilities	2,...
...1892, balance available	...
...t appropriated by act approved July 13, 1892	1...
...t available for fiscal year ending June 30, 1893	151,854.13
...nt (estimated) required for completion of existing project	1,524,000.00
...nt that can be profitably expended in fiscal year ending June ...1894	500,000.00

...itted in compliance with requirements of sections 2 of river and ...rbor acts of 1866 and 1867.

REPORT OF MR. R. S. BURNETT, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Frankfort, Ky., July 1, 1892.

...R: I respectfully submit the following report on the improvement of the ...ky River, Kentucky, for the fiscal year ending June 30, 1892:

LOCK NO. 6.

ABUTMENT.

...ry.—Began excavating for abutment May 16. Completed excavating June ...gan setting stone June 5. Completed setting stone July 2. Set 7 cubic yards ...ic feet) of coping on return wing into bank. The return wing into bank was ...7 feet 6 inches by stepping back 6 feet 5 inches from face of abutment six ...feet 5 inches in length, rise 15 inches each.

LOCK.

... excavating for foundation April 27. Completed excavation June ...tone for foundation July 6. Completed foundation July 26. ... for lock walls July 27. Completed setting stone October 24,

...—Length of foundation on river-lock wall, 254 feet. ...idth, 24 feet.

Timbers.—Constructed crib 18 feet wide, 18 feet high, and 350 feet long from the abutment to the cofferdam; sunk same with riprap stone to solid rock.

Laid the following amount of timber:

	Feet, B. M.
57 pieces 12 by 12 inches by 10 feet	6,840
728 pieces 12 by 12 inches by 16 feet	139,776
618 pieces 12 by 12 inches by 20 feet	148,320
649 pieces 12 by 12 inches by 24 feet	186,912
171 pieces 12 by 12 inches by 30 feet	61,560
358 pieces 12 by 12 inches by 32 feet	137,472
2,581	680,880

Sheathing.—Spiked the following oak sheathing on dam:

Oak lumber—	Feet, B. M.
2-inch	24,216
3-inch	66,291
5-inch	560
6-inch	34,524
9-inch	165,626
	291,217

Spikes.—Used the following amount of spikes:

Spikes—	
½ by 6 inches	
½ by 8 inches	
¾ by 12 inches	
¾ by 16 inches	
¾ by 24 inches	

Stone.—Placed 16,361 cubic yards 8 cubic feet of riprap stone in cribbing.

Backing.—Placed 10,949 cubic yards of sand, clay, and gravel, and 2,235 cubic yards of fascines behind dam.

UPPER SHORE GUIDE WALL.

Excavation.—Removed by picking, shoveling, wheeling, and hoisting, 2,586 cubic yards of sand, clay, earth, and gravel to solid rock for foundation.

Piling.—Drove 32 piles, aggregating 293 linear feet.

Timber laid.—Laid the following amount of timber:

	Feet, B. M.
17 pieces 6 by 12 inches by 16 feet	1,632
184 pieces 12 by 12 inches by 16 feet	35,328
172 pieces 12 by 12 inches by 20 feet	41,280
135 pieces 12 by 12 inches by 24 feet	38,880
20 pieces 12 by 12 inches by 30 feet	7,200
46 pieces 12 by 12 inches by 32 feet	17,664
574 pieces.	141,984

Spikes.—Used the following number of spikes:

Spikes:	
¾ by 12 inches	50
¾ by 16 inches	1,026
¾ by 24 inches	114

Stone.—Placed 846 cubic yards of riprap stone in cribbing.

Filling.—Placed behind wall 212 cubic yards of riprap stone.

Dimension of wall.—One hundred and forty-three by 16 feet. Foundation of wall, 24 feet.

LOWER SHORE GUIDE WALL.

[illegible]vation.—Removed by picking, shoveling, wheeling, and hoisting, 3,477 cubic [illegible] sand, clay, earth, and gravel. Blasted 165 cubic yards of solid rock for foun-[illegible]4 feet wide.

Coping stone	
Special stone	
Dressed face	
Quarry face	
Scoured stone	
Foundation stone	
Backing stone	
Concrete	
Spawls and riprap stone	
Grout	
Total amount stone	

Stonework—Rehandled and assorted 8,842 ... stone yard.

Filling.—Placed behind shore-lock wall ... and riprap stone.

Stonework.—Inspected and loaded cut stone ... No. 6. Recut special, dressed-face, quarry ... beveled backing in lock walls. Drilled lew... Cut closures and checks in stone; rounded ... walls. Cut, drilled, and trimmed holes in ... channels and drilled holes for anchor rods a... and trimmed manholes in river and shore ... and mud sills. Cut and rounded co... trimmed stone for grates covering ... and placed same in position. Dri... in position. Bolted all ladders in lo... frames, shafts, screens, and lonsm... Placed iron trestles in position...

... and Lower Lock Gates.—Dressed ... gates in lock walls. Placed op... leaf yellow pine in construction...

... Dredge *Willie* dredged 5... *Ward* dredged 12,723 cubic yards...

Began excavating June 13 ... September 2. Complet... dam, 60 feet.

... excavated to an average ... feet in length and 25 ... amount 1,495 cubic yards ... dredged 20,010 cubic ... of sand, clay, and g... picking, shoveling, and...

... 1,281 piles, 2,877 lin... dam, to an average depth...

umber from river
t, B. M., of hewed
ge, removed same to
platform from coffer-
General work about

ember 14, 1891, to take the
latter had her boilers re-

Removed with scrapers from
ndel for dredge *Ward*, derrick
ock.

BOAT.

it and other material for the works.
d foundations in river for derricks.
ng cofferdam from upper and lower
walls; handled cement and riprap
ound lock and dam.

GE BOAT WARD.

dged the following amount of material:
l, clay, gravel, and stone; for dam, 20,010
lock entrances, 12,723 cubic yards of sand,
ipper handle, and replaced same with new;
inches.
me: 1 dipper, 1 dipper handle, 1 spud, 2 cam
ing wheel, 1 junction band, 1 lever, 1 pump
ts; broke backing chain eleven times, hoisting

S DREDGE BOAT WILLIE.

dredged the following amount of material: For
and, clay, and gravel; for dam, 8,677 cubic yards
k entrances, 500 cubic yards of sand, clay, and

…nding *June 30, 1892.*

	1890.	1891.	1892.
	Tons.	*Tons.*	*Tons.*
……	158,902	224,844	72,749
……	10,670	15,258	13,336
…miscel-…	19,554	21,739	40,618
……	909	1,602	9,025
……	4,682	3,761	21,831
……	2,763	5,636	11,199
……	4,142	4,306	4,098
……	1,995	2,023	3,1[illegible]2
……	210,354	289,219	431,846

…Kentucky River, Kentucky.*

	Length.	Breadth.	Depth.	Tonnage.
	Feet.	*Feet.*	*Feet.*	
	100	15	3	43.64
…	92	13.6	2.2	21.32

…S.

… THE SIX LOCKS AND DAMS ON …, KENTUCKY.

…sion of these locks and dams in …more or less crippled condition, the …yed and the lock gates and operat… need absolute removal or extensive

…tirely rebuilt, the others nearly so. …locks have been constructed, and the …ents protected by timber cribbing to

… been built, the areas in rear of the …nd the grounds graded, sown with grass

… and Dam No. 6, slack-water navigation …which is 121 miles above the mouth of

…general repairs have been made to the …ting torn off by drift, and placing backing …top leaks, etc.

… locks have consisted in replacing defective …by putting in new blocks and arms. When …e been dredged, so as to afford navigation …he lower miter sills, and the guide and pro…nces have been kept in repair.

…e from snags by the United States snag boat … belonging to the general improvement of … a large part of the time operated under the … operating and care of canals, etc., applied …cky. In her present condition this boat is

…er's dwelling is required at Lock No 2.

...of expenses incurred in preserving and maintaining navigation on that ... the Kentucky River, Kentucky, improved by locks and dams, etc.—Continued.

	Lock No. 5.				Lock No. 6.			
	Salaries.	Labor and material.	Current and contingent expenses.	Total.	Salaries.	Labor and material.	Current and contingent expenses.	Total.
1891.								
	$213.00	$110.00	$29.28	352.28				
	233.00	48.10	1.40	282.50				
	165.00	97.70	6.30	269.00				
	229.00	374.56	17.23	620.79				
	227.00	115.30	6.95	349.25				
	233.00	50.36		283.36	$95.00	$27.92		$122.92
1892.								
	186.68	1.80		188.48	186.68	182.55	14.40	
	153.34	9.20		162.54	153.34			
	153.34		2.40	155.74	153.34	56.78	2.40	
	153.34	72.00		225.34	153.34	131.72		
	207.51	89.85	1.08	298.44	207.51	11.40	1.08	
	203.34	165.35	14.47	383.16	203.34	106.60	25.32	
Total	2,357.55	1,134.22	79.11	3,570.88	1,152.55	516.97	43.20	1,

Months.	United States snag boat Kentucky and steamer Fulton.				United States dredges Wil			
	Salaries and labor.	Repairs.	Supplies.	Total.	Salaries and labor.	Repairs.	Su	
1891.								
	$973.50	$79.44	$452.71	$1,505.65	$407.78	$52.88	$6.15	$466.81
	1,021.00		450.45	1,471.45	290.00	11.20	58.91	360.11
ber	959.49	16.90	548.61	1,525.00			51.35	51.35
	936.82		199.28	1,136.10	433.38	451.06		884.44
ber	948.50		984.44	1,932.94	427.50			427.50
er	932.50	11.10	704.05	1,647.65	435.00	47.81		482.81
1892.								
y	832.49		1.50	833.99	307.17			307.17
ry	589.00			589.00	140.00		10.60	150.60
	446.00	120.68	54.56	621.24	204.00			204.00
	491.00			491.00	214.84	33.70		248.54
	780.32			780.32	323.83			323.83
	972.99	3.13	654.60	1,630.72	390.00		496.15	886.15
Total	9,883.61	231.25	4,050.20	14,165.06	3,573.50	596.65	623.16	4,793.31

SUMMARY.

...o. 1, Kentucky River, Kentucky	$9,826.17
...o. 2, Kentucky River, Kentucky	2,884.08
...o. 3, Kentucky River, Kentucky	3,053.44
...o. 4, Kentucky River, Kentucky	4,148.11
...o. 5, Kentucky River, Kentucky	3,570.88
...o. 6, Kentucky River, Kentucky	1,712.72
...States snagboat *Kentucky* and steamer *Fulton*	14,165.06
...States dredges *Willie* and *Ward*	4,793.31
...eper's dwelling, Lock No. 2	1,446.10
...eper's dwelling, Lock No. 3	1,316.77
...eper's dwelling, Lock No. 5	978.17
... boat	1,104.59
...rand total	48,999.40

With the exception of N[illegible] ams are in an effective [illegible] ctly extended downst[illegible] [illegible] at once, high wat[illegible] ow. For details conc[illegible] ention is invited to the [illegible] herewith:

1885	[illegible]
1886	[illegible]
1887	[illegible]
1888	[illegible]
1889	[illegible]
1890	[illegible]
1891	[illegible]
1892	[illegible]
Total	[illegible]

Detailed statement of [illegible] portion of the Ken[illegible] year ending June

Months.
1891.
July
August
September
October
November
December
1892.
January
February
March
April
May
June
Total

Month
1891
[illegible]
1892
[illegible]
Total.

LOCK NO. 3.

...g knocked off by drift; respiked old sheathing; re-
...f dam.
...pleted construction of lock-keeper's dwelling; laid 66
...around dwelling; graded and sodded around dwell-

...s required at either lock entrance.
...n old lock-keeper's dwelling; repaired and repainted lock
...irons; whitewashed fence around premises; removed drift
...ces and walls.
...was no suspension of navigation at this lock except for
...alls were submerged eleven days during the year.
...urred April 22, upper gauge reading 24 feet, lower gauge

...urred November 5, lower gauge reading 5 feet, upper gauge

LOCK NO. 4.

...l from steps of dam 324 pieces of defective step sheathing and re-
... new oak sheathing; repaired upper slope of dam.
...wall.—Spiked 1,188 feet B. M. oak sheathing on face of wall.
...—Repaired and repainted lock gates and operating irons; removed
...entrances and walls; repaired tool house; stopped leak in dam; re-
...crete crib wall; built fence at lower end of premises; whitewashed

...—Dredge *Ward* dredged 1,010 cubic yards of sand and mud from upper
...and 25 logs; from the lock pit, 200 cubic yards, and from the lower entrance,
...yards of sand and mud.
...*remarks.*—There was no suspension of navigation at this lock except for
...during the year. The lock walls were submerged thirteen days.
...ighest water occurred April 22, upper gauge reading 22.3 feet, lower gauge
...25.8 feet.
...west water occurred October 17, upper gauge reading 4.8 feet, lower gauge
...4.4 feet.
...*ing Lee Town bar.*—This bar had shoaled so badly during the past year that it
...d dredging. The dredge *Ward* has dredged, in deepening and widening the
..., 3,500 cubic yards of earth, sand, and gravel, and removed same in dump

LOCK NO. 5.

...—To stop leak through the dam, 377 cubic yards of stone and clay and 20
...f brush were placed behind as backing. Respiked old step sheathing; removed
...tive pieces and replaced same with new oak sheathing.
...*-keeper's dwelling.*—Completed construction of new dwelling for lock-keeper;
...l and built brick walks around dwelling; constructed 1 tool house.
...*ral work.*—Tore down old dwelling and utilized material in building walks
...cing Government land. Painted lock gates and assistant lock-keeper's dwell-
...moved drift from lock entrance and lock walls.
...*ral remarks.*—Navigation was suspended fifteen days on account of high water
...rteen days on account of low water, caused by the construction of Lock No.
...leaks in the dam at Lock No. 5. The entire river was shut off from below
...No. 6 for a period of twenty-eight days at the driest season of the year, when
...the water was being voided from the upper river, the lower river being depend-
...on small branches and springs to maintain the pool, while pool No. 6 was fill-
...This will account for all the low gauge readings at all the locks.
...lowest gauge reading occurred October 15, upper gauge reading 0.10 foot, lower
...reading 4.90 feet. The highest water occurred April 22, the upper gauge
...g 22.60 feet, the lower gauge reading 33.50 feet.

LOCK NO. 6.

...lock was in operating condition for navigation November 21, 1891. For lack
...ds the lower shore and river guide walls, as well as the upper river guide wall,
...not constructed.
...ing behind the lock wall, grading and paving the bank, and constructing lock-
...r's dwelling were also omitted. A sufficient quantity of backing was not
...behind the dam.

kages on Kentucky River, Kentucky, for fiscal year ending June 30, 1892.

ks.	Days operated.	Days suspended.*	Going up. Steamboats.	Going up. Barges and flats.	Going up. Miscellaneous.	Going down. Steamboats.	Going down. Barges and flats.	Going down. Rafts.	Going down. Miscellaneous.	Total crafts and flats passing.	Total number lockages.
....	336	30	439	153	64	453	182	223	70	1,564	1,2[illegible]
....	348	18	426	156	94	438	134	195	125	1,562	1,3[illegible]
....	355	11	290	149	89	290	147	114	114	1,193	1,063
....	353	13	301	157	160	302	149	209	155	1,433	1,236
....	338	28	179	63	105	175	59	1,431	134	2,146	1,447
....	223	......	47	61	42	47	61	1,271	31	1,580	685
....	......	......	1,682	733	554	1,705	732	2,443	649	9,496	4,999

h water and filling Pool No. 6.

G G 6.

IENT OF LICKING RIVER, KENTUCKY, BETWEEN FARMERS AND WEST LIBERTY.

ject for the improvement of this river was approved by the of War under date of September 20, 1888, and provides for f snags, detached rocks, and bowlders, with a view to im- ow-water navigation and rafting.

close of the last fiscal year a working party, which had com- ork at West Liberty, May 15, had reached Blackwater Creek, below. During the balance of the season, which closed Sep- , the work of improvement was carried to Farmers, and the ninent obstructions removed or lessened in degree. The gen- each season has been to afford as much relief as possible in of general improvement of the river between Farmers and erty, a distance of 68 miles, and the small appropriations e it impossible to thoroughly complete the work in any lo-

the fiscal year ending June 30, 1892, the following work was

Class of work.	Number.	Cubic yards.	Average length.	Average circumference.
			Feet.	*Feet.*
moved	....	2,[illegible]	....	....
moved	....	[illegible]	....	....
d	4[illegible]	....	[illegible]	5.2
d	1[illegible]3	....	6[illegible].4	5.[illegible]
ved	[illegible]	....	....	....

ver, under the present project, is not susceptible of permanent nent, for the reason that such obstructions as snags, leaning mps, etc., are liable to occur after each high water.

al estimate of the cost of this improvement was $17,680 iles of river between Farmers and West Liberty, and it is l that of the balance yet unappropriated $5,000 be appro- fiscal year ending June 30, 1894.

[illegible] WEST VIRGINIA [illegible]

[illegible] the [illegible]
[illegible] miles and [illegible]
[illegible] and the [illegible]
[illegible] and the [illegible]
[illegible] boundary between [illegible]
[illegible] southwest [illegible]
[illegible] with the [illegible]
[illegible] in the [illegible]

ses during low water, and thus afford advantages for mining coal at no other location for a single lock could give.

At the close of the last fiscal year the lock was completed and quipped, a part—80 feet—of the permanent dam had been constructed, nd the timber for the remainder had been contracted for and partly elivered. The abutment had already been built. The construction of fixed dam was opposed by the timber and shipping interests, and nder date of May 20, 1891, a Board of Engineer Officers was constituted "to consider and report upon the subject of the dam to be built n the Big Sandy River."

In its final report, the Board recommended the substitution of a needle dam in place of a fixed dam, the clear height of the pool formed by it to be 13 feet above the sill of the Navigable Pass.

As the length of the Navigable Pass should be sufficient to accommodate the commerce that may use it, and as the transportation of timber by rafting is the principal industry as yet developed on the river, the pass should evidently be long enough to pass rafts of the ordinary size, particularly as rafting is carried on at stages as low as 6 feet.

Considerations of economy with regard to construction and operation require that the pass should be as short as possible, consistent with the requirements of commerce. The circumstances of the case appear to require that the pass should be about 130 feet long.

In determining the elevation of the sill of the pass, the general principle that it, the sill, must not be an obstruction to navigation, should govern; in other words there must be as much depth on it, as boats can carry to it. This consideration would fix its elevation at least as low as the highest shoals.

When the lock was planned the elevation of its lower miter sill was fixed at 9 inches below the then accepted low water. Since then there are indications that the low-water surface at Louisa is higher than it was formerly. This is evidenced by the gauge readings in connection with the general condition of the river at the present lowest stages, and the fact that a part of the old steamboat landing at Louisa, which was formerly out of the water at lowest stages, is now and has been for a number of years, submerged at the lowest water. Push-boat navigation, which is effective with a draft of 9 inches, forms a fairly good practical standard of comparison for determining the relation between lowest stages of different years.

Granting that the reading of the lowest water is greater now than it was in former years, an explanation for it may be found, possibly, in the fact that since the commencement of the construction of the lock there has been a great change in the condition of affairs at and near the site of the lock, due to the partial obstruction of the natural waterway; but whether the change in low-water level will continue to exist as it now is, increase or diminish, can hardly be stated definitely, although the last would appear to be the most unlikely to occur.

Should there be no further change, it would be safe, taking into account the gauge readings during the low-water season, to place the sill of the pass one foot above the lower miter sill of the lock.

The needles forming the dam, pass, and weir, are to be supported by e trestles, with an escapement which will allow the escape of all eedles between adjacent trestles at one time, thus doing away the slow and laborious method of taking out each needle sepa-

ns and estimates of cost of the dam and its accessories will be itted at an early date.

site of Louisa is a movable dam of needles supported by trestles, and recommends the substitution of that type for the fixed dam now in course of construction. The estimated cost of constructing the movable dam proposed is $93,000, and, as there are only $17,000 on hand available for the fixed dam, a further appropriation of $76,000 will be necessary if the views of the Board are to be carried out.

I concur in the recommendations of the Board and recommend that the report be transmitted to the Speaker of the House of Representatives for the information of the Committee on Rivers and Harbors.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[illegible] PROCTOR,
Secretary of War.

[illegible] OF OFFICERS OF THE CORPS OF ENGINEERS ON [illegible] SANDY RIVER, NEAR LOUISA, KENTUCKY.

NOVEMBER 10, 1891.

[illegible] Board of Officers of the Corps of Engineers, consti- [illegible] from your office, May 20, 1891, "to con- [illegible] the subject of the dam to be built in the Big [illegible] Louisa, Ky., have the honor to submit final report,

[illegible] authorized, and was under construction, of [illegible] construction was going on the subject of [illegible] the Board because of a communication [illegible] Mr. E. Nigh, of Ironton, Ohio, [illegible] the Senator to the Secretary of [illegible] was made to the type of [illegible] was expressed for a "wicket dam [illegible] request was made "to have [illegible] with the work." This [illegible] report by this Board. [illegible] regard to the kind of [illegible]

[illegible] the Board assembled at [illegible] the next day at 10 [illegible] statement of parties in in- [illegible] of the fixed dam, [illegible] dam, and others [illegible] to completion.

[illegible] representatives from [illegible] forks, as [illegible] with the [illegible] Board was un- [illegible] Those [illegible] expressing [illegible] the dam be movable. [illegible]

[illegible] the rafts as [illegible] the raft- [illegible]

[illegible] will so fill

be useless, and for the same reason the exit from the lock ill so fill in with sand as to prevent the passing of rafts even ı great part of the rafting stages.

opposed to the change of type desire the work to be carried on esent authorized, because—

ıe dam now under construction can be completed and made e at an earlier period than a dam of the changed type can be

he system of fixed dams will cost less than a system of movable nd consequently the river will be sooner improved with the ; appropriations made for the work.

ıarties dissent from the parties opposed in regard to the appre- s of serious evils inherent to the fixed type when applied to the ıdy River.

this report, and returned with the original case, are a number nunications in which parties in interest have expressed views sides of the question at issue and to which attention is invited. first dam, while one in a series of similar structures, is specially d, in advance of the construction of others in the series, to pro- ›ool for the harboring of loaded barges during low water. These ın not get out of the pool during low water because of the lack ;h below the lock and out to the Ohio River. A rise from ›er river must then be awaited. The rises from the upper river arge numbers of rafts, and it would then come about that the ccumulated in this harboring pool and the arriving rafts would eeking passage through the lock during these periods of high To what extent this demand would tax the capacity of the lock ıin periods of time can not be determined from any data now at To assume how many barges would be harbored in the pool at ; time would be mere guesswork. Information in regard to the ' of rafts arriving per hour for any defined period is very in- ·. Attention is invited to the following tabular statement:

Timber output of Big Sandy River, 1882–'90.

ic feet.	Number of lockages of 8,000 cubic feet each.	Number of days river was at rafting stage at Louisa, Ky., 6 to 15 feet.	Remarks.
24,000	690	....	
95,000	587	10	Record last half year only; no record for first half year.
26,920	778	80	
44,565	543	68	
71,360	1,021	143	
89,080	1,211	65	
25,210	665	29	Record for first half year only; no record for last half year.
55,000	569	182	
18,735	602	142	

* Given in reports as 107,083 tons, including cross ties.

lock is large enough to take two rafts at one lockage, and it is d that three lockages at least could be made in one hour. The nfavorable year for the lock would have been 1887, when 1,211 ›s of rafts would have been required in sixty-five days, or less venty lockages per day. No other year for which the record is te would have required as great an average as ten lockages per ring the rafting stages. There is no doubt that the lock could

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] tests ar

[illegible]

[illegible] is conce

[illegible] The stre

[illegible] against th

[illegible] arrest the n

[illegible] to the determ

[illegible] are brought do

[illegible] is available.

[illegible] for the Board n

[illegible] shown. The section

[illegible] within a short interv

[illegible] salt wave do

[illegible] before the m

[illegible] a met

[illegible]

[illegible] down from ab

[illegible] decreasing the

[illegible] progress dow

[illegible] the lowering of

[illegible] available

[illegible]

[illegible] used only du

[illegible] salt would be

[illegible] general

[illegible] the

determined whether there has been any deposit of sand to inter-th the passage through the lock. If such be found, the deposit removed and the lock put in perfect condition for use before the eed be closed. Thus navigation will not be prevented for an in-

practical use of a movable dam, as indeed of any dam, involves ly of water to cover the leakage through it when closed; other-he maintenance of the pool to its normal or even to a useful level impracticable. Measurements of the discharge of the river at varying from 16.2 feet on the gauge down to 1.98 feet on the have been made, and a tabulation of these measurements is in-with this report. In a wicket dam the spaces between the s are 4 inches wide. Under the conditions at Louisa the dis-through one of these spaces at low water would be about 52¼ feet per second if the wickets were as high as at Dam No. 5, Kanawha River.

e assume a weir with wickets 8 feet high, the discharge through ace would be about 24¼ cubic feet per second. If wickets be 4 om center to center throughout, this leakage through the spaces ot of pass would be about 13 cubic feet, and per foot of weir would out 6 cubic feet per second. Assuming for the Louisa dam 124 r the pass and 176 for the weir, their would be required about cubic feet per second to supply this leakage; that is, an amount to the discharge of the stream at the guage reading of 5 feet, or hat over.

spaces between the wickets, however, are covered at need by ings called joint covers, laid cornerwise upon them. An actual ence with a discharge measurement on the Great Kanawha River ven the following data: There are 62 wickets in the pass and 53 weir. Those in the pass are 13 feet vertical height from the sill top of the wicket, and inclined at an angle of 15½°; similarly on the weir are 5 feet high, and inclined at an angle of 12°. The below the dam stood 1.64 feet above the sill of the pass. The as maintained at fifteen-hundredths of a foot below the tops of ckets. Under these conditions the discharge through each space en the wickets of the pass would be nearly 52 cubic feet per sec-nd through each space between the wickets on the weir about 12 feet; that is, it would require 3,860 cubic feet per second to sup-e leakage through these spaces of Dam 5. Joint covers had been l over 60 of the spaces in the pass, and over 21 spaces on the weir. ischarge of the stream was measured below the dam and found to out 1,130 cubic feet per second. This measurement was taken the Elk River, and assuming the discharge of that tributary as 30 cubic feet, the balance of 1,100 cubic feet maintained the pool n 5 to the level and under the conditions stated; that is, this par-vering reduced the amount necessary to maintain the pool to 30 nt of that necessary to supply the discharge through all the spaces overed. There were 2 spaces in the pass and 32 on the weir ered. The estimated discharge through these spaces was about bic feet per second, leaving 612 cubic feet as the leakage through int-covered portion of the dam, and between the wickets and the f that portion not joint covered. Omitting consideration for the f the leakage under the wickets having no joint covers, the leakage gh the joint-covered portion of the dam would be less than 1⅞ cubic er foot of the aggregate length of the joint-covered portions of the weir. But the leakage under the wickets is not to be neg-

ill suffice to maintain the pool to a useful height. This addi-
ver, in the opinion of the Board, is easily feasible.
bserved that the lowest gauge reading so far reached this year
which measurement of discharge has been made is not so low
een recorded in past years; the low water of 1883 was 1.23
r. How much less the discharges were in the lower recorded
f past years can not be ascertained or even estimated. There
ations that the bottom of the stream has filled somewhat with
these latter years, and a result of this filling would be that
scharge would correspond to higher gauge reading. So that,
the gauge reading has been as much lower as stated, it does
e that the discharge has been correspondingly low. The tabu-
the gauge record indicates an obliteration of the lesser gauge
as time progresses; such would actually result from filling of
om.
full and careful consideration of all the elements determining
n, the Board are of opinion that the best type of dam for the
ouisa is a needle dam, and they recommend the substitution of
e for the fixed dam. It is further recommended that the height
am from the sill of the pass to the normal level of the pool be
13 feet, and that the dam be built across the river opposite the
of the lock as is done in our practice, leaving all other details
ought out by the officer in charge.
eedle dam for the site near Louisa will cost somewhat less than
t dam.
'9 the recommendation was made by the officer in charge to
fixed dam, with a view of ultimately turning the fixed dams
able ones. Since that time experience has been had in this
with the operation and action of movable dams, and the Board
pinion that the trial now made should be with that kind of

this report are inclosed a number of letters and papers ad-
to the Board, and a list of them is also herewith.
ated cost of constructing a movable dam of needles, supported
tles, Poirée system, on Big Sandy River, near Louisa, Ky.:
le pass, 125 feet; weir, 175 feet; vertical height of needles of
feet; of weir, 8 feet.

PASS AND WEIR.

ts:	
sill, 223.75 cubic yards, at $20	$4,475.00
trestle stone, 102.5 cubic yards, at $16	1,640.00
ed stone, 839 cubic yards, at $7	5,873.00
g stone, 315 cubic yards, at $10	3,150.00
ete stone, 2,688 cubic yards, at $7	18,816.00
ght-iron tie-rods, etc., 13,200 pounds, at 4 cents	528.00
iron anchors, 11,000 pounds, at 4 cents	440.00
le journal-boxes, 17,625 pounds, at 7 cents	1,233.75
, nuts	300.00
	36,455.75
abutment:	
g, 79 cubic yards, at $16	1,264.00
ry face stone, 241 cubic yards, at $8	1,928.00
ed stone, 341 cubic yards, at $7	2,387.00
ing stone, 1,169 cubic yards, at $5.50	6,429.50
	12,008.50

[illegible]

iines have been opened at and near Peach Orchard, and quite e shipments are made by rail to Ashland, on the Ohio, where in barges for transportation down that river. Could coal be out by water from the mines the output of coal would be largely l.

rk on this stream can only be done to advantage during low was September 10, when the working parties were sent out. ork of previous years has removed the most important obstruc- that during the past season it was only necessary to clear out hat had become obstructed by material washed in during the g high waters, and take out such obstructions as logs, stumps rs that are always found in the channel after a rise. llowing is a summary of the season's work:

Work.	Cubic yards.	Number.	Average length.
moved	320		
emoved	1,310		
ed		390	25.7
ed		150	69.3
oved		276	
l		9	

ream under the present project is incapable of permanent im- nt, as the obstructions to navigation, such as snags, stumps, logs, liable to re-form at any time and an annual appropriation of ,500 is needed to keep it clear.

APPROPRIATIONS.

880	$2,500
1881	2,000
1882	5,000
85	5,000
1886	3,750
r 19, 1890	2,500
al	20,750

Money statement.

91, balance unexpended	$1,151.76
892, amount expended during fiscal year	1,131.90
92, balance unexpended	19.86
ppropriated by act approved July 13, 1892	2,500.00
vailable for fiscal year ending June 30, 1893	2,519.86
that can be profitably expended in fiscal year ending June 30, 1894	2,500.00

ed in compliance with requirements of sections 2 of river and r acts of 1866 and 1867.

G G 9.

EMENT OF TUG FORK OF BIG SANDY RIVER, WEST VIRGINIA AND KENTUCKY.

ug Fork is the eastern of the two forks which unite at the town a, 26 miles from the Ohio, to form the Big Sandy River. It the southwest corner of West Virginia and flows towards the

has been no change in the situation so far as I can determine, that the obstructions have been increased.
stream is incapable of permanent improvement, as the obstrucrmed by logs, snags, etc., are liable to re-form at any time, and annual appropriation is needed to keep it free.
ollowing is a summary of work done during the past fiscal year:

k removed	cubic yards.	80
k removed	do	2,147
noved	number	392
noved	do	392
emoved	do	350
ped	do	192

APPROPRIATIONS.

1880	$2,500
1881	2,000
, 1882	5,000
84	5,000
, 1886	3,750
er 19, 1890	2,500
tal	20,750

Money statement.

891, balance unexpended	$1,421.67
1892, amount expended during fiscal year	1,270.33
892, balance unexpended	151.34
892, outstanding liabilities	40.55
892, balance available	110.79
appropriated by act approved July 13, 1892	2,500.00
available for fiscal year ending June 30, 1893	2,610.79
it that can be profitably expended in fiscal year ending June 30, 1894, tted in compliance with requirements of sections 2 of river and or acts of 1866 and 1867.	2,500.00

G G 10.

IMPROVEMENT OF GUYANDOTTE RIVER, WEST VIRGINIA.

Guyandotte River rises in the southwestern part of West Virnd, flowing in a northwesterly direction, empties into the Ohio s above the mouth of the Big Sandy and 39 miles below the of the Great Kanawha.

project for the improvement was adopted in 1878, and contemthe obtaining of a clear channel with a width of 30 feet and a epth of 18 inches during five months of the year by the removal s, snags, and other obstructions. This river was practically before work commenced, except during rises of considerable

stream was once improved by the State of Virginia by the conn of six locks and dams. The locks were constructed of timber, a matter of course, after a time, the charges for repairs, rendered necessary by the natural decay of the wood, became very great, and a little further along the system was abandoned, and what had formerly constituted a useful improvement now became obstructions. The old locks and dams were carried away in part from time to time by floods, so that when the first report on this river was made by Maj. William E. Merrill in 1875 most of them had been partially washed away, but the ruins of one still constituted the worst obstruction on the river.

There are two milldams—Pecks, 7 miles below Logan, and Lamberts, 19 miles below Pecks—that still constitute serious obstructions to navigation, and have been reported to the Department as such. The authority for their construction in the first place was based upon a permit from the circuit court, and their continuance has been a nuisance and constant damage to the river interests.

The work in previous years has been to cut passage ways through the old dams where required, make channels through the shoals for push boats, and remove such obstr ions as rocks, snags, stumps, logs, etc., existing in the channel, he river as would interfere with rafting at ordinary and low raising stages. During the past year the work done has been with a view to assisting the running of rafts. The stream is incapable of permanent improvement, as the obstructions in the channel, such as trees, snags, logs, etc., are liable to re-form. The stream up to Logan, a distance of 81½ miles, has an average fall of about 22 inches to the mile.

For details concerning the work attention is invited to the report of Assistant Engineer B. F. Thomas, attached hereto.

APPROPRIATIONS.

June 18, 1878	$2,000	July 5, 1884 *	$2,000
March 3, 1879	1,000	August 11, 1888	2,000
June 14, 1880	2,000	September 19, 1890	2,000
March 3, 1881	3,500		
August 2, 1882	2,000	Total	16,500

Money statement.

July 1, 1891, balance unexpended	$1,397.00
June 30, 1892, amount expended during fiscal year	1,303.30
July 1, 1892, balance unexpended	93.70
July 1, 1892, outstanding liabilities	.25
July 1, 1892, balance available	93.45
Amount appropriated by act approved July 13, 1892	2,000.00
Amount available for fiscal year ending June 30, 1893	2,093.45
Amount that can be profitably expended in fiscal year ending June 30, 1894	2,000.00
Submitted in compliance with requirements of sections of river and harbor acts of 1866 and 1867.	

REPORT OF MR. B. F. THOMAS, ASSISTANT ENGINEER.

LOUISA, KY., *June 30, 1892.*

MAJOR: At the close of the last fiscal year a force was at work on Guyandotte River at Big Huff Creek widening the chute at that point. About 1,600 cubic yards of rock were removed during the first half of July, when the party began the descent of

* Made available by act of August 5, 1886.

r, working as they went. At Fish Trap Shoal a large rock was taken out; ee which was in the chute. The point of the bar was cut off and a slip on bank was removed. At Neiberts Bend, 7 miles above Logan, a portion oint of Cloyds Island and a heavy rock slip on the east side of the river noved, forming a most useful and excellent piece of work. The point of a ar was cut off at Lawsons Mill, where the river makes a short bend. A large taken out of the main channel at Logan and three more near King Shoal. cks were removed at Dry Island and also three at King. Some rocks were about 5 miles below Big Hart Creek. A great many trees, stumps, snags, re removed all along the river from Kings Shoal to Rogers Dam, a distance iles. At Barboursville a very bad piece of river was found and considerable as done there, but the appropriation was exhausted without completing the ment. There is a rocky island and also a rock bar that ought to be removed, lie in a bend of the river and at certain stages of water are a great and dan- obstruction. A detailed statement of work done is below:

ck removed	cubic yards..	424
ock removed	do....	4,280
emoved		15
emoved		32
emoved		7
s removed		300
d with boats	miles..	172½
ployed (average)		10

improvements made by the United States on this stream have been of great to the people of that section, and it is estimated that the output of timber atly increased this year. A small steamboat now plies the river, and if the ment would remove the dams in the lower part of the streams there is nothing er steam navigation to within 7 miles of Logan, or a distance of 73 miles. Of there are other obstructions in the bed of the river and overhanging timber must be removed before navigation can be an entire success, but the principal o be done is to secure the removal of the dams heretofore reported as obstruc- o navigation. I think that further appropriation for the Guyandotte River be made for that purpose solely until the removal of all dams is effected. R. able conducted the work.
ectfully submitted.

B. F. THOMAS,
Assistant Engineer.

D. W. LOCKWOOD,
Cincinnati, Ohio.

COMMERCIAL STATISTICS.

erce of Guyandotte River, West Virginia, for the fiscal year ending June 30, 1892.

Articles.	1891.	1892.
	Tons.	*Tons.*
es		12,500
	60,000	90,000
neous	1,128	1,300
otal	61,128	103,800

List of boats plying on Guyandotte River, West Virginia.

Name.	Character.	Length.	Breadth.	Depth.	Tonnage.
		Feet.	*Feet.*	*Feet.*	
Lirker (tow)	Side wheel	73	8	2	7

G G II.

IMPROVEMENT OF LITTLE KANAWHA RIVER, WEST VIRGINIA.

The Little Kanawha drains the central portion of West Virgini rising in Upshur County; its course is a little north of west and empties into the Ohio at Parkersburg; its total length is about 1 miles.

The Little Kanawha Navigation Company owns and operates fo locks and dams on this river, which furnish slack-water navigation fro the Ohio up to a point two miles above the village of Burning Spring where the United States lock is located, but the service of this sy tem is very poor, owing to the dilapitated condition of both locks an dams; breaks and washouts are of frequent occurrence during hig water, and the interruption to navigation in consequence expensi and harassing.

The present project for the improvement of this river, adopted i 1876 and modified in 1880, contemplates the construction of a lock an dam to extend slack-water navigation for a draft of 4 feet a distance 12 miles above the point reached by the navigation company, and th improvement of the natural channel of the upper river by the remova of obstructions, etc., for a distance of 80 miles, the object of the latte being to obtain a channel of a minimum width of 40 feet with a dept of 2 feet for at least four months in each year.

During the past fiscal year the lock and dam were completed to such an extent that the lock was opened to navigation December 2, 1891. It was found impossible to complete the backing of the dam before the winter set in, and this work was deferred until after the spring floods. The backing of the dam is now in progress and will be completed in a short time. As always happens where proper bank protection is not put in in advance, the banks just below the lock and abutment have washed considerably, but not to a dangerous ex- tent. The completion of the lower shore guide wall and placing of rip- rap below the abutment will effectually secure the banks against further washing.

For details of work done during the past year attention is invited to the report of Assistant Engineer B. F. Thomas, appended hereto.

APPROPRIATIONS.

August 14, 1876	$7,300	August 5, 1886	$16,87
June 18, 1878	18,000	August 11, 1888	25,00
March 3, 1879	18,000	September 19, 1890	40,00
June 14, 1880	15,000		
March 3, 1881	40,000	Total	211,17
August 2, 1882	31,000		

Money statement.

July 1, 1891, balance unexpended	$27,315.2
June 30, 1892, amount expended during fiscal year	23,805.8
July 1, 1892, balance unexpended	3,509.4
July 1, 1892, outstanding liabilities	986.(
July 1, 1892, balance available	2,523.:

... the space behind the lock
... next month, as the cold weathe
... building the protection cribs i
... was done in September, and
... used in filling the cribs. Th
... transported in cars down
... the works. At the start the
... quarry, but owing to th
... on the ground without
... hauling up the empties.
... at the top of the incline.
... very well. Now that a p
... to obtain stone from a qu

... lock gates without pump
... across the lock jus
... longer of use. When put
... half a mile below l
... the lock chamber an
... the concrete was tal

... an adjacent sa
... and this had to
... during the season
... was pumped ou
... The
... by men
... The material th
... barge loads
... During

erable inconvenience and expense as well as delay was caused by the draw- pool to repair the Palestine Lock, belonging to the Little Kanawha Navi- ompany. This so reduced the water that but small loads of stone could be nd even these had to be tied up some distance below when needed and the eeled in barrows to its destination. At times the length of wheeling was It was very tiring to men as well as expensive and slow.

this year the contract for timber for dam was filled, and timber for the cribs purchased. T. W. Moore, the contractor, furnished 417,686 board measure mber. Smith & Co. also furnished some timber for protection cribs. The s were furnished by Pattin, Hall & Pattin, of Marietta, Ohio.

tfully submitted.

B. F. THOMAS,
Assistant Engineer.

. W. LOCKWOOD,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

of Little Kanawha River, West Virginia, for fiscal year ending June 30, 1892,

Articles.	1890.	1891.	1892.
	Tons.	*Tons.*	*Tons.*
	1,100	10,507	3,100
	8,540	28,677	20,486
	678	1,450	1,738
	24,500	26,964	10,050
	70,000	59,703	109,337
road	27,650	48,312	92,200
rs	1,563	1,500	1,343
eous	6,084	13,575	6,000
al	140,115	190,688	244,254

List of boats plying on Little Kanawha River, West Virginia.

[Character, stern-wheel.]

Name.	Length.	Breadth.	Depth.	Tonnage.
	Feet.	*Feet.*	*Feet.*	
packet)	104	19.5	4.2	75.78
lton (packet)	105	22	3.6	67.54
ason (tow)	99	17	2.6	80.45
tow)	66.5	....	3	34.93
(tow)	86	13.6	....	....
tow)	98.4	15.1	2.6	37.16

G G 12.

ATING AND KEEPING IN REPAIR THE LOCK AND DAM ON LITTLE KANAWHA RIVER, WEST VIRGINIA.

k and Dam No. 5 of the Little Kanawha River were so far ad- d towards ultimate completion that the lock was opened to navi- December 2, 1891, and has since that time been continuously ted, with the exception of a short time during June, when it was l to readjust the lower gates to the miter sill and put new screens chamber openings of the lower culverts.

lerable damage was done to the dam during the winter by s and ties going over it and pounding off the sheeting of the , but as the companies or firms engaged in running logs in

this manner have put in booms above the lock, it is hoped that t
will be no trouble from this source in the future.

Allotment for year ending June 30, 1892, $1,500.

Detailed statement of expenses incurred in preserving and maintaining navigation o portion of the Little Kanawha River, West Virginia, improved by lock and dam duri fiscal year ending June 30, 1892.

Months.	Salaries.	Labor and material.	Current and contingent expenses.	T
1891.				
December	$95.00			
1892.				
January	95.00		$14.25	
February	95.00	$21.25	3.65	
March	95.00		1.25	
April	95.00		1.25	
May	95.00			
June	95.00			
Total	665.00	21.25	20.40	

REPORT OF MR. B. F. THOMAS, ASSISTANT ENGINEER.

LOUISA, KY., *June 30, 1*

MAJOR: Locking was begun on the Little Kanawha River, at Lock No. 5, o cember 2 last, and nothing has occurred to interfere with navigation since except a short stoppage to repair a leak between the lower gates and miter sill ing the present month. The lock has been in fine working condition ever si was opened to navigation. While the approaches to the lock were being made after the completion of the dam, some of the timber firms operating on the became fearful that navigation through the lock would not be opened speedil made no preparations for holding their timber in the upper pool, but allowed escape over the dam. This was continued for several weeks after navigation established and assured, and the dam was greatly injured by the loose logs and ties pounding the decking or floor. The lower step of the dam has been partl ried away and nearly all loosened, and the entire lower face of the work has damaged more or less. For the past two or three months but few logs have over the dam, and the lockage of rafts has greatly increased in consequence. construction of this dam has lengthened the navigable river about 12 miles boats run regularly to Creston at the mouth of the West Fork. This is of benefit, not only to people living in the vicinity of the pool, but also to those pying the upper part of the valley, as it brings the head of navigation much n to them.

The intention originally was to employ but one lock tender, as is done on the below owned by the Little Kanawha Navigation Company, and with this ide one lock house was built. The greatly increased business of the river, partic in timber and cross-ties, which is always greatest at the upper lock, made i essary to employ an additional lock tender, and it will be to the interest of the U States to erect another dwelling this season for his use.

No damage of consequence has resulted to the lock. Two wicket screens torn off during the high water of the winter and spring, but caused neither i venience nor delay to navigation.

The river bank below the abutment has washed away considerably, and it v be best to protect it with riprap before another winter. Below the lock ther been some erosion of the land, but it has not yet progressed far enough to caus easiness, and the probabilities are that it will stop without damage to the wo adjacent property.

Respectfully submitted.

B. F. THOMAS,
Assistant Engin

Maj. D. W. LOCKWOOD,
Corps of Engineers, U. S. A.

*ges on Little Kanawha River, West Virginia, for fiscal year ending June 30, 1892.**

ited	197
nded	13
boats	259
and flats	168
laneous	61
n:	
boats	361
and flats	146
	1,915
laneous	52
s and flats passing	2,913
ber of lockages	2,871

G G 13.

OVEMENT OF BUCKHANNON RIVER, WEST VIRGINIA.

t for the improvement of this stream, approved in 1884, is that portion of the river between the Three Forks and the khannon, a distance of 24½ miles. The obstructions consist and bowlders, some of which are estimated to contain 500

t called for a channel 30 feet wide.

on River is a tributary of the Tygart Valley, and rising in stern part of Randolph County, W. Va., flows a little east il it empties in the Tygart Valley River in Barbour County. nce from the Three Forks to the mouth is 47½ miles, and the of the stream is about 57 miles.

e past fiscal year work was commenced during the last gust, and continued so long as the balance of funds available ant.

large bowlders were removed, containing in all 3,510 cubic one, and 136 trees and 25 logs were taken from drifts and

onal appropriation is required for this work.

APPROPRIATIONS.

	$1,500.00
	1,500.00
8	1,500.00
1890	1,000.00
	5,500.00

Money statement.

alance unexpended	$1,027.40
amount expended during fiscal year	1,010.18
alance unexpended	17.22

* through lock suspended six days on account of high water, and seven lock gates.

APPENDIX H H.

IMPROVEMENT OF HARBORS ON LAKE SUPERIOR.

REPORT OF CAPTAIN W. L. FISK, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Harbor at Grand Marais, Minnesota.
2. Harbor at Agate Bay, Minnesota.
3. Harbor at Duluth, Minnesota.
4. Harbor at Superior Bay and St. Louis Bay, Wisconsin.
5. Minnesota Point at Superior, Wisconsin.
6. Harbor at Ashland, Wisconsin.
7. Harbor at Ontonagon, Michigan.
8. Eagle Harbor, Michigan.
9. Harbor at Marquette, Michigan.
10. Harbor of refuge at Grand Marais, Michigan.

EXAMINATION AND SURVEY.

11. St. Louis River, Minnesota and Wisconsin, from Grassy Point, in St. Louis Bay, to Fond du Lac.

UNITED STATES ENGINEER OFFICE,
Duluth, Minn., July 1, 1892.

GENERAL: I have the honor to transmit herewith annual reports upon works of river and harbor improvement at present in my charge for the fiscal year ending June 30, 1892.

Very respectfully, your obedient servant,

W. L. FISK,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

H H 1.

IMPROVEMENT OF HARBOR AT GRAND MARAIS, MINNESOTA.

On the north shore of Lake Superior there are very few localities where safe anchorage for vessels can be found, and Grand Marais offers the only harbor of refuge during storms between Agate Bay and Pigeon River, the international boundary, a distance of 120 miles. It is not yet a shipping port of much importance, but it is so near the rich iron ore deposits of the Vermillion Range that it is probable a railroad will soon be built to connect it with them.

The approved project of 1879 is to build two breakwater piers, each [illegible]50 feet long, from the east and west points of the bay, or one pier 700 [illegible] long from the east point, and dredge an anchorage area of about [illegible] acres to a depth of at least 16 feet, all at an estimated cost of [illegible].

The object of this work is to provide a harbor for purposes of refuge and commerce, which it has fully accomplished as far as completed.

The improvement of the harbor commenced in 1880; at the present time the length of completed breakwater is 350 feet, or one-half of the whole, and the 16-foot anchorage is 21.5 acres in extent, or a little more than four-fifths of that contemplated by the original project.

The anchorage is compact in shape and fairly well protected, but this space is not of sufficient size to permit more than one or two vessels to maneuver with safety. The harbor is so small its entire area, 61 acres, should be utilized. To do this in the best manner would require 500 feet extension of the breakwater, and additional dredging to the amount of about 450,000 cubic yards. The extension of the breakwater would cost about $100 per foot, or $50,000; the additional dredging, at the present contract price of 20 cents per yard, would cost about $90,000 more, which, with 10 per cent for contingencies, would make a total of $154,000 to complete this excellent harbor. The original estimate of the cost of improving this harbor was $139,669.40, but contemplated protecting and dredging only a part of it.

During the year small repairs were made to the breakwater, which is in good condition.

The contract under way at the date of the last annual report was completed the following August, 70,850.9 yards having been dredged during the fiscal year just closed, or a total under the contract of 100,780 yards.

This work is in the collection district of Duluth, Minn. Duluth, Minn is the nearest port of entry. The nearest light-house is situated on the breakwater at Grand Marais.

Abstract of appropriations for improving harbor at Grand Marais, Minn.

By act of Congress—		By act of Congress—	
Approved March 1, 1879	$10,000	Approved August 5, 1886	$10,000
Approved June 14, 1880	10,000	Passed August 11, 1888	15,000
Approved March 3, 1881	20,000	Approved September 19, 1890	22,350
Passed August 2, 1882	20,000		
Approved July 5, 1884	10,000	Total	117,350

EXPENDITURES.

Amount expended under approved project to June 30, 1892	$115,883.71
Balance available July 1, 1892	1,466.29

ESTIMATES.

Original (estimated) amount required to complete the improvement	$139,669.40
Amount that can be profitably expended	100,000.00

Money statement.

July 1, 1891, balance unexpended*	$22,922.18
June 30, 1892, amount expended during fiscal year	21,455.89
July 1, 1892, balance unexpended	1,466.29
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	11,466.29
Amount (estimated) required for completion of existing project	12,319.40
Amount that can be profitably expended in fiscal year ending June 30, 1894	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

* The balance unexpended July 1, 1891, as shown in Annual Report for 1891 is $22,888.85; the difference, $33.33, is amount disallowed on Voucher No. 1, item 1, fourth quarter, 1891.

handling of merchandise. The commerce soon grew out of all pro
tion to the size of the harbor, and for the security of this commer
was necessary to supplement the natural protection by artificial me

The approved project of 1887 is to construct two breakwater pier
a line towards each other from the eastern and western points of
bay, to be 1,000 feet and 900 feet long, respectively, leaving an open
of 1,340 feet between their extremities and inclosing an area of
acres.

The original estimate of cost was $213,000, which was increase
$244,208 in Annual Report of 1887 on account of higher prices.

The object is to protect shipping at the wharves which otherw
would be greatly exposed. Work was commenced in 1887 on the
pier, which, including 200 feet built under the contract in progres
date of last annual report, is now 750 feet in length, leaving 250
to be built to complete it, while nothing has been done on the w
pier; the work is therefore a little more than one-third done, but
remaining two-thirds will cost considerably more than twice what
already been expended, for the reason that it is in much deeper wa

There is not yet perfect security from southwest storms for ves
lying at the merchandise dock, but it is no longer necessary to le
the harbor and seek security elsewhere. The favorable results alre
obtained with the portion of the breakwater now built are much gre
than anticipated, and emphasize the advisability of speedily comp
ing the remainder of the projected piers.

During the past winter the Duluth and Iron Range Railroad put
third large ore dock, which it is now extending to about double
capacity originally intended, and will soon put in two more, mak
five in all.

To protect vessels at these new docks as much as possible, the
work should be done on the west pier, and in order to give good s
ter the entire 900 feet of it should be completed; this would cost a
$135,000, and this amount could be profitably expended during
year.

The Iron Range is the only railroad using this harbor as a shipp
point, and the business of the place has heretofore been entirely
sidiary to the iron-ore interests of the Vermillion Range, but the
mense quantities of excellent iron ore recently developed in the
sabe Range bid fair to be quite as important as the former and
likely to seek an outlet through Agate Bay. Of iron ore alone t
were shipped from this port during the season of 1891, 1,000,052
tons.

Agate Bay (known locally as Two Harbors) is in the collection district of
luth, Minn., which is also the nearest port of entry. The nearest light-hou
situated on the east point, Agate Bay, Minnesota.

Abstract of appropriations for improving harbor at Agate Bay, Minnesota.

By act of Congress:	
Approved August 5, 1886	$22,5
Passed August 11, 1888	15,0
Approved September 19, 1890	25,0
Total	62,5

EXPENDITURES.

Amount expended under approved project to June 30, 1892	$61,3
Balance available July 1, 1892	1,1

ESTIMATES.

Estimated amount required to complete the improvement	$181,708.00
Estimated amount required annually for preserving and maintaining when improvement is completed	2,000.00

Money statement.

July 1, 1891, balance unexpended	$26,244.21
June 30, 1892, amount expended during fiscal year	25,128.80
July 1, 1892, balance unexpended	1,115.41
Amount appropriated by act approved July 13, 1892	30,000.00
Amount available for fiscal year ending June 30, 1893	31,115.41
Amount (estimated) required for completion of existing project	151,708.00
Amount that can be profitably expen[illegible]ne 30, 1894	135,000.00
Submitted in compliance with requ[illegible] river and harbor acts of 1866 and 1867.	

COMME[illegible]TIS[illegible]

Vessels arriving and de[illegible] Minnesota.

Year.	Vessels.	Estimated tonnage.	Increase.
1885	174	295,800	....
1886	263	460,000	164,200
1887	465	697,500	237,500
1888	749	1,436,000	738,500
1889	1,255	2,400,000	964,000
1890: Steam, 968; Sail, 82	1,050	2,625,000	225,000
1891: Steam, 1,188; Sail and whaleback, 62	1,250	2,915,000	290,000

Receipts and shipments.

Year.	Ore shipped.	Other freight received and shipped.	Total.
	Tons.	*Tons.*	*Tons.*
1885	225,484	10,895	236,379
1886	304,396	21,954	326,350
1887	394,252	6,620	400,872
1888	509,964	30,352	540,316
1889	924,054	31,731	955,785
1890	984,215	37,268	1,021,483
1891	1,000,052	41,181	1,041,233

Estimated value of freight received and shipped. (Exclusive of ore.)

1887	$96,000
1888	212,000
1889	222,000
1890	246,000
1891	225,000

There were no new lines of transportation established last year.

HH 3.

IMPROVEMENT OF HARBOR AT DULUTH, MINNESOTA.

THE CANAL, OR ENTRY.

The question of ownership of the land occupied by the canal is unsettled, and is somewhat complicated owing to the deed of the of Duluth to the platted lots having been accepted in part only by act of Congress of August 11, 1888, to the claims of the late Mr. Wil Hoesing to property not included in the deed but covered by the ca and to the fact that the city of Duluth has never vacated to the Un States the underlying portions of streets.

No work of any kind was done on the canal piers during the y but a contract has just been let for placing a new pierhead crib at end of the south pier and repairing the old one, which has been b damaged by ice and threatens the safety of the outer light-h There is no question of land ownership at this point.

The north pierhead has also been considerably damaged, alth not so badly as the other. It will, however, soon require repairing

There is now on hand for repairs to piers something over $14, which has been reserved from various appropriations for the ha but the contract just let will require, including inspection expe something over $10,000, leaving available for emergencies only a $4,000. As the piers are old and the superstructure considerably aged and decayed, $25,000 should be available for repairs. The now over 20 feet of water nearly the entire length of the canal, 12,000 yards of dredging will give an available depth of 22 feet thro

While the piers were built for a depth in the canal of only 12 they show no signs of giving way with an existing depth of from over 20 feet, which means that they will not have to be rebuilt at p ent for the new 22-foot channel.

THE HARBOR BASIN.

No work has been done upon the harbor basin during the year, no complaints of shoaling have been heard. This basin should b larged where it joins the new channel east of Rice Point, as boats constantly backing out from one wharf to move to another, and probably less than a half dozen exceptions all vessels bound to W Superior this season have come in through the canal and passed thro this basin and the new channel over to the West Superior wha At least $75,000 could be profitably expended in this work during next year.

RICE POINT CHANNEL.

The dredging for the new channel east of Rice Point was comme in 1889, but as the funds alloted were not sufficient to give a navig channel through, it was not carried beyond the old dike. Whe river and harbor act of 1890 was passed the opening of this channe considered of such importance that authority was given by the S tary of War to continue the dredging upon the terms of the 1889 tract without losing the time necessary to advertise for new bids, an agreement to that effect was entered into with Williams, Upha o., the former contractors. The act of Congress was signed on the 9th of September, and dredging was begun on the 24th. When work topped for the season sufficient had been done to permit the passage f large boats with careful handling by tugs.

An examination of the channel made just before the breaking up of he ice in April, 1891, showed that it had held unexpectedly well, but ad a least width between 15-foot curves of only 45 feet. Work was esumed on the 28th of that month, as soon as the ice would permit, he channel carefully trimmed up and widened, until when the funds were exhausted, May 28, it had a least width of about 110 feet between 15-foot curves. An examination made during last winter after a full season's use of this channel showed surprisingly good results, the least width between 15-foot curves being 90 feet at two points while the average width throughout was 125 feet. The length of this channel is 1.6 miles. The present project calls for a width in this channel of 200 feet, but in my opinion it shoul[illegible] at least 400 feet to safely and conveniently accommodate the traffi[illegible] passing through it. The custom-house records show 1,610 arriva[illegible] departures of vessels from West Superior during the season of [illegible] aggregate registered tonnage being 2,064,463, of which over [illegible]ut used this channel. In addition it is used by numerous tugs[illegible] with large rafts of logs in tow, and the large ferryboats make [illegible] in both directions. It is at present by far the most imp[illegible] the harbor improvement at the head of the lakes, and [illegible] be profitably expended upon it during the next fiscal y[illegible].

The estimated cost of the 20[illegible]l was $119,552, of which $63,000 has already been allotte[illegible],552 to complete.

NORTH-SHORE CHANNEL, ST. LOUIS BAY.

With the $40,000 allotted for this channel from the appropriation made August 11, 1888, a channel of such width as could be made at a single cut of a dredge was dug between the deep water at Rice Point and that at Grassy Point. Though it had a depth of 14 feet throughout its length, its width was not sufficient to render it safely practicable for vessels of ordinary size. Important manufacturing industries are now located at Grassy Point, and the obliteration of this insignificant channel by neglect would work a great injury to these important interests and to the commerce dependent upon them. Aside from this, it is a matter of considerable economy to complete such channels as soon as possible, and thus avoid expensive redredging. The river and harbor act of September 19, 1890, gave $60,000 for the continuation of this work. Dredging was begun under the new contract May 28, 1891, and completed on the 17th of October, when this channel had throughout a width of at least 100 feet, and the mills at West Duluth had begun shipping lumber through it. An examination made through the ice during last winter showed the channel to be holding well, as it was in practically the same condition as when work stopped.

The estimated cost of this channel is $163,000. There therefore remains to be supplied $63,000, which amount could be most advantageously expended during the next year.

PARK POINT CHANNEL.

hing has been done to this proposed channel.

HARBOR LINES.

Several instances of illegal dumping of dredgings in the harbor fall were reported to United States district attorney for Minnes under the provisions of the last river and harbor bill. The offe plead guilty and a nominal fine was imposed. Since that time no o cases have been detected.

FURTHER IMPROVEMENTS.

In view of the increased depth adopted for the new lock at Sault Marie and connecting lake channels, it becomes necessary to subm revised estimate of the cost of the approved project for this harbo order that the necessary depths may be available here by the time t are in the lower lake channels.

The approved project calls for an anchorage area inside the ca 3,200 feet long by 1,450 feet wide; a channel east of Rice Point 200 wide; a channel 200 feet wide along the north shore of St. Louis from Rice Point to the deep water of St. Louis River at Grassy Po and a channel along the 2,640 feet of Minnesota Point dock line n est the canal. At present the anchorage area has a depth of 16 throughout; the Rice Point channel is 100 feet wide between 15- curves; the channel along the north shore of St. Louis Bay is also feet wide between 15-foot curves; and nothing has been done on Minnesota Point (Park Point) channel.

With 21 feet in running channels the harbor and its channels sh have a depth of not less than 22 feet in order that deep laden vessel starting and stopping shall not throw up troublesome lumps with t wheels, and on this basis the following amounts must be dredged,

(1) Canal, 12,258 cubic yards, at 15 cents	$1,83
(2) Harbor or anchorage area, 847,617 cubic yards, at 15 cents	127,14
(3) Rice Point channel (200 feet wide between 22-foot curves), 444,661 cubic yards, at 15 cents	66,69
(4) Minnesota (Park) Point channel (200 feet wide between 22-foot curves), 343,211 cubic yards, at 15 cents	51,48
(5) St. Louis Bay channel (200 feet wide between 22-foot curves), 758,204 cubic yards, at 18 cents	136,47
2,405,951 cubic yards	383,63
Contingencies, 10 per cent	38,36
Total	422,00
Required to complete project as it now exists (16-foot depths)	224,53
Increase	197,47

It will probably be necessary to dump most or all of the dred material in the lake, and on account of the long tow the St. Louis work will cost more than the rest.

Of the above items (1), the greater part of (2), and (3) may be cla as urgent, while (5) can probably be done gradually, as its use for present is almost entirely by lumber vessels, which will not require maximum depth; (4) is not necessary at present, although it may b a short time.

The St. Louis River above Grassy Point has a depth of over 10 for several miles and 8 feet to Fond du Lac Station. Four or five can be carried up to the foot of the rapids, from which point up river has a fall of about 600 feet in less than 7 miles. The utiliza this immense water power has already been commenced, the first m, located at Thomson, being now about completed and giving a head 36 feet, but it appears that a deep navigable channel to Fond du Lac essential to the success of any enterprises in this locality.

The estimated cost of a channel 100 feet wide and 16 feet deep from rassy Point to the deep pool near Fond du Lac is $112,822.88 (see parate report of survey of St. Louis River herewith),* and $50,000 uld be profitably expended on it during next year.

CONDITION OF WORK.

The canal piers are in fairly good condition, but need extensive re-airs, particularly the superstructure. The entire work will eventually quire to be replaced with more durable material.

The ruling depths in the portions of the harbor dredged by the United tates are:

	Feet.
canal	17
the inner basin or harbor	16
channel on north shore of St. Louis I r	16
new channel east of Rice Point	16

Résumé of recommendations.

or next year:	
For canal piers	$25,000
For the Rice Point Channel	100,000
For North Shore Channel, St. Louis	63,000
For enlargement and development basin	75,000
For St. Louis River above Grassy P	50,000
Total	313,000

This work is in the collection district of Duluth, Minn., which is also the port of ntry. The nearest light-house is situated on the outer end of the south pier of the Duluth Canal and a range light is located on the inner end of the same pier.

Abstract of appropriations for improving harbor at Duluth, Minnesota.

By act of Congress approved—	
March 3, 1871	$60,000.00
June 10, 1872	50,000.00
Allotted from act passed March 3, 1873	36,049.20
By act of Congress approved—	
June 23, 1874	10,000.00
March 3, 1875	35,000.00
August 14, 1876	15,000.00
June 18, 1878	30,000.00
March 3, 1879	25,000.00
June 14, 1880	25,000.00
March 3, 1881	40,000.00
y act of Congress passed August 2, 1882	45,000.00
y act of Congress approved—	
July 5, 1884	45,000.00
August 5, 1886	56,250.00
y act of Congress passed August 11, 1888	80,000.00
y act of Congress approved September 19, 1890	100,000.00
Total	652,299.20

following statement shows the manner in which the appropriations ed. The amount expended under the different classes

*Appendix H H 11.

of es the cost of soundings, superintendence, buoying,
co

Total amount ended to June 30, 1892:

Breakwater	$110,0
Canal piers, etc	77,5
Dredging	447,8
Total	635,3

Expended prior to present project:

Breakwater	110,0
Canal piers, etc	45,6
Dredging	114,9
Total	270,6

Expended under present project (ado 1881):

Canal piers, etc	31,8
Dredging	332,8
Total	364,6

Money s tement.

July 1, 1891, balance unexpended		$62,8
June 30, 1892, amount expended during f year		45,8
July 1, 1892, balance unexpended		17,0
July 1, 1892, outstanding liabilities	$62.23	
July 1, 1892, amount covered by uncompleted contracts	10,240.00	
		10,30
July 1, 1892, balance available		6,70
Amount appropriated by act approved July 13, 1892		125,00
Amount available for fiscal year ending June 30, 1893		131,70
Amount (estimated) required for completion of existing project		122,02
Amount that can be profitably expended in fiscal year ending June 30, 1894		313,00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals received for constructing a protection crib and repairs to canal pi Duluth, Minn., opened June 14, 1892, at Duluth, Minn.

No.	Name and address of bidder.	For protection crib, including riprap.	For repairs to old pierhead.	Tot amou bi
1	Andrew J. Wenzell, Grand Rapids, Mich	$8,600	$3,000.00	$11,
2	Louis Meining, Duluth, Minn	7,859	2,789.20	10,
3	Francis L. McDonald, Duluth, Minn	8,549	1,675.00	10,
4	Fred. H. Quinby and Francis Omeis, Duluth, Minn	8,300	1,700.00	10,
5	William E. Davis and Peter P. Ferguson, Duluth, Minn	8,600	3,183.00	11,
6	James Edward Smith, Marquette, Mich	9,141	2,143.00	11,
7	E. J. Amory, Duluth, Minn	14,500	3,500.00	18,

Contract awarded to Fred. H. Quinby and Francis Omeis with the approv the Chief of Engineers.

COMMERCIAL STATISTICS.

Arrivals and clearances of vessels at Duluth, Minn., for 1890 and 1891.

Designation.	1890.				1891.			
	Arrivals.	Clearances.	Total.	Tonnage.	Arrivals.	Clearances.	Total.	Tonnage.
Coastwise	1,102	1,125	2,227	2,554,020	1,291	1,301	2,592	[illegible]
Foreign	164	143	307	186,334	153	150	303	[illegible]
Total	1,266	1,268	2,534	2,740,354	1,444	1,451	2,895	3,268,[illegible]

Comparative statement of arrivals and clearances, 1890 and 1891.

Year.	Vessels.	Tonnage.	Ave[illegible] ton[illegible]
1890	2,534	2,740,354	[illegible]
1891	2,895	3,268,031	[illegible]
Increase	361	527,677	[illegible]

Principal domestic commodities received and shipped by lake, 1891.

Receipts:	Tons.	Shipments:	To[illegible]
Coal	778,982	Wheat	[illegible]
Lime and cement	45,994	Flour	[illegible]
Lime and building stone	33,312	Oats and corn	[illegible]
Salt	21,741	Lumber	[illegible]
General merchandise	270,174	General merchandise	[illegible]
Total	1,150,203	Total	726,682

Receipts of coal and shipments of flour eastward for nine years.

Year.	Coal.	Flour.	Year.	Coal.	Flour.
1883	420,000	91,896	1888	1,435,000	171,223
1884	372,000	79,801	1889	1,045,000	198,053
1885	695,000	113,190	1890	*735,995	149,112
1886	736,000	133,036	1891	778,982	170,774
1887	1,041,000	120,627			

*Coal receipts prior to 1890 are given for the head of the lake (Duluth and Superior), since then for Duluth only.

The storage capacity of Duluth elevator system is 21,300,000 bushels, and that of Duluth elevators proper 12,650,000 bushels. The following table gives the receipts and shipments of wheat for twenty-one years.

Year.	Receipts.	Shipments.	Total.	Year.	Receipts.	Shipments.	Total.
Ending Dec. 31—	*Tons.*	*Tons.*	*Tons.*	Ending Aug. 31—	*Tons.*	*Tons.*	*Tons.*
1891	1,144,082	1,058,449	2,202,531	1880	40,430	43,610	84,040
1890	460,244	427,725	887,969	1879	45,722	44,617	90,339
1889	513,827	409,410	923,237	1878	54,092	54,000	108,092
1888	239,802	404,485	644,287	1877	13,817	15,117	28,934
1887	514,089	585,558	1,099,647	1876	43,536	41,292	84,828
1886	675,977	530,048	1,206,025	1875	34,137	32,436	66,573
1885	446,590	421,973	868,563	1874	67,224	72,725	139,949
18[illegible]	411,688	346,537	758,235	1873	59,444	47,495	106,939
[illegible]g Aug.				1872	27,948	28,531	56,479
				1871	16,703	16,345	33,048
[illegible]	141,234	137,607	278,841				
[illegible]	97,[illegible]7	99,264	197,251				
[illegible]	9[illegible]5	85,966	185,931				

[illegible]nt of wheat at the head of the lake (Duluth and Superior com-

Average vessel tonnage for seven years.

	Tons.		Tons.
[illegible]	[illegible]	[illegible]	970
[illegible]	[illegible]	[illegible]	1,061
[illegible]	[illegible]	[illegible]	1,129
[illegible]	[illegible]		

Comparative statement of arrivals and clearances of vessels at Duluth for fifteen years.

Year.	Arrivals.	Clearances.	Total.	Year.	Arrivals.	Clearances.	Total.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]				

New lines of transportation esta[illegible] The American Steel Barge Company, capital, [illegible]; tonnage, [illegible] of five steamers and twelve barges of the whaleback type of constr[illegible] the steamers carried a cargo of grain to Liverpool, England, via St. La[illegible] thence to New York and via Cape Horn to Puget Sound. (2) The [illegible] line, Ogdensburg, N. Y.; tonnage, [illegible].

Comparative statement [illegible] orts and exports.

Year.	Free goods.	Dutiable.	Value of goods in bonded warehouses.	Duties collected.	Domestic exports.
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	1,435,447
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Opening and closing of navigation.

Year.	Opening.	Closing.	Year.	Opening.	Closing.
[illegible]	Apr. 27	Nov. 29	[illegible]	Apr. 11	Dec. [illegible]
[illegible]	May 7	Dec. [illegible]	[illegible]	Apr. 16	Dec. [illegible]
[illegible]	May 4	Dec. [illegible]	[illegible]	Apr. 30	Dec. [illegible]
[illegible]	May [illegible]	Dec. [illegible]	[illegible]	Apr. 26	....

H H 4.

IMPROVEMENT OF HARBOR AT SUPERIOR BAY AND ST. LOUIS BAY, WISCONSIN.

The natural channel connecting Superior Bay with Lake Superior is at the southern extremity of Superior Bay. It was originally obstructed by shifting bars with scarcely 9 feet of water over them, to remedy which the citizens of Superior, previous to 1866, had made some attempts at pier work, which was subsequently taken in hand by the United States and the improvements continued until the piers have reached an aggregate length of 5,650 feet.

When the improvement was commenced 12 feet depth in the channel was more than sufficient to meet the requirements of the largest vessels. This depth has been increased and maintained for some time at 17 feet, and at no distant day will have to be still further increased to 22 feet. The crib piers which define this channel are in most part badly conditioned for the present depth of 17 feet, they having been intended originally for not over 12 feet. A further increase in the depth of the channel may possibly make it necessary to replace them with better-proportioned structures.

In the meantime the superstructures will have to be extensively repaired. In fact, extensive repairs are urgently needed now, but the $15,000 held in reserve for this purpose is not safely sufficient to meet the damages liable to result from a single severe storm. It is in reality an emergency fund, and until something more is in sight can not be properly used in making general repairs. It is in the interest of economy as matters stand at present to postpone all general repairs to the latest moment pending the consideration of the subject of reconstruction, but it is hoped that the greater portion of the present substructure cribs can be retained. In any event it will be necessary to maintain a reserve fund for repairs of all kinds until the general repairs are completed. At present this should not be less than $15,000.

The shore on the Wisconsin side is advancing rapidly, and soon the sand which drifts around the end of the Wisconsin pier will necessitate the extension of this pier. If this extension is to provide for 22 feet depth it will cost $30,500.

CHANNEL IN SUPERIOR BAY.

The channel in Superior Bay has neither the directness nor width to permit vessels to reach Connor Point safely without the assistance of a tug or local pilot, though its condition has been vastly improved in the past few years. Its present condition is good, but vessels bound for West Superior will not use it so long as the shorter and much easier route through Duluth Canal is in good condition. It is used considerably, however, by rafts, and should not be allowed to deteriorate.

In order that vessels may navigate this channel at all times safely it is essential that it be widened and straightened considerably.

During the next year $50,000 could be advantageously expended in continuation of this work.

QUEBEC DOCK CHANNEL.

No work was done on this channel during the year.

THE NEMADJI RIVER.

The commerce on the Nemadji River is increasing, owing to the location upon its banks of sawmills and brickkilns which depend upon the water transportation it affords to get their products to market.

The bar at its mouth is a serious obstruction and was dredged during last year, but will probably require redredging each year after the spring floods to maintain a serviceable channel; this will require about $5,000 annually.

CHANNEL ALONG WISCONSIN DOCK LINE, ST. LOUIS BAY.

The projected channel between Connor Point and Grassy Point along the West Superior dock line will be about 12,500 feet in length; of this

CHANNELS.

... length adopted for the new lock a... connecting lake channels, it is necessary to s... the approved project for this ha... may be available here as soon ...

... originally provided for maintaining ... channel 300 feet w... wide from the entry past Nemad... channel up Nemadji River 100 feet wide, and ... from Quebec Dock along the west side of S... St. Louis River, opposite Connor Point. To this h... a channel along the West Superior dock lin... 200 feet wide.

... conditions are as follows:

... has a depth of 16 feet, also the channel to Queb... Docks; nothing has been done in the channe... Quebec Dock and Connor Poi... Superior Dock line between ... channel crossing Superior Bay diagonally f... Connor Point; the channel up Nemadji River has nev... a narrow channel 12 to 14 feet deep was dredged t... mouth of the river last year; and the channe... the West Superior Dock line has a depth of ... of its length, nothing having been done ...

... channels the harbor and its channels ... order than deep-laden ... throw up troublesome lum... the following amounts ...

... $

The following statement shows the manner in which the approp tions have been expended. The amount expended under the diffe classes of work include the cost of examinations, soundings, supe tendence, buoying, and contingencies:

Repairs and beach protection	$13, 2
Construction and repairs to piers	318, 4
Dredging	222, 6
Total	554, 3

Money statement.

July 1, 1891, balance unexpended	$71, 6
June 30, 1892, amount expended during fiscal year	50, 1
July 1, 1892, balance unexpended	21, 54
Amount appropriated by act approved July 13, 1892	70, 00
Amount available for fiscal year ending June 30, 1893	91, 54
Amount (estimated) required for completion of existing project	156, 73
Amount that can be profitably expended in fiscal year ending June 30, 1894	275, 50
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

Arrivals and clearances of vessels at Superior, Wis., for two years.

Year.	Arrivals and clearances.	Tonna
1890	1, 256	1, 54
1891	1, 610	2, 06
Increase	354	52

Average vessel tonnage.

1890	1,
1891	1,
Increase	

Of the number of vessels reported above for 1891, 1,452 were steam and 158 s ing vessels.

The storage capacity of the Superior elevators is 8,300,000 bushels.

Shipments and receipts by lake of leading articles during season of 1891.

Shipments:	Tons.	Shipments—Continued.	To
Wheat	524, 786	Copper ore	15,
Other grain	2, 654	Lumber	10,
Flour	155, 860		
Wool	1, 000	Total	710,

Receipts:	To
Coal	877,
Cement	2,
Sugar	13,
General merchandise	12,
Total	906,
Total receipts and shipments	1, 616,

Comparative statement of receipts and shipments for 8 years.

Year.	Tons.	Year.	Tons.
1884	17,462	1888	327,327
1885	33,626	1889	1,006,542
1886	117,027	1890	1,495,885
1887	170,020	1891	1,616,648

Comparative statement of arrivals and clearances of vessels for 8 years.

Year.	Vessels.	Tonnage.	Year.	Vessels.	Tonnage.
1884	194	119,288	1888	812	915,816
1885	200	113,519	1889	900	1,122,048
1886	316	283,787	1890	1,256	1,541,777
1887	462	404,780	1891	1,610	2,964,463

H H 5.

IMPROVEMENT OF MINNESOTA POINT, AT SUPERIOR, WISCONSIN.

The approved project for this improvement consisted in building about 1,000 feet of sand fence near the old light-house on the southern extremity of the point to catch the drifting sand and prevent its blowing over into the Superior Channel, which is very close to the shore of the point in this vicinity, and about 200 feet at a low and narrow part of the point, known as "The Opening," about 2 miles north of the old entrance, to form a bank which would prevent the lake from cutting through into the bay during storms.

The fences were built according to the plans published in House Ex. Doc. No. 51, Fifty-first Congress, first session.

Work was begun by the contractors shortly before the opening of navigation and completed during the season of 1891.

This work is in the collection district of Duluth, Minn. The nearest light-house is situated on the outer end of north pier of the Superior entry.

Money statement.

July 1, 1891, balance unexpended	$368.41
June 30, 1892, amount expended during fiscal year	322.49
July 1, 1892, balance unexpended	45.92

H H 6.

IMPROVEMENT OF HARBOR AT ASHLAND, WISCONSIN.

The southern end of Chequamegon Bay forms the harbor of Ashland, and as the length of the bay is considerable it was necessary to protect the wharves from the waves to enable vessels to use them at all times. The approved project is for the construction of a pile, slab, and rock breakwater 8,000 feet long, dredging a channel of the necessary depth along the dock line, and closing the breach in Chequamegon Point with a brush and stone dike.

The breakwater consists of three rows of piling filled in with slabs which are held in place by large rock ballast. The construction seems somewhat light, considering the ice in the bay, but has so far answered the purpo [illegible] ntly, with the great recommendation that it is very cheap, cos [illegible] er last season's contract only $25.95 per running foot as against about $140 per foot for the usual form of crib breakwater constructed in about the same depth of water.

In 1889 a length of 4,650 feet was built, of which 50 feet was subsequently carried away. Under last season's contract 1,080 feet were added to it; its total length now 5,680 feet, and the breach in Chequamegon Point was closed by a brush and stone dike 4,200 feet long. In addition to the new work repairs to the old portion were made to the amount of $3,782. These were rendered necessary by the settlement of the slab filling and the shifting of considerable of the ballast, which was apparently of too small size.

The breakwater is still of insufficient length to give protection to all the wharves of the city, but its influence in diminishing the turbulence of the waters of the harbor i [illegible] apparent. To build the remaining 2,320 feet of the bre [illegible] timated at present contract prices, will cost $94,000, inclu [illegible] le necessary repairs and contingencies.

A harbor line has been est [illegible] the city, but there is not a uniformity of depth along it. [illegible] channel 200 feet wide and 17 feet deep along this dock line [illegible] 0 cubic yards of material will have to be excavated. This [illegible] 3,500, provided no rock is encountered.

In order to give access to the wh [illegible] for vessels drawing the full depth that the new lock at Sault S [illegible] ie is expected to give, a channel not less than 200 feet wide, [illegible] depth of 22 feet, should be dredged along the dock line by the [illegible] he new lock is completed, and to that end work should be begun soon.

This channel will require the removal of 903,497 cubic yards of material, and at 18 cents per yard would cost $162,629.46; adding 10 per cent for contingencies makes the total estimated cost of this channel $178,892.40.

The principal shipments from Ashland are iron ore and lumber.

There is an iron furnace and general machine shop in operation and it is presumed that the other enterprises which are expected to locate here will materially increase the shipments of manufactured articles and general merchandise.

There has been expended during the year just closed $59,400.87 and the total amount expended under approved project to date is $137,138.67.

RECOMMENDATIONS.

For 2,320 feet extension to the breakwater	$70,000
For repairs and contingencies	24,000
For dredging	93,500
Total	187,500

This work is in the collection district of Superior, Mich., Marquette, Mich., being the port of entry; nearest light-house, La Pointe, on Chequamegon Point, at entrance of Chequamegon Bay.

Abstract of appropriations for improving harbor at Ashland, Wis.

By act of Congress approved August 5, 1886	$22,500
By act of Congress of August 11, 1888	60,000
By act of Congress approved September 19, 1890	60,000
Total	142,500

Money statement.

, 1891, balance unexpended	$64,762.20
0, 1892, amount expended during fiscal year	59,400.87
, 1892, balance unexpended	5,361.33
nt appropriated by act approved July 13, 1892	45,000.00
nt available for fiscal year ending June 30, 1893	50,361.33
ount (estimated) required for completion of existing project	142,500.00
ount that can be profitably expended in fiscal year ending June 30, 1894	142,500.00

mitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Arrivals and clearances of vessels at Ashland, Wis., for two years.

Year.	Number.	Tonnage.
	4,489	2,750,000
	4,099	No record.
Decrease	390	

Principal articles of export and import for 1891.

Exports:	Tons.	Imports:	Tons.
Iron ore	1,253,493	Coal	560,480
Pig iron	37,192	Cement	2,222
Stone, building	938,420	Salt	8,254
Lumber	404,904	Fire brick, fire clay	326
Lath	9,750		
Shingles	2,500	Total	571,282
Total	2,646,259	Total receipts and shipments	3,217,541

Comparative statement of receipts and shipments for five years.

	Tons.
1887	1,401,454
1888	1,357,472
1889	1,971,213
1890	2,816,924
1891	3,217,541

Arrivals and clearances of vessels for five years.

1887	892
1888	2,375
1889	3,171
1890	4,489
1891	4,099

H H 7.

IMPROVEMENT OF HARBOR AT ONTONAGON, MICHIGAN.

In 1887 the Ontonagon River, which forms the harbor, had fairly deep water in it, but its mouth was obstructed by a bar which had but

7 feet depth over it. The project adopted then for the harbor it offe was to build parallel piers projecting into the lake on either side of t river's mouth, the expectation being that the current of the river wo have sufficient force to maintain a depth between the piers of 12 f or more. This expectation has not been fully realized, although t piers are nearly of the proposed length, the east pier being 2,315 f in length and the west pier 2,675 feet.

It appears that the river during the freshets is heavily charged w sand, and the bar at the entrance forms as fast as the piers are tended. The channel which the river is able to maintain through t bar is shifting and uncertain.

Unless the piers can be speedily extended into deep water, whi owing to the gradual slope of the lake bottom and consequent gr expense, is hardly practicable, it does not appear advisable to ca the pier work any farther at present. The improvement of the har can probably be more economically pursued by dredging a cha through the bar each year.

The portion of the piers composed of piling is very much dec and needs replacing. This will cost $15,600. The dredging will about $10,000 annually.

The remaining 150 feet of superstructure on the west pier was pleted in August last under the contract in progress at the date o last annual report.

The amount expended during the year was $9,585.39.

The total cost of the improvement to June 30, 1891, was $302,7

As a result of the improvement there was a channel with least of 16 feet, but it is likely to shoal again.

This work is in the collection district of Superior, Mich.; nearest port of Marquette, Mich. A light is shown on the outer end of the west pier at Ontor Mich.

Abstract of appropriations for improving harbor at Ontonagon, Mich.

By act of Congress—	
Approved March 2, 1867	$
Approved July 7, 1870	
Approved June 23, 1874	
Approved March 3, 1875	
Approved August 14, 1876	
Approved June 18, 1878	
Approved March 3, 1879	
Approved June 14, 1880	
Approved March 3, 1881	
Passed August 2, 1882	
Approved July 5, 1884	
Approved August 5, 1886	
Passed August 11, 1888	
Approved September 19, 1890	
Total	3

EXPENDITURES.

Amount expended under approved project to date	$306,
Balance available July 1, 1892	1,
Estimated amount required annually for preserving and maintaining (dredging)	10,
Estimated amount required for repairing piers	15,
Total	25,

Money statement.

91, balance unexpended * ....
1892, amount expended during fiscal year ....

92, balance unexpended ....
appropriated by act approved July 13, 1892 ....

available for fiscal year ending June 30, 1893 .... 21.

t (estimated) required for completion of existing project....
t that can be profitably expended in fiscal year ending June 30, 1
tted in compliance with requirements of sections 2 of river
er acts of 1866 and 1867.

COMMERCIAL STATISTICS, ONTONAGON, MICHIGAN.

ing able to obtain the statistics for the years 1889, 1890, or 1891, I
the calendar year 1888.

Arrivals and clearances of vessels.

Year.	Arrivals.	Clearances.	Tonna
....	174	174	222,000
....	120	120	188,100

Principal articles of export and import.

Articles.	1887.	1888.
	Tons.	*Tons.*
er....................	28,929	42,858
r....................	119	143
....	140	12
al merchandise....................	200	98
al....................	29,388	43,111
al merchandise....................	1,600	1,665
....	600	....
....	504	....
....	26	....
....	47	....
....	500	1,050
stock	....	26
ed lumber	....	22
al....................	3,277	2,763

H H 8.

IMPROVEMENT OF EAGLE HARBOR, MICHIGAN.

harbor was improved in order to form one of the harbors of ref-
this shore of Lake Superior. The entrance to the small bay

ance unexpended July 1, 1891, as shown in Annual Report for 1891, is
he difference, $52.37, is amount credited to this appropriation on account
n by Maj. Charles E. L. B. Davis, Corps of Engineers, U. S. Army, as per
emen T ; Auditor's Office, November 12, 1891.

... made for the commencement of this extension in the river ... bill of August 11, 1888.

... under this appropriation was for 180 feet extension of ... but after getting all the embankment and cribs in place ... latter were carried away by a severe storm, leaving as the ... the season's work 180 feet of embankment and one crib 60 ... Considerable damage was also done to the remainder

... much speculation as to the integrity of the riprap founda... examination made through the ice, and since, proves that it ... injury. From this it appears that where there are no deflect... or obstructions reaching to or above the surface of the water ... little force exerted by the waves at 14 feet depth.

... of the breakwater is in an exposed place, and it is use... to carry on work upon it during the stormy seasons of ... There does not, however, appear to be any necessity for alter... of construction materially, for where the cribs and super... finished the pier is sufficiently strong. As a precaution ... building, however, the cribs should be decked over with ... as soon as filled with rock, as otherwise the rock is liable ... out by the waves and the stability of the crib destroyed. ... safely done in those cases like Marquette, where the cribs ... a substantial riprap foundation, as there would be but ... for the ballast to escape, and even if some did escape the ... would not be affected, and therefore the stability of the ... would be preserved.

... in progress at date of last annual report was for 120 ... work and superstructure on the 120 feet of embankment, ... the cribs were taken by the storm, and 120 feet of entirely ... embankment, cribs, and superstructure, making a total ex... breakwater of 240 feet. The remaining 700 feet of extension ... needed, and the estimated cost at last contract prices is ... contingencies, etc., $9,800; a total of $107,800. In addition, not less than $15,000 will be required for repairs to old work ... period of construction.

... superstructure of the portion of the breakwater commenced in ... finished in 1875 has been extensively repaired, but is never... as secure as is to be desired. Much of the timber has already ... place several years longer than the usual life of timber in this ... and the time is short, if it has not already arrived, when this ... work must be replaced by more permanent material.

... for a concrete superstructure was prepared, and was ap... February 27, 1890. This superstructure is estimated to cost ...71, of which sum $100,000 could be expended judiciously in ...

... lines were established by the honorable Secretary of War in ... 1889, and a reconsideration of the subject occurred upon the ... of the Duluth, South Shore and Atlantic Railway Company. ... the action of the honorable Secretary of War upon this new mo... railroad company extended the ore dock, as prayed for in the ... I am not advised as to the final action upon the railroad com... petition, but no complaints from interested citizens of Mar... from owners or masters of vessels visiting this port have so ... received regarding these extensions beyond the harbor lines,

from which it is to be inferred that the encroachment is rather view
as advantageous to all concerned.

RECOMMENDATIONS FOR NEXT YEAR.

For pier extension	$107,
For concrete superstructure to all work	100,
General repairs	15,
Total	222,

Abstract of appropriations for improving harbor at Marquette, Mich.

By act of Congress approved—	
March 2, 1867 (allotment)	$85,
April 10, 1869 (allotment)	26,
July 11, 1870	25,
March 3, 1871	60,
June 10, 1872	50,
March 3, 1873	15,
June 23, 1874	15,
March 3, 1875	15,
August 14, 1876	2,
June 18, 1878	2,
March 3, 1879	1,
June 14, 1880	1,
By act of Congress passed August 2, 1882	16,
By act of Congress approved—	
July 5, 1884	5,
August 5, 1886	10,
By act of August 11, 1888	25,
By act approved September 19, 1890	40,
Total	394,

Money statement.

July 1, 1891, balance unexpended	$44,459.
June 30, 1892, amount expended during fiscal year	29,798.
July 1, 1892, balance unexpended	14,660.
July 1, 1892, outstanding liabilities	100.
July 1, 1892, balance available	14,560.
Amount appropriated by act approved July 13, 1892	80,000.
Amount available for fiscal year ending June 30, 1893	94,560.
Amount (estimated) required for completion of existing project	275,736.
Amount that can be profitably expended in fiscal year ending June 30, 1894	222,800.

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS, MARQUETTE, MICHIGAN.

Arrivals	1,
Clearances	1,
Tonnage	2,867,

Principal articles of export and import.

Exports:	Tons.
Iron ore	1,057,830
Pig iron	4,862
Lumber	40,000
General merchandise	3,000
Total	1,105,692

Imports:	Tons.
Coal	148,560
Limestone	1,057
Sandstone	2,857
Lumber	2,475
Brick	3,087
General merchandise	20,000
Total	178,036

Vessel tonnage.

Year.	Tonnage.	Average tonnage.
1890	3,077,566	1,061
1891	2,867,020	931
Decrease	210,546	130

There have been no new lines of transportation established.

H H 10.

IMPROVEMENT OF HARBOR OF REFUGE AT GRAND MARAIS, MICHIGAN.

The harbor of Grand Marais, Michigan, was only accessible for vessels drawing less than 9 feet. Once within the bay, there is ample depth to float the largest vessels. As a harbor of refuge it is of pressing importance to the shipping navigating the Lakes in this vicinity, as the many wrecks in this neighborhood bear witness.

The project for the improvement of this harbor was adopted in 1881, and has for its object the creation of a safe entrance into the bay for vessels of the largest size. The entrance channel is to be about 300 feet in width, protected by crib piers on either side. The west pier is now 1,406 feet long, including 100 feet of pile dike, and the east pier is 853 feet long, including 100 feet of pile dike.

A channel 150 feet wide and 17 feet deep was dredged out between the piers in 1889. As the sand was piled up between the piers at the inner ends to the height of the superstructures, it was not supposed that the dredged channel would remain open, but it was believed that while the waves and currents might level the sand between the piers and obliterate the channel no accessions of sand were anticipated. An examination was made in June, 1890, and, compared with the survey made in 1888, showed considerable change. The sand had been leveled and distributed over a rather larger area than was expected, and, although no accession of sand appears to have occurred, the character of the bar and the condition of the shore at the inner ends of the piers would indicate that a large quantity of sand had been washed into the channel and afterwards washed out.

The storm of December 28, 1890, carried away the end of th[illegible] pier with [illegible] between the piers near the end of the east pier. It is too badly damaged to be replaced [illegible] money were available for that purpose.

A more substantial form of protection at the inner ends of the [illegible] than that originally constructed appeared essential, particularly f[illegible] east pier, as the water had cut through behind it.

Two contracts were made for work at this place last year. On[illegible] for building new shore-end of east pier with protecting spurs on th[illegible] side, [illegible] of piers, and repairing the damaged [illegible] crib. The other was for dredging between the piers. In addition [illegible] was expended in repairing damages that occurred after the cont[illegible] were let.

The new shore-end of the east pier, with its protecting spurs, [illegible] to have fully accomplished its purpose of closing the cut aroun[illegible] end, and when last visited had gathered a large quantity of san[illegible] parently securing the shore connection.

Although properly the dredging should have been delayed unti[illegible] piers were finished, the pressing need of a channel of some kin[illegible] the harbor warranted the commencement of this work, and durin[illegible] year a channel [illegible] feet wide with least depth of 17 feet was [illegible] dredged through and used last fall by several vessels seeking sh[illegible] from storms.

During the dredging the crib mentioned as having been left i[illegible] channel by the storms in December, 1890, was carried out by an[illegible] gale and deposited to the eastward of the east pier, where it is en[illegible] out of the way.

To complete the work according to the approved project, 40[illegible] remain to be added to the west and 900 feet to the east pier. I[illegible] extension of the piers continues with reasonable celerity, proba[illegible] [illegible] will not be [illegible], but will pre[illegible] [illegible] sufficient to serve the commercial interests of this [illegible] [illegible] the lack of this essential.

The commercial interests [illegible] this harbor, which [illegible] make it a shipping point in the event of there being a sufficient [illegible] of water in the channel to accommodate the vessels engaged in [illegible] business, and I think that it would not be long after obtaining a [illegible]gable channel into it before the harbor would claim other distinc[illegible] than that of a harbor of refuge.

Original estimate (see Report of Chief of Engineers, 1881, page [illegible])	$4[illegible]
Appropriated	2[illegible]

This work is in the collection district of Superior, Mich. Nearest light-hou[illegible] *[illegible], Mich.*

Abstract of appropriations for improving harbor of refuge at Grand Marais, [illegible]

By act of Congress—	
Approved June 14, 1880	$[illegible]
Approved March 3, 1881	
Passed August 2, 1882	
Approved July 5, 1884	
Approved August 5, 1886	
Of August 11, 1888	
Approved September 19, 1890	
Total	2[illegible]

Money statement.

1891, balance unexpended[a]	$50,369.20
0, 1892, amount expended during fiscal year	45,727.26
, 1892, balance unexpended	4,641.94
. 1892, outstanding liabilities	19.20
, 1892, balance available	4,622.74
nt appropriated by act approved July 13, 1892	30,000.00
nt available for fiscal year ending June 30, 1893	34,622.74
ount (estimated) required for completion of existing project	188,750.00
ount that can be profitably expended in fiscal year ending June 30, 1894	100,000.00

bmitted in compliance with requirements of sections 2 of river and arbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Arrivals and clearances of vessels at Grand Marais, Mich.

Vessels.	Number.	Tonnage.
mers	116	12,000
ng vessels	30	8,000
Total	146	20,000

Principal articles of export and import.

	Tons.		Tons.
orts:		Imports—Continued.	
Fish	300	Coal	150
Shingles	32	General merchandise	100
orts:		Miscellaneous	150
Lumber	20		
Hay and grain	600	Total	1,356
Iron	4		

Receipts and shipments for five years.

	Tons.
	1,910
	6,270
	8,686
	9,405
	1,356

[a] he balance unexpended July 1, 1891, as shown in Annual Report for 1891, is 41.15. The difference, $28.05, is amount credited to this appropriation on ac- t of fuel drawn by Maj. Charles E. L. B. Davis, Corps of Engineers, U. S. Army, r transfer settlement from Third Auditor's Office, November 12, 1891.

ady these interests are being established along St. Louis Bay iver to Fond du Lac, and it is probable that long before any conble progress can be made towards improving the channels of ap by water the necessity for them will be pressing.

ny opinion it is not too early to make the surveys and examinarequired for the preparation of a general project for improving St. River upon a scale adequate to meet the prospective demands of erce.

lieve that St. Louis River, from Grassy Point, in St. Louis Bay, esota, to Fond du Lac, is worthy of improvement by the General nment, and I recommend that the within project for its survey xamination be approved.

O. M. POE,
Colonel, Corps of Engineers,
Engineer, Northwest Division.

TER OF ST. LOUIS LAND IMPROVEMENT COMPANY OF DULUTH, MINNESOTA.

DULUTH, MINN., *September 25, 1890.*

SIR: In the matter of a preliminary survey of the St. Louis River from Point to Fond du lac, and the demands of commerce for the immediate ng of the same, it may be of assistance to you to know something of the ins and purposes of the land companies who are now engaged in developing roperties on said river.

St. Louis Land Company, which I represent, owns 2,600 acres on the Wisconle, comprising sections 14, 15, 22, and 23, and lots in front of said sections on iver in township 48 north, range 15 west, Douglas County, about 2½ miles the St. Louis water power. Our capital stock is $1,000,000, $600,000 of which is ed in these lands. The balance of the stock is to be sold and the cash ob- therefor used for the developing of the same. We have already sold 250,000 old the balance ready for sale when we need the money. The cash received this stock and also from the sale of lots, so far as may be necessary, will be for securing manufacturing plants, railroads, improving our water front, and neral developing of our town site. The Duluth and Southern Railroad, a new will have its terminals, car shops, etc., upon our town site, and will run in a erly direction, intersecting the Northern Pacific, the Great Northern, the Soo, number of other roads in its course to Minneapolis and St. Paul, Red Wing, ome miles farther south.

gineers have already commenced the survey of this road, and over 17 miles are ly under contract to be built within this year. The Northern Pacific is also ying a route to reach the river at this point. From this point to St. Paul will me 20 miles shorter than any other road now connecting St. Paul with the of the lakes. The effect of congregating these different systems of roads at point must of necessity establish a large system of coal docks, grain elevators, ng mills, etc.

have already secured a flouring mill with a capacity of from 6,000 to 7,000 ls a day, that will commence putting its foundations in within the next ten or n days. Also some six or seven manufacturing plants, each of which is a heavy it-producer. We purpose continuing to induce manufacturing plants to estabhemselves upon our town-site, and expect to establish here a large manufacturown in a very brief time. The chief reason for locating manufactories at this is on account of its nearness to the falls of the St. Louis River, with its almost austible supply of power. A company has already been formed, with a capital ,000,000, to purchase this water power of Jay Cook and his associates and immely commence developing the same by a series of dams that will produce at least horse power. This power will be used to generate electricity, which will be mitted to the manufacturing plants, which are located sufficiently near to ren feasible. The effect of the development of this water power must necessarily e building of large manufacturing industries along the line of the navigable ons of the river, all of which must of necessity be very much handicapped they can obtain the benefit of lake navigation.

more detailed statement of our plans will be of assistance to you I shall be ed to render it at your suggestion.

Very truly,

A. C. OTIS,
General Manager, St. Louis Land and Improvement Company.

JAMES B. QUINN.

LETTER OF NEW DULUTH LAND COMPANY.

DULUTH, MINN., *September 29, 1890.*

DEAR SIR: We desire to call your attention to the necessity of dredging and improving the St. Louis Bay and St. Louis River to Fond du Lac.

The New Duluth Land Company have secured and are now improving some 2,000 acres of land in sections 2, 3, 4, 9, 10, and 11, in township 48 north, range 15 west, in St. Louis County, Minn.

We have already secured industries, both wood and iron working, to employ 1,200 men constantly, and are now negotiating with other industries to employ as many more, with every prospect of locating them during the coming winter.

Among the industries already located will be two large sawmills, which will need water transportation for their output; large iron, brass, and wood working establishments that will need large quantities of coal to be delivered by water. The St. Louis Water Power Company have contracted, as soon as the falls are improved, to furnish [illegible] power for still larger industries, and there is every reason to believe that the power will be improved so as to furnish this power within the next twelve months.

At Fond du Lac are large brown-stone quarries, shipping large quantities of stone which they are obliged to barge down the river.

The Northern Pacific, and St. Paul and Duluth, and Duluth Short Line railroads already pass through our property and have partial terminals at New Duluth, [illegible]. The Duluth and Southern, a new road projected from Duluth to Red Wing, [illegible] all roads between St. Paul and Duluth, is already under contract and [illegible] to build their first 100 miles this winter, and expect to bridge the St. Louis River between St. Louis and New Duluth and have their terminals at New Duluth. The Duluth and Winnipeg Road will also have their terminals in part at New Duluth. South Shore and Atlantic, the Soo Road, and Superior Terminal Company will [illegible] New Duluth over the bridge of the Duluth and Southern, and will make New Duluth their point for transfer.

We are negotiating now with the Duluth and Northern and expect to secure the terminals of that road at New Duluth. Between Duluth and New Duluth, the St. Louis Bay Land Company and the Ironton Land Company in Minnesota, and St. Louis Land Company in Wisconsin, have already secured large tracts of land and large industries to employ several thousand men, all wanting facilities for water shipment.

In behalf of the New Duluth Land Company we respectfully request that in making [illegible] report to the War Department you recommend an appropriation for dredging and improving St. Louis Bay and River for such an amount as you deem advisable and necessary.

Respectfully, yours,

NEW DULUTH LAND COMPANY,
By FRANK R. WEBBER,
President of the New Duluth Land Company.

Maj. [illegible] S. QUINN,
[illegible]

LETTER [illegible] LAND COMPANY AND ST. LOUIS BAY LAND COMPANY.

[illegible], MINN., *September 29, 1890.*

DEAR SIR: We [illegible] the necessity of dredging and improving [illegible] St. Louis Bay and St. Louis River from Grassy Point to Fond du Lac.

Within the last six months four important land companies have organized and are making [illegible] improvements on the St. Louis Bay and River, and all of said companies [illegible] important industry to be built in the near future. The St. Louis Bay Land Company owns land in sections 14 and 23, and the Ironton Land Company land in section 23, township 49, range 15, St. Louis County, Minn., and [illegible] the Ironton Steel Works, a manufacturing [illegible] steel iron, structural iron, etc., and employ in the [illegible].

They will build a dock and expect to receive coal and other freight from the East and part of their manufactured products by boat to Milwaukee, Detroit, and other [illegible] of lakes. The other land companies referred to are the New Duluth Land Company, which has 2,000 acres of land in sections 2, 3, 4, 9, 10, and 11, township 48, range 15, St. Louis County, Minn., and the St. Louis Land Company, which owns land in sections 14 and 15, 22, 23, 48-15 in Douglas County, Wis., both of which have already secured industries which will want facilities for receiving coal and freight from the East and shipping part of the products East also by boat.

behalf of the St. Louis Bay Land Company and the Ironton Land Company we spectfully request that in making your report to the War Department you recommend an appropriation for dredging and improving said St. Louis Bay and River of h an amount as you may deem necessary and advisable.

Most respectfully,

IRONTON LAND COMPANY,
By E. L. EMERY,
Manager.
ST. LOUIS BAY LAND COMPANY,
By C. E. LOVETT & CO.,
Agents.

Maj. JAS. B. QUINN,
Corps of Engineers.

URVEY OF ST. LOUIS RIVER, MINNESOTA AND WISCONSIN, FROM GRASSY POINT, IN ST. LOUIS BAY, TO FOND DU LAC.

UNITED STATES ENGINEER OFFICE,
Duluth, Minn., November 10, 1891.

GENERAL: I have the honor to submit the following report on the urvey of "St. Louis River from Grassy Point, in St. Louis Bay, to Fond du Lac, or the State line between Minnesota and Wisconsin."

The preliminary examination was made by Maj. James B. Quinn, Corps of Engineers, who reported the river worthy of improvement and recommended an allotment of $3,400 to make a complete survey of the portion under consideration. The amount allowed, however, was but $600, and with this it has only been possible to check up a survey made in 1884–'85, as described in the report of Assistant Engineer J. H. Darling, herewith, to which reference is made for details.

The portion of the river susceptible of improvement terminates about 1 mile above Fond du Lac, the village being 14½ miles by water above the Grassy Point Railroad bridge, and 20¼ miles from the Duluth Canal. About 4½ miles above Fond du Lac is the foot of the Dalles, which extend about 4 miles up the river, and in which the fall is 480 feet.

From the natural pool at the boom just below Fond du Lac down to Grassy Point there is practically slackwater, and as the river carries little or no sediment any improvements made would be practically permanent. As will be seen from the chart,* this part of the river consists of a succession of long, deep pools (usually with 18 feet or more of water in them) separated by comparatively short bars, with minimum depths of 7½ to 12 feet over them, so the amount of excavation necessary to make a channel the entire distance 100 feet wide at bottom and 16 feet deep, including 8 per cent increase in volume for scow measurement, is but 410,265 cubic yards. The character of the material to be excavated could not be accurately determined, as the small sum available for the survey would not permit of making borings, but from the best available information it is believed to be sand covered with mud in the lower part, running into clay covered with mud in the upper part of the portion of the river considered. The disposal of the dredgings would be somewhat difficult, as it would probably be necessary to tow to the lake for a dumping ground or rehandle it. However, as dredging has been done this year in St. Louis Bay for 14 cents, probably 25 cents per cubic yard would be a fair estimate, and at this figure the cost of the work would be as follows:

410,265 cubic yards, at 25 cents	$102,566.25
Contingencies, etc., 10 per cent	10,256.63
Total	112,822.88

*Not printed.

In my opinion this improvement should be undertaken, as there are already very considerable manufacturing interests along this part of the river, and its banks will be the natural location for the new manufactures constantly seeking the head of the lakes.

The manufacturing interests already located on the river above Grassy Point represent actual investment in buildings and plant of over $1,000,000, and exclusive of the sawmills have a capacity sufficient to give employment to nearly or quite 2,000 men.

Among these interests are a large and very complete blast furnace and steel works, a large establishment for the manufacturing of railroad cars and general work, furniture factories, saw and flour mills, iron works, sash and door factories, hardware manufacturing, brick works, brownstone quarries, etc.

The development of the water power on the river by a company controlling the [illegible] in the Dalles has been begun, and when completed will furnish over 62,000 horse power on the minimum discharge of 2,000 cubic feet per second. Of the ten dams contemplated, No. [illegible], near the head of the Dalles, was built last spring, gives an available head of about 40 feet, and furnishes power to a large establishment for making a fine quality of pressed brick by patented process, from the slate which is found near it in unlimited quantities; Dam No. [illegible], near the lower end of the Dalles, is under contract. The ultimate idea seems to be to distribute the power in the form of electricity, and [illegible] it is altogether probable that the interests using the water would be located on the river below Fond du Lac; this is, of course, purely speculative as yet, but the considerable interests already in existence seem to me to deserve an improvement which can be made at such comparatively small cost.

[illegible] respectfully, your obedient servant,

W. L. Fisk,
Captain, Corps of Engineers.

[illegible] Thomas L. Casey,
[illegible] Engineers, U. S. A.

[illegible] Poe, Corps of Engineers, Division Engineer, [illegible]

[First indorsement.]

U. S. Engineer Office,
Detroit, Mich., November 19, 1891.

[illegible] the Chief of Engineers. I concur [illegible] this report.

O. M. Poe,
Colonel, Corps of Engineers, etc.,
Division Engineer, Northwest Division.

[illegible] ASSISTANT ENGINEER.

United States Engineer Office,
Duluth, Minn., August 31, 1891.

[illegible] of the survey of the St. Louis River [illegible] under your direction and in accordance [illegible] September [illegible], 1890, and for which the sum of $800 was [illegible]

[illegible]rvey was made in April and May, 1891. The character of [illegible] survey an[illegible] accomplished are as follows:

SOUNDINGS.

[illegible] covered the main channel of the river beginning at a point (marked A on [illegible] near Grassy Point and proceeding up to three-fourths mile above the village [illegible] du Lac, this being a little above the foot of the rapids, and as far up as it [illegible]sible to use a sounding boat.

[illegible]ength of this main river channel is 13 miles. Soundings were also made [illegible] the secondary channels, also navigable, and separated from the main cha[illegible] islands. Soundings are plotted as taken, correcting only for error of lead [illegible]d no reduction made to any particular plane or stage.

[illegible]ge was set at New Duluth on April 7, with its zero at surface of the water, [illegible]dings made thereafter on days in which work was done. This gauge was [illegible]ted with a bench mark on a large elm tree near a sawmill (as shown on the [illegible]he zero of gauge being 5.169 feet below the bench mark. This bench mark [illegible]tablished by the St. Louis Railway Company and St. Louis and Superior [illegible]al Railway Company, and is 503.83 feet above their datum plane. This [illegible] plane has not been referred to Lake Superior nor to any known elevation as [illegible] can learn. The gauge readings may be of use in comparing subsequent sur[illegible]ith this one.

[illegible]wing are the dates on which soundings were made, and the readings of [illegible] at New Duluth and at Duluth:

[+ is above zero; — is below zero.]

Location of soundings.	Date.		New Duluth gauge.	Duluth gauge.	Remarks.
	1891.		*Feet.*	*Feet.*	
[illegible], near Grassy Point, to B, near New Du[illegible] Soundings taken through the ice.	April	1	....	—0.5	
		2	....	—0.5	
		3	....	—0.5	
		4	....	—0.4	
		6	....	—0.5	
		7	0.0	—0.4	
		8	....	—0.3	
		9	+0.7	—0.4	Northeast gale on 9th.
		11	+0.4	—0.6	
		15	+0.2	—0.4	
		16	+0.4	—0.3	
[illegible]ean	....		+0.2*	—0.4	
[illegible], near New Duluth, to the rapids above [illegible]du Lac. Soundings taken from a boat.	April	25	+0.8	—0.3	
		28	+0.8	—0.2	
		29	+0.8	—0.1	
		30	+0.7	—0.3	
	May	1	+0.5	—0.3	
		2	+0.6	—0.2	
	....		+0.7	—0.2	

[illegible] mean is taken on the assumption that the stage for April 1, 2, 3, 4, 6, and 8, on which readings [illegible] made, was somewhere between 0.0 and +0.17, which I consider likely from what I observed [illegible]ver and weather. See also a memorandum on next page.

[illegible]tional gauge readings may be found in the field-notes sounding book.
[illegible]uluth gauge is in Duluth Harbor, near the canal, its zero at the plane of [illegible]hich is a low-water stage of the lake and harbor, but not extreme low water. [illegible]ne of 1873 is 601.2 feet above sea level, and the mean level of the lake is [illegible] feet above sea level.

[illegible]e time of setting the new Duluth guage, April 7, 1891, I made this memoran-

[illegible] Cooper, at New Duluth, who seems to be a builder or contractor and is now [illegible] in a sawmill, tells me that the river has not risen any yet this spring, excepting [illegible] a recent heavy northeaster when the water backed up and rose 1 foot, and [illegible] down again; that the water is considered to be now at about the lowest [illegible] it ever gets, and that it has been known to reach a point 7 feet higher [illegible]nt. * * *

[illegible]s been no rain yet to speak of; the snow is thawing gradually for the [illegible] one or two days quite rapidly, and considerable now remains. Not [illegible]t through the canal." * * *

Mr. Parkinson's angles as I remeasured show a tolerable agreement. These measured not only for testing them, but in order to confirm the identity of was found.

...to computing my additions to Parkinson's triangulation I found it necessary ...mpute his triangles from the line △ 4—△ 5 to line △ 20—△ 22 (this being ...system on the river), taking the angles out from his field notes on account ...arkinson's computation being lost. I also computed the azimuths and ...tes of his stations and mine. These computations are in Triangulation, an ...e book.

...ngulation stations platted on the map of this survey (excepting △ 4 and ...l also △ 3a, which falls outside of sheet 1, are marked by iron gas pipe, ...ve in number. Each pipe is 1¼ inches in external diameter, 3 feet long, ...a point at lower end, and driven vertically into the ground, so as to leave ...4 inches projecting above the surface. Further description of the stations ...in the field notes of this survey.

...rk of measuring the angles, marking the stations with iron monuments, ...g the triangles, azimuths, and coördinates, and plotting the stations was ...

TOPOGRAPHY.

...ed in a note on sheet 1, the results of this survey are mapped with black ...ls certain portions of the map which it was impossible to cover by this sur...ck of funds, have been copied in sienna color, from the last previous survey, ...e by Parkinson in 1884–'85, already referred to.

...thod of mapping has been as follows: The results of the present survey ...t mapped on mounted drawing paper, which map is to be retained at this ...its incomplete state, and additions made to it later if desired. A copy of ...then made with black ink on tracing linen, sheets 1 and 2 (these forming ...designed for transmittal to Washington). These sheets were then placed ...Parkinson's map of 1884–'85, adjusted into position by means of the trian...stations common to the two maps, and the copy made in sienna color of ...ons desired to be added. In joining common portions of shore line and ...lines of the two surveys, discrepancies were found, as might be expected; ...s very small, usually not large, but occasionally large, especially in the case ...ore of swamps, which rise but little above the water. Here a difference in ...of the river for the two surveys would give different positions for the shore ...oreover, the survey of 1884–'85 was made in the winter, and during at least ...r portion of that survey the snow was deep, as I know, and this would ...ake it hard to tell the position of some portions of the swamp line, and thus ...se of error. Wherever a discrepancy was found in copying from Parkin...p the line of his map was bent aside for several hundred feet, usually back ...point of meeting, so as to join on the line of the present survey, the latter ...g changed in any case. The present survey as a rule located the shore line ...tely adjoining the main channel, and of all channels in which soundings ...de. The portion below New Duluth was located mainly by cross-sectioning ...e at time of making the soundings. Other topography by stadia, angles, ...ning or taping. Some points were located by computed triangles.

...urvey located instrumentally section corners and subdivision corners, ...n in number. These have a small circle drawn around them on the map. ...t of these were found marked by stone monuments, a few of them by wooden ...d one by an iron monument. The permanent monuments established and ...t stations and at section corners will be valuable hereafter in laying out ...States improvements of the channels or in establishing harbor lines; in ...public and private improvements that may be made and adding same to ..., or in making detached surveys of localities on the river; and in enabling ...rveys at any time to be compared with this and with Parkinson's.

...wns of West Duluth, New Duluth, Ironton, and St. Louis have sprung up ...since Parkinson's survey. These, and that of Fond du Lac, have been mapped ...ing instrumentally one or more street or block corners and the direction of ...and the filling out the remaining streets (as far as deemed best) from re...lats or other maps and plats considered authentic. Much of the outer por...West Duluth and of the plat of St. Louis, and to a less extent of the plats ...on and Fond du Lac have been omitted for want of room or other good ... For filling out the streets of West Duluth Roe's Atlas was made use of, ...mapping the car works, blast furnace, and woolen mills. With this ex...all the buildings and docks shown on the map were located instrumentally. ...ork of locating shore line and other topography was by Assistant Dever.

APPENDIX I I.

OVEMENT OF PORTAGE LAKE AND LAKE SUPERIOR CANALS, CROSS KEWEENAW POINT, MICHIGAN, OF HARBORS ON WESTERN IORE OF LAKE MICHIGAN NORTH OF CHICAGO, ILLINOIS, AND OF OX AND MENOMINEE RIVERS, WISCONSIN.

ORT OF MAJOR JAMES F. GREGORY, CORPS OF ENGINEERS, OFFI-ER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892, VITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

- ortage Lake and Lake Superior canals, across Keweenaw Point, Michigan.
- Ianistique Harbor, Michigan.
- Cedar River Harbor, Michigan.
- Ienominee Harbor, Michigan and Wisconsin.
- Ienominee River, Michigan and Wisconsin.
- Oconto Harbor, Wisconsin.
- Pensaukee Harbor, Wisconsin.
- Green Bay Harbor, Wisconsin.
- Harbor of refuge at entrance of Sturgeon Bay Canal, Wisconsin.
- Ahnapee Harbor, Wisconsin.

11. Kewaunee Harbor, Wisconsin.
12. Two Rivers Harbor, Wisconsin.
13. Manitowoc Harbor, Wisconsin.
14. Sheboygan Harbor, Wisconsin.
15. Port Washington Harbor, Wisconsin.
16. Harbor of refuge at Milwaukee Bay, Wisconsin.
17. Milwaukee Harbor, Wisconsin.
18. Racine Harbor, Wisconsin.
19. Kenosha Harbor, Wisconsin.
20. Waukegan Harbor, Illinois.
21. Fox River, Wisconsin.
22. Operating and care of locks and dams on Fox River, Wisconsin.

UNITED STATES, ENGINEER OFFICE,
Milwaukee, Wis., July 8, 1892.

ENERAL: I have the honor to transmit herewith annual report for works of river and harbor improvement in my charge for the fiscal r ending June 30, 1892.

Very respectfully, your obedient servant,

JAMES F. GREGORY,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[illegible] concerning this water [illegible]
[illegible] Report of the Chief of [illegible]
[illegible] briefly the history [illegible]
[illegible] improvements [illegible]
[illegible]

[illegible] of the waterway and its connection [illegible]
[illegible] of the north and northwest [illegible]
[illegible] with the improvement [illegible]
[illegible]

[illegible] Congress approved June [illegible] [illegible]
[illegible] line in Portage Lake.

The river and harbor act of September [illegible] [illegible]
[illegible] United States "of the two canals [illegible]
[illegible] Improvement Company [illegible]
[illegible] Lake and the Lake Superior Ship [illegible]
[illegible] from Portage Lake to Lake S[illegible]
[illegible] across Keweenaw Point, [illegible]
[illegible] Superior, in the State of M[illegible]
[illegible] and the artificial cut made [illegible]
[illegible] to commerce and navigat[illegible]
[illegible] on Portage Lake, the [illegible]
[illegible] Bay, with all the [illegible]
[illegible] free from all incumbrances, [illegible]
[illegible]"

[illegible] constituted by Special [illegible]
[illegible] Corps of Engineers, [illegible]
[illegible] and report upon certain [illegible]
[illegible] August 5, 1886, [illegible]
[illegible] report dated, Army [illegible]
[illegible] the following [illegible]
[illegible] H. R. Ex. Doc. No. [illegible]

[illegible] Sault Ste. Marie [illegible]

about 2 miles from Lake Superior, on the northwest side of Keweenaw
ends southward, receiving from the east the overflow of Torch Lake.
depth of both lakes is ample for all purposes of commerce, present and
They drain, by Portage River into Keweenaw Bay, the great reëntrant
the promontory and the southern shore of Lake Superior. The original
could be carried through Portage River into the lake was from 3 to 5 feet.
his depth on many interior rivers large expenditures are annually made by
ment.
and Houghton are the chief shipping ports of the copper industry. They
each other on Portage Lake, about 10 miles from Lake Superior. When
ment of the mines had reached such a point as to render the demand for in-
ilities of communication imperative, the country was upon the eve of civil
work was inaugurated and has been completed without assistance from
Government.
ct of cutting a ship canal through the ridge of sand and hardpan separat-
h end of Portage Lake from Lake Superior was also formed during the
company was incorporated for the purpose. The present canal has re-
r various changes in organization, which will be considered more in detail
e General Government has aided this part of the work by appropriating
es of public lands. No other assistance was received from the General
t or from the State of Michigan.
ro improvements, although owned by separate corporations, are now
controlled by the same individuals.
mportance of Portage Lake Route.—Before going into details respecting
r, present condition, and present value of this waterway, its national
will be considered from two points of view: That of interstate com-
that of copper production.
commerce.—The records of the Sault Ste. Marie Canal afford precise data
to judge of the extent and nature of the commerce of Lake Superior.
ing figures exhibit the freight which has passed through the canal dur-
t five years:

Years.	Registered tonnage.	Actual freight.
....	2,092,521	1,567,741
....	2,468,083	2,020,521
....	2,042,259	2,267,105
....	2,997,837	2,874,557
....	3,035,937	3,256,628

* * * * * *

M. Poe, Corps of Engineers, in his reports for intervening years,
following statistics of registered tonnage and actual freight
hrough the St. Marys Falls Canal from 1886 to 1890, inclusive:

Years.	Registered tonnage.	Actual freight.
....	3,529,184	3,701,014
....	4,388,691	4,882,802
....	4,741,076	5,581,169
....	7,899,604	8,288,580
....	8,454,435	9,041,213

e few ports on the northern shore of Lake Superior at which our vessels
itable to trade. They naturally hug the southern shore, on which are sit-
centers of the iron, copper, and lumber industries; where are imported
upplies of coal, lime, building materials, machinery, provisions, and sup-
ery kind, and where are exported iron, copper, and lumber. At Duluth
ior City the exports of grain and imports of every kind needed to develop
gion opened by the Northern Pacific and other railroads swell the traffic
rmous and increasing figures given above. Keweenaw Point, as already
s far out into the lake and obstructs this natural route of trade.
he prevailing storms of the Lake Superior region are from the northwest
ast. The natural route of commerce near the southern side lies, there-
ghout its whole extent along a lee shore. During the summer months

Bay to Portage L...
Iron Company C...
water communic...
Keweenaw Ba...
Portage River ...
to render them ...
the works of i...
Lake Superior ...
connected there...
fifty thousand d...

The Board of ...
agraph 3, H...
August 13, 18...
act of Congre...
made a very ful...
December 22, 1...

The report is ...
gress, second se...

The southern sho...
on the west, a dire...
parallel of north la...
of Keweenaw Poi...
engaged in the ...

been brought to bear upon the company to reduce the :oll were reduced by nearly 50 per cent below what they ... since 1863. The demand now is that the tolls shall be re- . hat the waterway shall be further enlarged. None of the ... hold any interest in the corporation, and we are informed ... owned entirely by persons nonresidents in the district.

... *Canal, Railway, and Iron Company.*—The opening of Portage ... improvement of Portage River, to vessels navigating Lake ... n to go within a trifle over 2 miles of Lake Superior on the ... Point. The advantage which would accrue from making the ... from the east side to the west side of Keweenaw Point was volved the construction of an artificial canal 2 miles long, it its entrance from Lake Superior. The expense of such a work ...eans of the persons immediately interested in the local trade of ... the benefits to result from it would be national rather than local, ... to be expected from the tolls would probably not pay interest upon ... many years.

... entitled the Portage Lake and Lake Superior Ship Canal Company under the State laws of 1864, its articles of agreement being filed ...ary of state of Michigan July 15, 1864. By a joint resolution of the ...ature dated January 21, 1865. Congress was asked to aid the enter- ... of land. The Minnesota legislature passed a resolution to the same ... 24, 1865. Congress responded by granting to the State of Michigan, ...oved March 3, 1865, 200,000 acres of land. By act approved March ...ands were conferred by the State upon the above-mentioned corpora- ...tain conditions. A plan of construction was then adopted, which was ... than had at first been contemplated. Additional aid was sought ... by the governor and Representatives of Michigan. The legislatures ... and New York passed resolutions February 27, 1866, asking Congress ...enterprise. A number of cities also sent in petitions to the same effect. ...gain responded by granting 200,000 additional acres of land by act ap- ...ly 3, 1866.

...al was to be 13 feet deep and 100 feet wide and to be provided with a break- ...ts Lake Superior end. For several years operations were limited to survey- ...round, procuring machinery, and the exploration of lands to be selected ... grant. The original surveys and plans were made by Mr. I. N. Greene, ...or the State. It was not until 1868 that the work of excavation was actu- ...n, and at the end of that year only a few thousand yards had been exca- ...n the spring of 1869 the work was resumed with great activity, and was ... pushed during that and the following year. Mr. John H. Forster super- Greene as engineer for the State June 1, 1869. In 1871 the work was embar- ...r want of funds, and made unsatisfactory progress. The title of the com- altered to Lake Superior Ship Canal Railroad and Iron Company. In this ...ompany failed, and a receiver was appointed by the United States circuit Michigan with authority to borrow money for the purpose of completing The work advanced slowly during the two following years.

... of Congress making the first grant of land required that the works should ...ted by March 3, 1867. The act making the second grant extended this time ...rs, or to March 3, 1870. The time was subsequently extended to March 3, again to March 3, 1873, and finally to December 1, 1873. On the 18th of 1873, the State engineer, Mr. Forster, certified that the works were com- ...ording to law. and on the 29th of November, 1873, the governor of Michigan ...hat the works were built according to law, but that the title to the lands ...ch they were situated being vested in the officers of the company as indi- ...nd not in the company itself, he did not consider the works completed in ...e with the act of Congress. It was not until June 25, 1875, that the Gov- ...re his final certificate that the works were completed, the delay being ... the transfer of legal title required by him. Technically, therefore, the ...re completed in 1875, but as a matter of fact they were completed in 1873.

1877, after protracted litigation, the property was sold under decree of ...e. It was purchased by Messrs. Mann and Wilson, for the bondholders ...itors of the old company, who organized the present company, under the ...ake Superior Ship Canal, Railroad, and Iron Company. The consideration ...d in the deed to Mann and Wilson was $870,000. In the deed from them to ...ompany the consideration was $100, subject to prior incumbrances amount- ...6,385 and accrued interest at 10 per cent. The present company had no ... with the old company.

...l, independently of the lands attaching thereto, has not proved a finan- ... The income from the tolls has been almost wholly expended in keep- ...air.

It appears from the foregoing facts that part[illegible] by Keweenaw Point and partly to secure a need[illegible] of a ship-canal to perfect the Portage Lake ro[illegible] gation interests of the lakes even if private ent[illegible] not already begun the improvement. * * *

HISTORY OF THE PORTA[illegible]

(1) *Portage River improvement.*—By the year[illegible] Portage Lake had acquired an importance[illegible] transportation a necessity. At the mouth[illegible] from 5 to 7 feet over the bar. Vessels arr[illegible] freight was transferred by lighters to dock[illegible] towed to scows, upon which it was towed to [illegible] cost of $4 per ton. The expense, delay, and [illegible] of procedure led those who suffered there[illegible] river and bar and constructing a breakw[illegible] subscription, the contributors being the [illegible] St. Mary's, Albany and Boston, and Isle R[illegible] and land owners, Messrs. Sheldon and [illegible] as engineer and a contract was made wit[illegible] 10 feet deep and 50 feet wide at bottom[illegible] the engineer selected a point farther to [illegible] a canal leading to it through a tamarack [illegible] The object of the breakwater was to [illegible] from filling up the mouth of the canal. [illegible] was built during the winter of 1859-60, [illegible] then sunk and the stone hauled from [illegible] ranging from 25° to 30° below zero. [illegible] steamer was piloted through the cut al[illegible] the contract for the improvement was [illegible] This work was done without the aid [illegible]

In the following year an act was p[illegible] the formation of companies to constr[illegible] act was approved and became law M[illegible] and River Improvement Company was [illegible] who had begun the improvement. Th[illegible] els drawing more than 9 feet, the ra[illegible]

The improvement thus far made, g[illegible] considerable sums, the chief amount [illegible] expended annually in maintaining and [illegible] and placing buoys and beacons. As [illegible] tions were called for in the use of the [illegible] to dangers encountered at

f the route have been made . No outlay has been made he cuts have been purchased title to them, as set forth in

soundings indicate a depth of at water surface is 100 feet, e maintaining 100 feet nearly ake) traverses a swampy region, nlargement. The northern half ld tamarack swamp and a range utcropping near Lake Superior.

tment consists of a front row of enter, capped a few inches above piling; a row of anchor piles is front row by timber braces. The aps are often decayed and the position. The superintend- where the route traverses sand double sheet piling should be cked the piles are pressed out canal in storms tear off the

the canal is formed by two which have resisted the storm pleted in 1873. The hardpan been of marked advantage in feet long, are of timber and at the shore line, widening epth at the date of our survey ice during the winter is said ore line, which tends to cause ng of sand around the ends of

to the canal, safe for large vessels during Superior in the spring and autumn, is a diffi- rise 6 feet above the surface of the lake when ing a moderate gale from the westward on with their solid crests fully up to the top of presented surfaces normal to the direction of into the air and solid water poured over the e oscillation extended into the canal quite ere informed that in the great northeast and more directly in the line of the canal, wave

this place it is a matter of vital importance rms. A report upon the subject by Maj. H. M. found in Senate Ex. Doc. No. 32, Forty-sixth

r act of September 19, 1890, provided: ving and continuing the use and navi- $10,000 for each of the present and the l."

project; but in the pending river and r improving the water communication Superior, from Keweenaw Bay to Lake gan, for a navigable depth of 16 feet at the bottom and for repairs to exist-

cks. The present works consist of ces on Lake Superior and Keweenaw , dredged cuts and channel-ways; avigation, as hereafter described.

... bar between
... there
... depth of wat
... the canals, l
... 12½ feet at
... of the wat
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... foot havi

... 1891, the last bo
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each side of the channel in about 12 feet of water. As these d to be of great assistance to vessels in making the channels at points, they were left in place until the close of navigation.

rly in May, 1892, soundings were again taken at the Lake Superior ance, which showed that a bar had formed between the outer of the piers and outside for a distance of 300 feet, with only from 12 feet of water on line with the center of the canal, where there 18 feet at the close of navigation last season.

nder agreement with Mr. James Pryor, of Houghton, Mich., dredg- was begun May 16 and finished June 1, 1892, 6,384 cubic yards of erial being removed, at a cost of 25 cents per yard.

his opened a channel about 60 feet wide and 17 feet to 18 feet in th of water outside and about 15 feet between the piers.

small amount of dredging (included in above-stated amount) was e in the channel, opposite the light-house, which gave relief at a y troublesome point.

he funds being exhausted further dredging was suspended.

Harbor lines in Portage Lake.—For about 7 miles of Portage Lake, in vicinity of Houghton and Hancock, harbor lines on each side were blished by the Board of Engineers constituted by Special Orders, 40, 1890, headquarters Corps of Engineers, in accordance with act Congress approved June 20, 1890.

he report of the Board was dated December 11, 1890, and received approval of the Assistant Secretary of War January 5, 1891.

These harbor lines were established to prevent encroachments on the nnel of Portage Lake by the various copper-mining companies ose stamp mills were located on the border of the lake.

At present the Franklin and the Atlantic are the only companies that mp their stamp refuse into the lake. They are erecting bulkheads prevent the refuse getting into the channel, and their dumps are sely watched to see that they do not encroach on the harbor lines. rveys and soundings are made from time to time to illustrate the ndition of the banks.

Copper smelting works that dump slag and cinders, electric-light nts that dump ashes, and all other establishments that are likely to mp refuse into the lake have been furnished with printed circulars taining the laws of Congress applying to such cases and have been rned not to infringe them.

Rules and regulations.—A new set of rules and regulations for the rigation of the canals were prepared and received the approval of the norable the Secretary of War, April 5, 1892. They have been printed l distributed, and no objections on the part of those who use the als have been made to their enforcement, except in the case of some resentative lumbermen in regard to one of the provisions of Rule 5, ich directs that "rafts shall be made up with logs parallel to each er, in the direction of raft lengths, secured and held closely together frequent cross sticks, chains, or cables." These lumbermen think it ardship and an unnecessary expense to them to be obliged to make their rafts as described in the rules. It appears to me both reason- e and necessary that rafts should be so made up that they will not nvenience general navigation more than is necessary and do as e damage to the canal banks as possible, and that to accommodate se conditions the logs should be parallel to each other and not ely boomed. In order, however, that the matter may receive proper sideration upon sufficient data, I directed Lieut. H. E. Waterman,

the front and the two sides secured by a telegraph wire. ...ed into this row if possible. A second row follows, ...ers being put on about every 25 feet. When filled the ...boom. All of the logs in these operations are pushed in

...re then united to form a raft or half raft, as they call it.

...w replaced by rope cross lines. "A" lines, as they are called, ...ing zigzag across the raft. All these lines are shown on the

...ightened by a Spanish windlass. One pole is held vertical, while ...a second in the rope, as shown in Fig. 2. The slack is then ...3, and when tight enough the windlass is simply laid flat. The ...together, but should not ride, or there is danger of their slip-...oom. The steamer is attached to the rear by three lines and pushes ...f towing it.

...pplication of the above methods in the Portage Lake Canals is con-...e principal difficulty is with the stiff boom. It is all right inside ...on Lake Superior, in a storm, nothing seems to hold as well as a loose ...logs not overlapping but connected by about 2 feet of chain. Rafts ...have been frequently abandoned during storms on the lake and after-...red unbroken.

...making up with the stiff boom as above described would not exceed ...M.

...ted that the following amounts will be towed through the Portage during the present season.

Owner.	Feet, B. M.	Down or up.
	7,000,000	Down.
	6,000,000	Do.
	2,500,000	Do.
	2,500,000	Do.
	2,000,000	Do.
	1,000,000	Do.
	3,000,000	Up.
	4,000,000	Do.

...not include the amounts which may be towed through the Upper Canal, ...robably be small.

...noted, however, that the difficulties in using this method are much ...e case of rafts bound up Portage River than those bound down. The ...use a stiff boom through the river and run their logs into a loose one at ...r crossing Keweenaw Bay, but to reverse the operation requires the ...f the raft in Keweenaw Bay, which might be a serious matter.

...e visit to Houghton I found that Mr. Hebard and Mr. Funke were mak-...ort to conform to the rule, though not employing the stiff boom. Their ...de up of a series of short strings, one in front of the other. Each string ...the four sides by eight boom sticks loosely connected, thus forming a ...t 30 feet on each side. This square is closely filled with logs laid par-...ry nearly preserves its shape, and would seem a fair compromise if one

...towed up Portage River, however, by Mr. Gregory are nothing but sack ...few cross lines, and constitute a serious obstruction. I would recom-...e be notified that he must make more of an effort to conform to the rules. ...ross line at each joint of the boom sticks would accomplish the result. ...e these can only be used successfully by arranging the logs in lines, all ...ne another.

...ion, I would recommend no changes in the rules relating to rafting for ... They should be given a fair trial by all the owners, as they are unques-... the benefit of the canals.

...respectfully, your obedient servant,

H. E. WATERMAN,
First Lieut. of Engineers.

...s F. GREGORY,
Corps of Engineers, U. S. A.

... appropriation for preservation of Portage ... Lake Superior ..., Michigan, act of September 19, 1890.

No.	To whom paid.	For what paid.	Am
1	Maj. Chas. E. L. B. Davis	Mileage	
2	do	do	
3	First Lieut. H. E. Waterman	do	
4	G. A. Marr	Traveling expenses	
5	Peter Primeau	Recording deeds	
6	F. Mayer & Co	Blue prints	
7	G. A. Marr	Services	
8	Paul Mondor	do	
9	S. Mott	do	
10	Hired men	Services August, 1891	
11	Des Forges & C	Stationery	
12	Albert H. Travethan	Services	
13	James Pryor	[illegible]	
14	J. B. Sturgis	Office rent	
15	Williams, Daugherty & Up...	Dredging	3,[illegible]
16	F. A. Douglas, agent	Express charges	
17	First Lieut. H. E. Waterman	Mileage	
	do	do	
	[illegible] Bever	Labor	
	[illegible]	Stone, etc	1
	[illegible]	Timber	
	[illegible]	Bolts, etc	
	[illegible]	Rope, etc	
	[illegible]	Stationery	
	[illegible]	Services	2
	[illegible]	do	
	[illegible]	Office rent	
	[illegible]	Services	
	[illegible]	Hire of tug	
	[illegible]	Services, September, 1891	
	[illegible]	Services, etc	3
	[illegible]	Mileage	
	[illegible]	Rules and regulations	
	[illegible]	Books	
	[illegible]	Mileage	
	[illegible]	Services	2
	[illegible]	do	
	[illegible]	do	
	[illegible]	Office rent	
	[illegible]	Book	
	[illegible]	[illegible]	
	[illegible]	Mileage	
	[illegible]	Services, October, 1891	
	[illegible]	[illegible]	
	[illegible]	Services	2

tatement of expenses made from appropriation for preservation of Portage Lake and Lake Superior canals, Michigan, etc.—Continued.

No. of voucher.	To whom paid.	For what paid.	Amount.
12	S. Mott	Services	$30.00
13	Hired men	Services, May, 1892	189.50
14	James Pryor	Dredging	1,506.07
15	L. Hennes & Co	Rope, etc	9.89
16	Chas. J. Hodge	Steel, etc	3.12
17	Paul Mondor	Services	45.00
18	S. Mott	do	30.00
19	J. B. Sturgis	Office rent	19.00
20	James R. Dee	Use of telephone lines	20.00
21	G. A. Marr	Services	200.00
	Total		9,833.65

RCIAL STATISTICS FOR THE CALENDAR YEAR ENDING DECEMBER 31, 1891.

tion district, Superior, Mich.; nearest port of entry, Houghton, Mich. There -house and range lights at each entrance to the canal. Range lights are t at the head of Portage River, and a single light on the outer end of the at the Portage Lake entrance to the upper canal.

the charge of the canals was assumed by the United States tolls were col- d complete commercial statistics were recorded. Since tolls were abolished ction of statistics has been more difficult.

of blanks for making reports were printed last winter and issued to vessels ng, the officers of the St. Marys Falls Canal assisting in the distribution of s by direction of Col. O. M. Poe, Corps of Engineers. Vessel masters or e required to make on these blanks complete returns of their cargoes, directly ival at the first United States post-office after leaving the canals. It is ex- hat this method will furnish next year complete statistics, or nearly so, of ness of the canals. The statistics reported below are only for the months of er, October, and November, 1891, and are those furnished by vessel agents, ers, and others, and are probably within the limit of business done during nths.

tatement of class and tonnage of vessels passing through Portage Lake and Lake erior canals during the months of September, October, and November, 1891.

Bound up.	Number.	Net tonnage.	Bound down.	Number.	Net tonnage.
	164	90,331	Steam	102	41,041
	43	13,220	Sail	22	3,883

mber of vessels, 331; total net tonnage, 148,475.

tatement of freight and passengers carried through the Portage Lake and Lake erior canals during the months of September, October, and November, 1891.

Bound up.	Net tons.	Bound down.	Net tons.
	48,748	Copper	13,000
ured iron	1,490	Flour	2,649
	130	Building stone	202
	110	Pig iron	382
ous merchandise	23,067	Lumber	6,052
s ... number	179	Logs	36,000
		Miscellaneous merchandise	786
		Passengers ... number	85

ight, 132,616 tons; total passengers, 264.

The followin cipal lines of steamers used the canals during the season 1891:

Bo

Lake Michigan and Lake Superior Transit Company, Chicago, Ill..............
Lake Superior Transit Company, Buffalo, N. Y ....
Ward's Detroit Line, Detroit, Mich..
Ward's Lake Superior Line, Detroit, Mich..................................

The principal lines ot steamers for the season of 1892 are as follows:

Bo

Lake Michigan and Lake Superior Transit Company, Chicago, Ill...............
Lake Superior Transit Company, Buffalo, N. Y...............................
Ward's Lake Superior Line, Detroit, Mich ....
Crescent Line, Detroit, Mich ....
Union Transit Company, Buffalo, N. Y.......................................

Besides the above regular lines of transportation there are a large number of ste barges and sailing vessels using the canals continually, and a large local busines done by tugs towing rafts of logs an nd scows with wood and lumber. is now arranged so that all of the ab can be reported regularly, and h after complete reports of statistics m e ected.

I I 2.

IMPROVEMENT OF MANISTIQUE HARBOR, MICHIGAN.

Object.—To secure a navigable channel from Lake Michigan into t mouth of the Manistique River, where the harbor of Manistique situated.

Project.—The original project, adopted in 1880, provided for the exc vation of about 20,000 cubic yards of material to complete a channel 1 feet wide and 12 feet deep between the piers constructed by local ent prise at the mouth of the Manistique River.

Present works.—No construction work was done by the United Stat Government. The piers were built and are still owned by private pa ties.

Depth of water.—Originally there was a depth of 7 feet, which w increased to 10 feet before any appropriation had been made by t Government. A survey made May 12, 1892, showed at that date channel between the piers of navigable width with a depth of 13 fe The outer bar was not clearly defined, but the ruling depth over it a peared to be about 11 feet. Dredging by private enterprise was progress, increasing the depth of water over the outer bar.

Operations during the fiscal year.—There were no operations duri the fiscal year ending June 30, 1892.

Remarks and recommendations.—The only work by the United Sta at this harbor has been the removal of 11,780 cubic yards of mater in 1880, under a contract with the Chicago Lumbering Company.

In October, 1880, a survey of the harbor showed that the directi of the piers lay across the natural channel. The company which h built the piers, and had also the contract for dredging, found it nec sary at this time to renew about 330 feet of the west pier which h been washed away. The superintendent of the company was notif by the officer in charge, Maj. H. M. Robert, that the pier lines wou have to be rectified to conform to the natural channel. The compa declined to comply with this demand, and their contract, which h been extended from December, 1880, to June 1, 1881, was annull

...re have been no operations at this harbor since, and no money is ...ed for its improvement.

...mated cost (see Report of Chief of Engineers, 1880, page 1931) $6,000

APPROPRIATIONS.

...of—
June 14, 1880 .... $5,000
March 3, 1881 1,000

Total 6,000

Money statement.

...1, 1891, balance unexpended $2,600.76
...30, 1892, amount expended during fiscal year 31.36

...1, 1892, balance unexpended 2,569.40

...MMERCIAL STATISTICS FOR THE CALENDAR YEAR ENDING DECEMBER 31, 1891.

[Furnished by Mr. J. D. Mersereau, secretary Chicago Lumbering Company.]

...ame of harbor, Manistique, Mich.; collection district, Superior, Mich.; nearest ...t-house, Poverty Island, Michigan.

Arrivals and departures of vessels.

Description.	Arrivals.		Departures.	
	Number.	Tonnage.	Number.	Tonnage.
...am	367	139,753	367	139,753
...il	299	83,789	299	83,789
Total	666	223,542	666	223,542

Principal articles of export and import.

...xports:	Tons.
Beer	23
Cattle	8
Fish	838
Flour	13
Hides	17
Iron and steel	14,265
Lath	4,271
Lime and cement	62
Lumber	158,646
Merchandise, general	102
Shingles	1,130
Pickets	2,775
Total	182,150

Total approximate value, $1,718,960.

...mports:	Tons.
Agricultural implements	17
Apples	86
Beans	29
Beer	147
Brick	80
Butter	49
Cattle	68

Imports—Continued.	Tons.
Cheese	6
Coal and coke	2,000
Corn	31
Eggs	27
Flour	360
Furniture	30
Hay	320
Hogs	31
Iron and steel	967
Cement	174
Merchandise, general	3,528
Mill stuffs	487
Oats	467
Oil	260
Plaster, land	6
Pork and beef	163
Potatoes	23
Salt	585
Sheep	3
Staves	190
Wagons and carriages	11
Total	10,145

Total approximate value, $343,484.

I I 3.

IMPRO EMENT OF CEDAR RIVER HARBOR, MICHIGAN.

Object.—To secure a navigable channel from Green Bay into C River, where the harbor of Cedar River is located.

Project.—The original project, adopted in 1883, provided for the struction of two parallel piers 200 feet apart, extending from the m of Cedar River to the 16-foot contour in Green Bay, and dredgi channel between them 14 feet deep; also removing an outer sho dredging to a depth of 15 feet.

A modification of this project, approved in 1884, provided for tinuing the piers in a direct line with the part already built, inste at an angle, as originally proposed.

Present works.—Pile piers lined with sheet piling: (1) East pier feet in length, 16 feet wid pier, 301 feet in length, 16 wide. All were built in 18 d are in good condition.

Depth of water.—Originally 8 feet, obstructed by a 3-foot in front of the mouth.

A survey made May 14, 1892, d a channel 20 feet wide, 12 deep, and 10 feet deep with a width of 40 feet. Dredgin private enterprise to improve the nnel was in progress.

Operations during the fiscal year.—There have been no opera during the fiscal year ending June 30, 1892.

Remarks and recommendations.—Work was suspended at this ha in November, 1885, and has not been resumed by the United S since that date. It is reported that some dredging was done by vate enterprise in 1891 and 1892.

In view of the small amount of commerce likely to be benefite its completion, no appropriation for continuing the improvement been recommended since 1885.

Original estimate (see Report of Chief of Engineers, 1882, page 2121)... $1

APPROPRIATIONS.

Act of—
August 2, 1882 .... $
July 5, 1884 ....

Total ....

Money statement.

July 1, 1891, balance unexpended	$2,
June 30, 1892, amount expended during fiscal year	
July 1, 1892, balance unexpended	2,
Amount (estimated) required for completion of existing project	108,
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR ENDING DECEMBER 31

[Furnished by Mr. Jesse Spalding, president Spalding Lumber Company.]

Name of harbor, Cedar River, Mich.; collection district, Superior, Mich.; n light-house, on north pier head, Cedar River Harbor, Michigan.

Arrivals and departures of vessels.

Description.	Arrivals.		Departures.	
	Number.	Tonnage.	Number.	Tonnage.
....	245	61,250	245	61,250
....	230	69,000	230	69,000
....	475	130,250	475	130,250

Principal articles of export and import.

	Tons.
tan	187
....	30
....	7½
....	1,430
er	45,000
telegraph	303
fence	3,325
s	187
les	1,800
ailroad	14,000
....	6,250
ıl	72,519½
proximate value, $630,000.	
s	6
....	105
....	20
r	3

Imports—Continued.	Tons.
Cattle	75
Coal and coke	125
Corn	56
Eggs	1
Flour	183
Hay	400
Hogs	7
Lime and cement	21
Merchandise, general	30
Mill stuffs	10
Oats	272
Oil	52
Pork and beef	30
Potatoes	15
Provisions	25
Salt	15
Total	1,451
Total approximate value, $150,000.	

I I 4.

EMENT OF MENOMINEE HARBOR, MICHIGAN AND WISCONSIN.

—To secure a navigable channel from Green Bay into the ıee River, where the harbor of Menominee is situated.

t.—The original project adopted in 1871 provided for the con- ı of two parallel piers 400 feet apart, extending from the mouth ver to the 15-foot contour in Green Bay, and dredging a chan- een them 14 feet deep. In 1874 it was decided to extend the the 16-foot contour.

t work.—(1) North pier, 1,854 feet in length, consisting of 585 ab pier, 20 feet wide; 609 feet of pile pier, 481 feet of the same a width of 14 feet, and 128 feet a width of 18 feet; 660 feet of) feet with a width of 20 feet, and 50 feet with a width of 24 feet. h pier, 2,710 feet in length, consisting of 1,900 feet of pile pier, t having a width of 14 feet and 96 feet a width of 18 feet, and of cribs 20 feet wide.

le piers were built in 1871–1874, and the cribs 1876–1884. The : in good condition. The north pile pier was rebuilt above the ıe in 1889, and is in good condition. The older part of the south is much decayed, and it should be rebuilt above the water line.

of water.—Originally 4 feet. The channel now is 200 feet wide eet deep the full length of the harbor piers.

tions during the fiscal year.—Dredging by hired labor and the nited States dredges Nos. 1 and 2, resulted in the formation of a channel ... from the 16 ... feet deep, exten... in the Me... end of the ch...

Remarks ...

mate for the ... the original ... object sought ... printed an...

A comparison ... show that in the ... and January, ... advanced 1,100 ... the 16-foot co... channel, and that ... center line of the channel limits. ... deposited wi...

Of the 1,900 linear ... least 1,000 linear ... 1871-187... delay. A section of ... water line wi... damaged by a freshet ... feet was b... undermined, rendering ... channel face b...

An appropriation of $... the repairs ... needed to this pier.

Original estimate (see Report ... page 139), $212,...

Act of—			
March 3, 1871	$2...		$10,...
June 10, 1872	...		12,...
March 3, 1873	...		15,...
June 23, 1874	...		16,...
March 3, 1875	...		8,...
August 14, 1876	...		8,...
June 18, 1878	...		8,...
March 3, 1879	...	Total	212,...

Money statement.

... unexpended ...	3,255.…
...	2,876.…
...	378.…
...	15,000.…
... 1884	15,000.…
... river and ...	

... CALENDAR YEAR ENDING DECEMBER 31, 1891.

... district, Superior, Mich.; neare... M...

	Departures.	
	Number.	Tonnage.
...	47...	100,...
...	...	83,...
...	...4	183,...

Principal articles of export and import.

	Tons.	Imports—Continued.	Tons.
...	1,000	Coal and coke	5,535
...	4,125	Flour	860
...r	442,500	Hay	10,000
...andise, general	7,000	Lime and cement	580
...s	30,000	Merchandise, general	6,000
...	1,462	Mill stuffs	10,500
...les	2,250	Oats	128
...	15,000	Posts, fence	513
		Salt	900
Total	503,337	Stone	7,000
		Wood	17,500
...s	293	Total	59,899
...	90		

...CIAL STATISTICS FOR THE CALENDAR YEAR ENDING DECEMBER 31, 1891.

[Furnished by Mr. K. Lundberg, deputy collector of customs.]

...f harbor, Marinette, Wis.; collection district, Milwaukee, Wis.; nearest ...e, on north pier-head, Menominee, Mich.

Arrivals and departures of vessels.

Description.	Arrivals.		Departures.	
	Number.	Tonnage.	Number.	Tonnage.
...	524	128,777	526	129,097
...	553	140,330	554	138,839
...	1,077	269,107	1,080	267,936

Principal articles of export and import.

	Tons.	Imports:	Tons.
...and coke	5,100	Apples	180
...	293½	Brick	600
...	14,492½	Butter	10
...ber	412,500	Flour	75
...	3,004	Hay	500
...ts	6,412	Merchandise, general	100
..., telegraph	42,500	Mill stuffs	200
..., fence	9,500	Oats	256
...	5,234	Oil	101
...doors, and blinds	3,100	Peas	2,022
...logs	180,000	Pork and beef	120
...gles	12,300	Potatoes	30
...	300	Salt	30
...l	15,000	Saw logs	75,000
		Stone	1,400
...al	709,736	Wood	2,500
...pproximate value, $4,000,000.		Total	83,124

I I 5.

...VEMENT OF MENOMINEE RIVER, MICHIGAN AND WISCONSIN.

...—The formation of a channel of navigable width, 16 feet deep, ... Bay to N. Ludington Company's mill, Marinette, Wis., a... about 2 miles.

The original project approved October 2, 1890, for the ... of $54,000 appropriated by act of September 19, 1890, was ...hannel 200 feet wide and 16 feet deep, from Green Bay ... as far as available funds would admit.

dredging closed for the season. W
... still in progress. Under this
... material were removed during the fisca
... and the use of United States dredg
... material were removed from the
... June 30, 1892. Dredge No. 2 w
... Dredge No. 1 was working
... year.

... purchase of materials in open
... plant.

...—The formation of a c
... was originally contemplated
... Engineer's Report for 1
... to reduce the upper 2,

... surveys made in 1889 and 18
... dredged considerable shoaling

... channel an appropriati

... No. 85, Fifty-first Congre

... Engineers, 1891, page
...

...

Total ...

...statement.

...

(estimated) required for completion of existing project* $10,000.00
that can be profitably expended in fiscal year ending June 30, 1894 10,000.00
ted in compliance with requirements of sections 2 of river and
or acts of 1866 and 1867.

RCIAL STATISTICS FOR THE CALENDAR YEAR ENDING DECEMBER 31, 1891.

mmercial statistics for the Menominee River are the same as for Menominee Michigan, and Marinette, Wis.

I I 6.

IMPROVEMENT OF OCONTO HARBOR, WISCONSIN.

t.—To secure a navigable channel from Green Bay up the Oconto to the city of Oconto.

ect.—The original project, adopted in 1882, provided for the ion of a channel 100 feet wide and 8 feet deep by extending the ier built by the city to the 10 foot contour in Green Bay, and ng between the piers and up the river to Section Street Bridge, nce of about 2 miles, the piers to be parallel to each other and t apart.

ent works.—(1) North pier, 1,603 feet long, 20 feet wide. For eet the piles are 5 feet apart; for the remaining 503 feet the piles eet apart on the channel side, and 2 feet apart on the outer side, ter being provided with wale timbers, cross-ties, and tie-rods. ling is composed of slabs and edgings ballasted with sand. (2) pier, 2,151 feet long, 20 feet wide. For 1,850 feet the piles are 5 art; the remaining 351 feet is close piling. The filling is composed of slabs and edgings ballasted with sand, except the outer 301 hich is covered with 2 feet thickness of stone. (3) The outer side south pier, beginning 300 feet from the outer end for a distance 0 feet, is protected from ice pressure by a line of close piling, shoreward for a distance of 850 feet by riprap. (4) Additional y is given to 1,850 feet of the south pier by a line of piles on the l side 3 feet apart, provided with wale timbers, cross-ties, and -rods at intervals of 9 feet.

h of water.—Originally 2 feet, increased to 3½ feet by local enter-

at of the soundings taken in May, 1892, shows the governing at the harbor entrance to be about 7½ feet, and in the river as far Spies Mill to be about 6½ feet.

ations during the fiscal year.—By hired labor and purchase of als in open market, the north pier, which was seriously damaged eshet in April, 1891, was repaired by driving a line of piles along annel face for a length of 750 feet. The piles were driven 3 feet from center to center, and provided with wales and binders.

arks and recommendations.—In order to maintain a depth of 8 water, periodical dredging will be necessary. The piers, being ail character, will require frequent repairs.

* For maintenance of channel.

For maintenance and preservation it is estimated that $10,[illegible] be needed for the fiscal year ending June 30, 1894.

Estimated cost (see Report of Chief of Engineers, 1888, page 1868)........ [illegible]

APPROPRIATIONS.

Act of—
March 3, 1881 .... [illegible]
August 2, 1882 .... [illegible]
July 5, 1884 .... [illegible]
August 5, 1886 .... [illegible]
August 11, 1888 .... [illegible]
July 13, 1892 .... [illegible]

Total .... [illegible]

Money statement.

July 1, 1891, balance unexpended	$2,[illegible]
June 30, 1892, amount expended during fiscal year	[illegible]
July 1, 1892, balance unexpended	[illegible]
Amount appropriated by act approved July 13, 1892	[illegible]
Amount available for the fiscal year ending June 30, 1893	[illegible]
Amount (estimated) required for the completion of existing project	[illegible]
Amount that can be profitably expended in fiscal year ending June 30, 1894	[illegible]

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

[illegible] *for repairing by hired labor, and [illegible] of the north pier at Oconto, Wisconsin.*

Articles and quantities.	Price.	Amount.
[illegible]	$5.00	$1,[illegible]
[illegible]	2.[illegible]	[illegible]
[illegible]	25.00	[illegible]
[illegible]	2.25	[illegible]
[illegible]	.25	[illegible]
[illegible]	1.75	[illegible]
		2,[illegible]

[illegible] CALENDAR YEAR ENDING DECEMBER 31, 18[illegible]

[illegible] by Mr. John [illegible], mayor.

[illegible] district, Milwaukee, Wis.; nearest lig[illegible]

[illegible]

Arrivals.		Departures.	
Number.	Tonnage.	Number.	Tonnage.
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

Principal articles of export and import.

	Tons.	Exports—Continued:	Tons.
	137½	Butter	¼
r	7,500	Coal and coke	300
es	150	Fish	50
ailroad	1,400	Flour	161½
		Hay	50
l	9,187½	Lime and cement	43¼
		Oil	45
		Sawlogs	72,000
	15	Stone	2,800
	23¼	Wood	1,000
	30		
	4,000	Total	80,519

I I 7.

IMPROVEMENT OF PENSAUKEE HARBOR, WISCONSIN.

—To secure a navigable channel from Green Bay into the Pen- iver.

t.—The original project, adopted in 1883, provides for continuing er, which had been built by private enterprise, until it should e 10-foot contour in Green Bay, and dredging a channel south depth of 10 feet and width of 100 feet, connecting the deep the river with the deep water in the bay.

t works.—(1) A slab pier, 1,300 feet long and 20 feet wide, h slabs and edgings and ballasted with sand and stone. It t in 1883 and repaired in 1885 and 1891. (2) One thousand six feet of slab pier, built by private enterprise, was nearly all d by a storm in 1885. The destruction of this work left the f the pier built by the United States a detached work.

of water.—Originally 2 feet; increased by private enterprise to 9 feet for a width of 30 feet. The destruction of the portion ier built by private enterprise by the storm of October, 1885, in restoring the channel to about its original condition.

rey made in May, 1890, showed the governing depth to be 2.8 feet.

tions during the fiscal year.—By hired labor and purchase of s in open market, about 600 linear feet of the west end of the naged by fire in September, 1891, were repaired in October and er, 1891.

ks and recommendations.—For the preservation of the existing is estimated that $1,000 will be needed for the fiscal year end- 30, 1894.

l further improvement of this harbor be deemed necessary it is that the modified project submitted in report dated Feburary he estimated cost of which is $8,800, would be all that is needed.

ivals or departures of vessels were reported at this harbor for dar year ending December 31, 1891. Several boats are engaged g, and it is claimed that this business would materially increase ter at the harbor entrance was deepened.

cost (see Report of Chief of Engineers, 1883, page 1652) $50,000

APPROPRIATIONS.

t 2, 1882	$10,000
, 1884	5,000
l	15,000

[illegible] B
[illegible] bay

[illegible]
[illegible] F
[illegible]

[illegible]

[illegible]

[illegible] the
[illegible]
[illegible] the

[illegible] 12
[illegible] and
[illegible] Sable

[illegible]
[illegible] end
[illegible]
[illegible] was built in 1879 [illegible] have
[illegible] 2 [illegible] 705
[illegible] sides
[illegible] 250
[illegible] feet high
[illegible] 1885.

[illegible] feet 12
[illegible]
[illegible] D [illegible]
[illegible] Haven, Mich.
[illegible] years. The
[illegible]
[illegible] 75,531 [illegible]

[illegible] No. 2 [illegible] eig

24, 1892, and suspended June 20, 1892, resulting in ...ubic yards of material.

...mmendations.—For continuing work on the 16-foot ...imated that $25,000 can be profitably expended during ...nding June 30, 1894, and for the preservation and main- ...e existing works $5,000 will be needed for the same period, ...0,000.

...t of the project adopted in 1881 (see Report of Chief of ..., 1881, page 2089)	$135,000.00
...st for a channel 16 feet deep, submitted February 12, 1892	91,915.00

APPROPRIATIONS.

Act of—		Act of—	
...e 23, 1866	$30,500	March 3, 1879	$4,000
...rch 2, 1867	45,000	June 14, 1880	6,000
...y 25, 1868 (allotted)	17,500	March 3, 1881	5,000
...ril 10, 1869 (allotted)	44,550	August 2, 1882	20,000
...y 11, 1870	17,500	July 5, 1884	10,000
...rch 3, 1871	17,500	August 5, 1886	7,000
...rch 3, 1873	20,000	August 11, 1888	10,000
...e 23, 1874	10,000	September 19, 1890	10,000
...rch 3, 1875	10,000	July 13, 1892	25,000
...gust 14, 1876	8,000		
...e 18, 1878	5,000	Total	322,550

Money statement.

...1891, balance unexpended	$10,224.80
..., 1892, amount expended during fiscal year	6,395.75
...1892, balance unexpended	3,829.05
...t appropriated by act approved July 13, 1892	25,000.00
...t available for fiscal year ending June 30, 1893	28,829.05
...nt (estimated) required for completion of existing project	71,915.00
...nt that can be profitably expended in fiscal year ending June 30, 1894	30,000.00
...itted in compliance with requirements of sections 2 of river and ...rbor acts of 1866 and 1867.	

...ERCIAL STATISTICS FOR THE CALENDAR YEAR ENDING DECEMBER 31, 1891.

[Furnished by Mr. Chas. Hartung, deputy collector of customs.]

...e of harbor, Green Bay, Wisconsin; collection district, Milwaukee, Wis.; ...light house, Grassy Island, Wisconsin.

Arrivals and departures of vessels.

Description.	Arrivals.		Departures.	
	Number.	Tonnage.	Number.	Tonnage.
...	435	157,271	431	157,535
...	262	49,079	271	48,545
...tal	697	206,350	702	206,080

...—The figures show that a larger class of vessels than formerly is being em- ...in the Green Bay trade. Thus, while there were 14 less arrivals in 1891 than ...e tonnage was 31,553 tons greater. There were 42 less departures in 1891 ...0, but the tonnage was 33,755 tons greater.

[illegible]

…RIATIONS

Act of—

…000	July 5, 188[illegible]
…000	Aug[illegible]
…,000	Septe[illegible]
…,000	July [illegible], 188[illegible]
…,000	
…,000	Total .... [illegible]
20,000	

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

... used and cost of same in place ... of ... linear feet of the south ... by John M. Bergman, dated December ...

Articles	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible] ... inches and ... inches ... feet B.M.	[illegible]
[illegible] ... inches ... feet ... feet B.M.	[illegible]
[illegible] ... feet ... feet B.M.	[illegible]
[illegible] ... pounds	[illegible]
[illegible]	[illegible]
[illegible] ... cords	[illegible]

[illegible]

... collection district, Milwaukee ...

[illegible]

[illegible]	Arrival		
	[illegible]	[illegible]	[illegible]

Remarks recommendations.—The steam tugs at this harb
employed in e fishing trade and towage of rafts from the nor
end of Lake ichigan and Green Bay, therefore they are not ava
for towing sailing vessels seeking entrance into the harbor;
when the wind is unfavorable they are obliged to "beat" in.
being shoal near the shore ends of the harbor piers, they some
touch bottom when well inside the harbor entrance. It will the
be desirable to dredge the channel 12 feet deep the full width be
the piers. This would require the removal of about 39,000 cubic
of material.

For the formation of a wider channel, maintenance of the same
rebuilding decayed superstructure, an appropriation of $12,000 is r
mended for the fiscal year ending Jule 30, 1894.

Estimated cost (see Report of Chief of Engineers, 1871, page 123)...... $265,

APPROPRIATIONS.

Act of—		Act of—	
March 3, 1871	$25,000	March 3, 1881	$
June 10, 1872	25,000	August 2, 1882	
March 3, 1873	25,000	July 5, 1884	
June 23, 1874	15,000	August 11, 1888	
March 3, 1875	15,000	September 19, 1890	
August 14, 1876	5,000	July 13, 1892	
June 18, 1878	10,000		
March 3, 1879	20,000	Total	2
June 14, 1880	20,000		

Money statement.

July 1, 1891, balance unexpended	$
June 30, 1892, amount expended during fiscal year	
July 1, 1892, balance unexpended	
Amount appropriated by act approved July 13, 1892	3,
Amount available for fiscal year ending June 30, 1893	3,
Amount (estimated) required for completion of existing project	59,
Amount that can be profitably expended in fiscal year ending June 30, 1894	12,

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR ENDING DECEMBER 31,

[Furnished by Mr. R. E. Mueller, mayor.]

Name of harbor, Two Rivers, Wis.; collection district, Milwaukee, Wis.; n
light-house, on north pier head, Two Rivers, Wis.

Arrivals and departures of vessels.

Description.	Arrivals.		Departur	
	Number.	Tonnage.	Number.	To
Steam	253	27,405	253	
Sail	63	16,523	63	
Total	316	43,928	316	

[illegible]

rials used and cost of same in place under contract dated December 18, 1890, ttio Truman and George Cooper, of Manitowoc, Wis., for rebuilding above the 742 linear feet of the north pier at Manitowoc Harbor, Wisconsin.

Articles.	Quantity.	Price.	Amount.
12 by 12 inches .... feet B. M..	145, 572	$27. 00	$3, 930. 44
by 12 inches .... do....	7, 890	19. 00	149. 91
.... pounds..	8, 628	. 03½	301. 98
.... do....	335	. 04	13. 40
.... cords..	34	6. 00	204. 00
....	....	....	4, 599. 73

ear foot $6.20

CIAL STATISTICS FOR THE CALENDAR YEAR ENDING DECEMBER 31, 1891.

[Furnished by Mr. Frederick Schuette, mayor.]

f harbor, Manitowoc, Wis.; collection district, Milwaukee, Wis.; nearest se, Manitowoc, Wis.

Arrivals and departures of vessels.

Description.	Arrivals.		Departures.	
	No.	*Tons.*	*No.*	*Tons.*
....	778	490, 073	781	489, 278
....	260	57, 395	259	56, 858
....	1, 038	547, 468	1, 040	546, 136

Principal articles of export and import (harbor only).

	Tons.
ultural implements...	250
y	47
....	175
....	1, 200
er	82½
le	30
se	2, 130
....	93¾
....	39, 664½
iture	1, 000
....	1, 200
s	25
her	375
ber	5, 250
handise (general)....	2, 500
tuffs	6, 750
....	1, 128
e	7, 510
and beef	42
toes and vegetables ...	870
....	126
gles	75
(railroad)	245

Exports—Continued.	Tons.
Wagons and carriages	225
Wheat	1, 071
Wool	5
Total	72, 069¼
Imports:	
Agricultural implements...	17¼
Coal and coke	129, 380
Iron and steel	502¼
Lath	185¾
Leather	46¾
Lime and cement	145
Lumber	6, 000
Merchandise (general).....	20, 000
Plaster, land	600
Salt	2, 670
Saw logs	13, 500
Stone	3, 500
Wood	10, 000
Total	186, 547¼

approximate value of exports, $3,250,000; total approximate value of im- ,750,000.

I I 14.

IMPROVEMENT OF SHEBOYGAN HARBOR, WISCONSIN.

Object.—To secure a navigable channel from Lake Michigan into Sheboygan River, where the harbor of Sheboygan is situated.

Project.—The project for the improvement of this harbor was adopt in 1852, and had for its object the formation of a 12-foot channel trance to the mouth of the Sheboygan River. This was modified 1873 so as to secure a deeper channel by farther pier extension a dredging. Both projects were completed within their estimated co and a channel was formed 100 feet wide, with a depth of 15 to 16 fe between the piers. A survey made in 1880 showed a depth of less th 12 feet between the piers and on the outer bar. The existing proje was adopted in 1881, its object bei to deepen the channel still fu ther by extending the piers to t 20-foot contour in the lake a dredging to a depth of 18 feet betwee their outer ends, the depth d creasing to 14 feet at the shore line.

Present works.—Pile and crib piers (1) North pier, 2,270 feet lo composed of 900 feet of pile and crib er, built by the city, from 12 to feet wide; 1,320 feet of cribs 20 fe wide, and 50 feet of cribs 30 fe wide. (2) South pier, 2,387 feet long, composed of 780 feet of pile a crib pier, built by the city, from 12 to 20 feet wide; 132 feet of pile p 20 feet wide, 1,425 feet of cribs 20 feet wide, and 50 feet of cribs 30 fe wide; built 1852-'91. About 850 feet of the north pier and 900 feet the south pier built, since 1871, are good condition, the cribs havi been sunk on a stone or pile found on. Previous to 1871 they we sunk on the natural lake bottom, composed of shifting sand, causi them to settle very unevenly.

Depth of water.—Originally 4 feet. A survey completed April 1892, showed the governing depth of water in the channel on that da to be about 13.7 feet.

Operations during the fiscal year.—Under contract dated Decemb 13, 1890, with Messrs. Truman and Cooper, of Manitowoc, the nor pier was extended 150 feet by the construction of three cribs, each feet long, 20 feet wide, and 20½ feet high, including superstructu These cribs were sunk upon foundations consisting of 24 piles for ea crib, cut off 13½ feet below the established datum plane. Work und this contract was completed October 20, 1891.

Dredging by hired labor and the use of United States Dredge No. for the improvement of the channel, was begun June 26, 1891, and progress at the beginning of the fiscal year. It was continued un August 15, 1891, when the work was closed and the dredge transferr to Port Washington. The dredging resulted in the formation of channel 16 feet deep with a width of 90 feet for about two-thirds of length and 60 feet wide for the remainder; 17,030 cubic yards material were removed during the fiscal year.

Remarks and recommendations.—A channel of less than 16 feet do not meet the present requirements of the commerce of this harbor. I reduction in depth to less than 14 feet this season, with no funds ava able for dredging, has been the source of much annoyance and serious loss to shippers and others interested in navigation.

Several vessels laden with coal for this port, after vainly attem to enter the harbor, have been obliged to seek other ports to dis their cargoes; and steamers plying the west shore of Lake Mic and advertising to stop here daily, have been obliged to pass in ithout stopping, thereby causing serious loss and great an- o owners of vessels, shippers, consignees, passengers, and rs more or less concerned.

an appropriation be made for the fiscal year ending June 30, proposed to expend it in pier extension and such dredging ts as may be necessary for the maintenance of the channel and n appropriation of $67,000 is recommended.

d cost of the present project, adopted in 1881 (see Report of gineers, 1881, page 2104)	$150,000
al estimate (see Report of Chief of Engineers, 1884, page 1856)...	45,000
d	195,000

APPROPRIATIONS.

		Act of—	
st 30, 1852	$10,000.00	June 18, 1878	$4,000.00
8, 1864 (allotted)	10,000.00	March 3, 1879	3,000.00
23, 1866	47,598.91	June 14, 1880	7,000.00
2, 1867	8,000.00	March 3, 1881	25,000.00
10, 1869 (allotted)	14,850.00	August 2, 1882	30,000.00
11, 1870	15,000.00	July 5, 1884	28,000.00
3, 1871	15,000.00	August 5, 1886	15,000.00
10, 1872	18,000.00	August 11, 1888	15,000.00
3, 1873	10,000.00	September 19, 1890	15,000.00
23, 1874	10,000.00	July 13, 1892	25,000.00
3, 1875	12,000.00		
st 14, 1876	6,000.00	Total	343,448.91

Money statement.

91, balance unexpended	$12,525.43
892, amount expended during fiscal year	12,392.75
92, balance unexpended	132.68
ppropriated by act approved July 13, 1892	25,000.00
vailable for fiscal year ending June 30, 1893	25,132.68
(estimated) required for completion of existing project	42,000.00
that can be profitably expended in fiscal year ending June 30, 1894	42,000.00

ted in compliance with requirements of sections 2 of river and r acts of 1866 and 1867.

---

aterials used and cost of same in place for extending the north pier 150 feet by 3 ch 50 by 20 by 20½ feet, at Sheboygan Harbor, Wis., under contract dated De- 13, 1890, with Horatio Truman and George Cooper, of Manitowoc, Wis.

Articles.	Quantity.	Price.	Amount.
r, 12 by 12 inches and 12 by 18 inches ....feet B. M..	98,856	$25.00	$2,471.40
mber. 12 by 12 inches and 12 by 18 inches ....do....	92,952	22.00	2,044.94
, 8 by 12 inches ....do....	9,240	18.00	166.32
piles ....number..	72	11.50	828.00
alts ....pounds..	12,685	.03	380.55
bolts ....do....	3,694 1/10	.04	147.77
n spikes ....do....	282	.04	11.28
............cords..	636 1/10	6.50	4,134.65
	....	....	10,184.91

inear foot, $67.89.

[illegible] STATISTICS FOR THE CALENDAR YEAR ENDING DECEMBER 31,

[[illegible] E. A. Warren, collector of customs, Milwaukee, Wis., and Mr. John M. [illegible] mayor of Sheboygan, Wis.]

Name of har[illegible], Sheboygan, Wis.; collection district, Milwaukee, Wis.; light-house, S[illegible], Sheboygan, Wis.

Arrivals and departures of vessels.

Description.	Arrivals.		Depa[rtures]
	No.	Tons.	No.
Steam	554	445,548	528
Sail	616		631
Total	1,170	445,548	1,159

[illegible] *export and import.*

Exports:	
Beef	[illegible]
Boots and shoes	[illegible]
Chairs	[illegible]
Cheese	[illegible]
Coal and coke	[illegible]
Eggs	[illegible]
Fish	[illegible]
Flour	[illegible]
Furniture	[illegible]
Hay	[illegible]
Hollow ware	[illegible]
Leather	[illegible]
Lime and stone	[illegible]
Machinery	[illegible]
Mineral water	[illegible]
Peas	500
Salt	730
Wooden ware	730
Veneering	2,000
Total	80,636
Total approximate value	$8,130,350

Imports:	
Bark (tan)	
Coal and coke	
Empty bottles	
Glue	
Hay and grain	
Hides	
Lime and cement	
Lumber and lath	
Merchandise (general)	
Oil and varnish	
Pig iron	
Plaster (land)	
Posts (fence) and ties	
Salt	
Shingles	
Wines and liquors	
Wood and slabs	
Veneering	
Total.	
Total approximate value	$4,[illegible]

I I 15.

IMPROVEMENT OF PORT WASHINGTON HARBOR, WISCONSI[N]

Object.—To secure a navigable channel entrance from Lake Mi[chigan] to a small artificial harbor formed by excavating two interior co[nnecting] basins.

Project.—The original project for the improvement of this harb[or was] adopted in 1869, and provided for the building of two paralle[l piers] extending from the shore line to 10 feet of water in the lake, a[nd the] excavation of a basin 600 feet long by 200 feet wide inside of th[e shore] line. In 1870 a deflection of about 10 degrees to the southwa[rd was] made in the direction of the piers, this being considered a mor[e favor]able direction for their alignment. In 1876 a further modific[ation of] the plan was made by excavating a second basin to the northwa[rd,] nearly at right angles to the first basin, and extending the piers [to the] 14-foot contour in the lake. This doubled the available area [of the] harbor and reduced the height of the entering waves very mat[erially.]

This is the project now being carried out. The two interior [basins] have a combined area of about 5¾ acres and area to be dredg[ed]

12 feet, with a channel of the same depth connecting them lake, the channel inclosed between two piers 150 feet apart nding out to 14 feet of water.

works.—(1) North pier, 920 feet long, composed of 370 feet 4 feet wide; 500 feet, 20 feet wide, and 50 feet, 24 feet wide. pier 1,226 feet long, composed of 370 feet of cribs 14 feet feet 20 feet wide, and 406 feet of pile revetment. The piers lt 1871–1887, and are in good condition, with the exception near feet of superstructure, built in 1871, which is much ded requires renewal.

of water.—The original depth of water at the mouth of Sauk as about one foot. Soundings taken in May, 1892, indicated a epth in the entrance channel of 10½ feet.

ions during the fiscal year.—By hired labor and the use of States Dredge No. 2, 14,360 cubic yards of material were removed e entrance channel and basins. Dredging was suspended 15, 1891, and the dredge transferred to Menomonee, Mich. 0 cords of stone were transferred from the shore end of the piers er heads and used for refilling and riprap where undue settled occurred.

rks and recommendations.—The north pier was built the full ontemplated in 1887. It is proposed to complete the south pier nding it 100 feet as soon as funds are appropriated.

September, 1890, to May, 1892, there was a deposit in the chan- basins of about 7,000 cubic yards of material, reducing the f water in the entrance channel about 1½ feet. The removal of 3,000 cubic yards of material is necessary to maintain the re- depth of water in the channel and basins. Three hundred and linear feet of the shore end of each pier, built in 1871, have seen one years' service. The superstructure of this portion of the badly decayed and should be rebuilt above the water line. imated cost of the dredging and rebuilding 640 linear feet of ucture is $10,000.

d an appropriation be made for the fiscal year ending June 30, is contemplated to expend it for dredging, and rebuilding above er line the shore ends of the north and south piers. An appro- of $16,500 is recommended.

APPROPRIATIONS.

Act of—		Act of—	
11, 1870	$15,000	March 3, 1881	$17,000
h 3, 1871	15,000	August 2, 1882	17,000
10, 1872	15,000	July 5, 1884	10,000
h 3, 1873	15,000	August 5, 1886	5,000
23, 1874	10,000	August 11, 1888	5,000
h 3, 1875	10,000	September 19, 1890	3,000
st 14, 1876	8,000	July 13, 1892	6,500
18, 1878	5,000		
h 3, 1879	7,500	Total	184,000
14, 1880	20,000		

Money statement.

91, balance unexpended	$3,034.70
1892, amount expended during fiscal year	2,901.34
92, balance unexpended	133.36
ppropriated by act approved July 13, 1892	6,500.00
vailable for fiscal year ending June 30, 1893	6,633.36

[illegible]

[illegible]

[illegible]

[illegible] Port Washington, [illegible]

[illegible]

[illegible]	[illegible]		[illegible]
	No.	Tons.	No.
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]	[illegible]

[illegible]

Exports: [illegible]

Imports:

- Apples [illegible]
- Bark (tan) [illegible]
- Barley [illegible]
- Beans [illegible]
- Beer [illegible]
- Butter [illegible]
- Cheese [illegible]
- Coal and coke [illegible]
- Flour [illegible]
- Hay [illegible]
- Hides [illegible]
- Iron and steel [illegible]
- Lath [illegible]
- Leather [illegible]
- Lime and cement [illegible]
- Lumber [illegible]
- Merchandise, general [illegible]
- Mill stuffs [illegible]
- Oats [illegible]
- Oil [illegible]
- Plaster (land) [illegible]
- Pork and beef [illegible]
- Posts [illegible]
- Potatoes [illegible]
- Provisions [illegible]
- Rye [illegible]
- Salt [illegible]
- Sand, brick and stone [illegible]
- Saw logs [illegible]
- Shingles [illegible]
- Stone [illegible]
- Wagons and carriages [illegible]
- Wheat [illegible]
- Wool [illegible]

Total [illegible]

Total approximate value [illegible]

[illegible]

I I 16.

HARBOR OF REFUGE AT MILWAUKEE BAY, WISCONSIN.

t.—To provide a secure anchorage for vessels engaged in the commerce of the lakes, by inclosing the northern section of kee Bay within a breakwater, formed of timber crib work, placed k upon a foundation of stone.

t.—The project was adopted in 1881 and provided for the construction of a breakwater, the north arm of which commences at a distance f about 600 feet from the north shore of the bay, in a depth of 8 water.

irection is S. 25° 19′ E. and its length 2,450 feet. From this e direction of the main arm of the breakwater is changed to S. . for the proposed distance of 5,200 feet, with an opening of 400 the distance of 1,000 feet from the angle, to provide a fair-weather ce and exit for vessels.

nt works.—The north arm of the breakwater is completed. The rtherly section of it, 600 feet in length, is comprised of 6 cribs, 100 feet long and 20 feet wide, and the remaining 1,850 feet of 37 , each 50 feet long by 24 feet wide.

e dimensions of the cribs forming the main arm to the northward e opening are 50 feet by 24 feet by 22½ feet, with the exception of No. 62, which is next to or immediately northward of the opening s 100 feet long by 24 feet wide by 22½ feet high, over the whole of h superstructure has been built to a height of 6 feet above datum. ven cribs, numbered from 63 to 69 inclusive, each of dimensions y 24 by 22½ feet, have been sunk to the southward of the openover 400 feet of which superstructure has been built.

e total length of substructure built is 4,150 feet, upon which 3,850 f superstructure has been built.

pth of water.—The slope of the lake bed from the northern end of reakwater to the angle formed by the north and main arms is 0.87 to 100 feet, the angle crib being set in 29.4 feet of water. The ge depth of water on the line of section of main arm to the south of the opening is 34.6 feet.

erations during the fiscal year.—Under the contract made with stopher H. Starke, dated December 13, 1890, Crib No. 62 was sunk e northward of the opening for fair-weather exit, and Crib No. 66′ built to a height of 18½ feet and sunk upon the foundation upon h the overturned Crib No. 66 was first placed. Cribs Nos. 67, 68, 69 were built and sunk in their respective positions and covered a decking of plank of 4 inches in thickness and 8 inches in width, pertures between planks being about 1½ inches wide. A similar ing of plank was spiked on the superstructure built under this ract over Cribs Nos. 63, 64, 65, and 66 to a height of 6 feet above m, the length of the substructure under the contract being 500 and of superstructure 525 feet.

e scow *Dunham* has been reëngaged to serve as light-ship at the h end of the breakwater, under a new agreement made with her r, in accordance with the terms of advertisement and sepecifica-

.

marks and recommendations.—On the 13th of May last soundings taken around cribs Nos. 62 to 69 inclusive, a plat of which shows but very slight changes have been made in their foundations durhe past winter. The superstructure has suffered no material damage, either from sea or ice, which is evidence that no storms of u[illegible] severity have occurred.

The shore accretions which have formed in the northern section [illegible] harbor are large, their superficial area being now about 15 acres [illegible]tent. The anchorage area outside of the contour line of 18 feet is [illegible] what diminished. The project adopted by the Board of Engineers [illegible]stituted by Special Orders No. 32, paragraph 2, Headquarters [illegible] of Engineers, dated April 7, 1881, was as follows:

> Starting from near North Point, in 8 feet of water, but leaving a gap of a[illegible] feet between the beginning of the breakwater and the shore, to be closed [illegible] if found necessary, etc.

From the rapidity with which the shore accretions have formed [illegible] now considered desirable to close the space between the norther[illegible] of the breakwater and the shore, leaving an opening of about [illegible] at the present end of the breakwater for the passage and accom[illegible]tion of small boats. A row of sheet piling, reinforced by main [illegible] and fenders, would effect this, at a cost not exceeding $12 per r[illegible] [illegible], or a total expenditure of about $6,240.

APPROPRIATIONS.

[illegible] 1881		$100
[illegible] 1882		100
[illegible]		85
[illegible]	[illegible]	
[illegible] Milwaukee Harbor	[illegible] 7.91	
		55
[illegible]		70
[illegible]		80
[illegible]		75
		5[illegible]

I I 17.

IMPROVEMENT OF MILWAUKEE HARBOR, WISCONSIN.

ct.—To secure a navigable channel from Lake Michigan into the ukee River, which is the interior harbor of Milwaukee.

ject.—The original project adopted in 1852 provided for the for- of a channel 260 feet wide and 12 feet deep, by dredging across int which overlapped the mouth of the Milwaukee River at the ce of 3,000 feet to the northward of its original outlet, and by the uction of parallel piers of crib work, each 1,120 feet in length, for rotection of the sides of the channel thus formed. In 1868 an sion of the piers became necessary for the requirements of com- , and under a continuation of the original project both the north outh piers were extended 600 feet into the lake to 18 feet depth ter.

ent works.—The entire length of the channel between the piers 0 feet; its width at the outer end has been increased through the rd settling of cribs to 284 feet.

width of each of the 1,120-foot sections of piers first built is 20 The pier extensions of 600 feet in length are 26 feet wide, except- e pier heads, which are each 30 feet wide and 50 feet long, pro- l by a bulkhead of piles and oak timbers.

superstructure of the inner section of the north pier for 1,052.6 f its length by 20 feet in width, is of quarry-faced dry stone ry, the side walls being 4 feet thick. Between these walls for a h of 663 feet the filling is of stone packed with gravel, and cov- with large paving stones of 9 inches in thickness. The filling en walls for the remaining 389.6 feet is of packed stone, with a yer of concrete pavement of 9 inches in thickness. Piles for the ction of the piers have been driven along the channel faces. The structure over the pier extensions of the 600 feet was built in 1871 872. In 1887 the superstructure of the 600 feet extension of the pier was cut down and rebuilt. In 1889 the superstructure of et of the outer section of the south pier was cut down and rebuilt.

pth of water.—Soundings were taken between the piers and in Michigan beyond the extremities of piers on the 4th day of May, a plat of which shows that since similar soundings were taken in mber, 1891, a deposit of about 0.8 feet of material has been made in channel between piers, leaving a depth of waterway of 17 feet. de of the pier extremities the water is fully 18 feet deep below the n plane.

erations during the fiscal year.—Proposals were opened on the day of July, 1891, for dredging the channel between the piers to pth of 18 feet and for a width of 162 feet. Mr. Christopher H. ke's bid for doing the work at 18 cents per cubic yard was the st offer received, and a contract was made with him on July 29, , under which 25,896 cubic yards of material were removed from channel. Ten and three-fourths cords of stone were purchased and d in the north pier in places where the concrete covering had been ved by the waves.

marks and recommendations.—In the report of June 30, 1889, the s of this harbor were stated in detail. The deterioration of the from wear and climate has been steadily progressing since that . In 1879 it was estimated that an average yearly expenditure of 00 would be required for the maintenance of this harbor. Since

hat time the average yearly expenditure ...
otal of the sums appropriated ...

APPROPRIATIONS.

Expended on former mouth of ...

August 30, 1852
March ... 18..
June 23, 1866
April 10, 1869 (allotment)
July 11, 1870
March ... 1871
March ... 1873
June 23, 1874
March 3, 1875
August 14, 1876
June 18, 1878
March 3, 1879

... (appropriation for harbor of refuge) ...

... 1883 ...

... of proposed ...

... work $... ...

ɪAL STATISTICS FOR THE CALENDAR YEAR ENDING DECEMBER 31, 1891.

f harbor, Milwaukee, Wis.; collection district, Milwaukee, Wis.; nearest try, Milwaukee, Wis.; amount of revenue collected during the year $365,-

Arrivals and departures of vessels.

Description.	Arrivals.		Departures.	
	No.	Tons.	No.	
....	3,873	3,158,757	3,771	
....	2,069	372,420	2,011	
....	5,942	3,531,177	5,782	3,5

lowing extracts taken from the annual report of the secretary of the cham- mmerce for the fiscal year ending April 4, 1892, show the receipts and ship- some of the leading articles of commerce at the harbor and city of Milwau- ıg the year:

Receipts and shipments.

:	Tons.
ey by (rail and lake).	235,030½
ey (local consump- n)	105,893
er	1,997¼
ır posts	12,332
se (Wisconsin)	6,452½
(by lake)	1,006,656
(by rail)	149,377
	32,569
s	2,716¾
wood	231,032
seed	17,382½
r	272,756¾
s	11,497¼
s (manufactured into ather)	6,184½
s	69,576
s	1,057¼
ore	134,324
ber	541,689
ı	4,851¼
	116,936
stuffs	24,163
	76,795
iron	35,292
toes	5,385¾
	93,974
gles	16,184½
ow	499½
at	325,394¾
d	1,962¾
tal	3,539,961¾

Shipments:	T
Barley	12
Butter	
Coal	60
Corn	
Flax-seed	
Flour	
Hides	
Hogs	4,
Lard	3,376¾
Lumber	261,582¼
Lath	1,831½
Malt	51,816¾
Meat (bulk)	6,861¼
Mill stuffs	90,624
Oats	38,698
Pork, beef, hams, shoulders, and middles	25,016½
Pig iron	38,481
Potatoes	1,675½
Salt	84,346
Shingles	11,895
Wheat	82,932½
Total	1,874,992¼

deposits	$865,401,940.58
ots of office of internal revenue	3,276,630.42

umber of manufacturing establishments in the city of Milwaukee is 3,258. aber of persons employed in these establishments is 55,890. The capital in- in manufactures is $80,506,500. The value of products during the year, ,885. Two new lines of steamers have been established, connecting with lines on the east shore of Lake Michigan, one of which connects with St. Mich., the other with the railroad lines at Benton Harbor. Milwaukee has dependent lines of steamers plying across the lake, besides the lines of amers along the west shore.

[illegible] providing

[illegible] pier was extended [illegible] further modification was [illegible] north pier [illegible] the depth of wa[illegible] pier extended [illegible]

Present condition.—The north pier is about 1,800 feet long. [illegible] section [illegible] feet wide; its middle section [illegible] feet wide, and its outer or eastern section of [illegible] 30 feet wide. The south pier is [illegible] feet long; its westerly section [illegible] feet wide, and its out[er] section [illegible] feet long and [illegible] feet wide. The north [pier] [illegible] feet farther into Lake Michigan than [the south] pier.

Depth of water.—The natural depth of water on the bar [at] the mouth of the river before artificial improvement was [illegible] [illegible] The effect of a northeast storm would be to deposit [sand] [illegible] an extent as to completely obstruct the entrance until an [illegible] of water in the river became sufficient to remove [illegible] and upon a change of wind sometimes a narrow channel [illegible] would be scoured out.

The work done under the project previous to 1866 [illegible] [illegible] to 10 feet in depth. The extension of the piers [illegible] dredging which has been done since 1866, has [illegible] channel of from 13 to 15 feet in depth, but the [illegible] channel is dependent upon a frequent [illegible]

[illegible] soundings taken at this harbor in April, 1882, sh[ow] [illegible] conditions of weather a vessel drawing 13 feet [illegible] removed in its accomplishment was 14,273 cubic yards. contract made with Messrs. Truman and Cooper, of date 13, 1890, for extending the south pier into lake Michigan for of 200 feet, by constructing 4 cribs, each of dimensions 50 34 feet, and sinking them on a foundation of piles, the speci- vas completed and a continuous superstructure built over ıeight of 6 feet above datum, before the 10th of October,

and recommendations.—Until both piers are extended farther ıke, a frequent use of the dredge will be necessary. The ture of the western section of the north pier 200 feet in 12 feet in width, and 635 feet of its middle section of 20 feet in ı a dilapidated condition, as is also 310 feet in length of the ture of the west end of the south pier. The damage to the outer end of the north pier, caused by the collision of the *'ity of Ludington*, of the Goodrich Transportation Company, rning of the 20th of December, 1891, is of a serious character, of the expense and difficulty incurred in repairing structures fractured below the water surface. The broken timbers of will have to be removed and replaced by new material to a t or more feet below datum.

f the piers should be extended 300 feet. In 1880 it was esti- at an average yearly expenditure of $8,000 would be required aintenance of this harbor. Since that time the total sum of ıtions made has been $63,500, of which $21,000 has been ap- pier extension, so that the average yearly expenditure for ınce of channel and repairs to piers has been but $3,541.66 per the past twelve years. This amount is inadequate to the ınce of the harbor as is apparent from its present condition.

APPROPRIATIONS.

		Act of—	
15, 1844	$12,500	June 18, 1878	$10,000
st 30, 1852	10,000	March 3, 1879	6,000
28, 1864	3,600	June 14, 1880	6,000
23, 1866	23,910	March 3, 1881	6,000
ı 2, 1867	45,000	August 2, 1882	7,000
10, 1869 (allotted)	22,275	July 5, 1884	7,000
11, 1870	10,000	August 5, 1886	10,000
h 3, 1871	10,000	August 11, 1888	10,000
h 3, 1873	20,000	September 19, 1890	17,500
23, 1874	10,000	July 13, 1892	25,000
h 3, 1875	10,000		
st 14, 1876	8,000	Total	289,785

Money statement.

91, balance unexpended	$17,643.88
892, amount expended during fiscal year	16,642.71
92, balance unexpended	1,001.17
ppropriated by act approved July 13, 1892	25,000.00
vailable for fiscal year ending June 30, 1893	26,001.17
(estimated) required for completion of existing project	39,500.00
that can be profitably expended in fiscal year ending June 30, 1894	39,500.00

ed in compliance with requirements of sections 2 of river and r acts of 1866 and 1867.

The w
periodica
maintain
ance of
dredge.
A plat
under fav
can enter

I I 19.

IMPROVEMENT OF KENOSHA HARBOR, WISCONSIN.

—To secure a navigable channel from Lake Michigan into the e basin at the mouth of Pike Creek, upon which the city and f Kenosha are situated.

t.—The original project for the improvement of this harbor, in 1852, was to secure a channel 12 feet deep from 12 feet of Lake Michigan to the interior basin or bayou by the construc- piers placed parallel to each other and 150 feet apart, and by g between them. In 1866 a modification of the original project le in order to provide a navigable channel 15 feet in depth. ther modification or extension of the project was made in 1889, rovided for the extension of the north pier 300 feet and of the ier 600 feet.

nt works.—The north pier is 1,600 feet long. Its inner or section, which was built either by private parties or the city of a, is of pile work, 365 feet in length, and is 12 feet wide. The ad- section to the eastward, built under the original project of 1852, b work 610 feet long and 18 feet wide. The extension of this e 1866 is 625 feet long, 250 feet of which is 30 feet wide. The ier is 950 feet long and 20 feet wide, commencing at the shore d extending into the lake. The north pier extends 270 feet into the lake than the south pier.

of water.—The natural depth of water at the mouth of Pike before it was improved changed with each recurring easterly not more than 2 or 3 feet could be depended upon at the entrance. rk first done under the project furnished a channel of from 9 to in depth between the piers.

xtensions of the piers since 1866, together with periodical dredg- ve generally provided a channel about 12 feet in depth, but in maintain a greater depth of water frequent dredging has been ry.

t of soundings which were taken at this harbor in April, 1892, n available depth of but 12½ feet of water in the channel. A ank in mid-channel has but 12 feet of water over it. An exten- posit of sand has been made since dredging was done in June, To restore the channel to a depth of 15 feet and width of 80 feet quire the removal of about 15,000 cubic yards of material, scow ement.

contour line of 13 feet extends 200 feet beyond the outer end of th pier, and the bank to the southward of the harbor entrance t 600 feet outside the eastern extremity of the south pier. Under nditions it is improbable that a channel of greater depth than 2½ feet of water can be maintained, except by a constant use of dge.

ations during the fiscal year.—At the close of the fiscal year end- ne 30, 1891, the three cribs which were built under the contract vith Messrs. Truman & Cooper, of date December 13, 1890, for ing the south pier 150 feet, were sunk in position. The super- re was subsequently built and supplied with stone ballast and d with a decking of 3-inch plank. The contract was closed July 1. An agreement was entered into with Mr. S. O. Dixon on 1892, for restoring the channel to 15 feet in depth and 80 feet in r its whole length, at a cost of 18½ cents per cubic yard of ma-

Arrivals and departures of vessels.

Description.	Arrivals.		Departures.	
	No.	Tons.	No.	Tons.
	72	11,379	72	11,358
	195	27,812	194	27,510
	267	39,191	266	38,868

Principal articles of export and import (harbor only).

	Tons.
	.3
	6
	800
	1.5
	112
	60
	6,750
	7,729.8
	16,500
coke	10,500

Imports—Continued.	Tons.
Hides	125
Lath	302.5
Lumber (hard and soft)	22,750
Peaches	6
Piles	120
Posts (fence)	228
Shingles	450
Slabs	300
Stone	5,600
Wood	2,750
Total	59,631½

I I 20.

IMPROVEMENT OF WAUKEGAN HARBOR, ILLINOIS.

—To provide a shelter for the protection of vessels engaged in ...erce of the city of Waukegan.

—In 1852 an appropriation of $15,000 was made for the "im...nt of the harbor and breakwater at Waukegan, Ill." The ...pted was a breakwater parallel to the shore in 20 feet of water. ...b, 30 by 25 feet, was placed in position, but was carried away ...m and the work then abandoned. In 1872 an examination and ...ere made, as called for by the river and harbor act of that year. ...n contemplated a breakwater in 24 feet of water. No action ...en on this report.

...aracter of the improvement of this harbor is somewhat dif...rom that of other points on the Great Lakes. Most of the ...ments have consisted in deepening the mouths of streams emp...to the lake, but at Waukegan there is only a creek emptying ...lake, and it is of no importance for harbor purposes.

...resent project was adopted in 1880, its intention being to con...n exterior basin of sufficient capacity to meet the requirements ...cal trade by inclosing a portion of Lake Michigan within piers ...ted of pile work, and an entrance channel between piers from 12 feet of water in Lake Michigan to the basin; the channel to be excavated by dredging to the depth of 12 feet.

...works.—The length of the north pier is 1,651.6 feet; the ...the south pier is 1,226.9 feet, making a total length of pier ...5 feet. The north pier, which incloses the basin, is com...s, the first of which runs easterly from inside the ...in 1879 for a distance of 345 feet into the lake.

This section is comprised of a single row of 12 by 12 inch squ piles, reinforced at the angle or outer end for a length of 80 oak piles driven at a distance of 12 feet from the front row, t space being filled with stone ballast.

The next section of pile work, 16 feet wide, runs in a south tion for a distance of 380.8 feet to the channel angle.

The next section of 16 feet in width, which runs in a sou direction for a distance of 533.8 feet from the channel ang prised of two rows of closely driven white oak piles, divide tions by cross rows driven at distances of about 32 feet ap sheeted with 3-inch pine plank, and filled with stone ballast of 2 feet above datum.

The outer section, of 16 feet in width and 392 feet in leng structed in the same manner as the preceding section, and to the line of the south pi[illegible] the distance between the piers feet.

The south pier is built [illegible] prolongation of the line of side of Madison street i[illegible]ty of Waukegan. The insi of this pier, 140.3 feet, is [illegible]sed of a single row of square of dimensions 12 by 12 in[illegible] 18 feet, with the exception o 24 piles, which are 22 fee[illegible]gth and 12 inches square.

The next outer section of 1[illegible] feet in length is constructe white oak piles, each 30 feet in length, on alignment at dis feet from center to center, and sheeted with two rows o dimensions 3 inches by 12 inches by 22 feet, driven close an joints, and spiked to the wales which inclose and secure piles.

The next section to the eastward, of 209 feet in length, is round white oak piles, each 30 feet long, driven at distance from center to center and secured with binders. On the s this row pine piles of 8 inches by 12 inches by 26 feet are dri [illegible] and bolted to the binder and reinforced with a p 8 by 12 inches. The outer section of this pier is [illegible] feet l composed of two parallel rows of white-oak piles, driven [illegible] at a distance of 16 feet from center to center of rows, and into sections of about 32 feet each. [illegible]

[illegible]

r more than 1,300 feet to the eastward of the line of

undings taken at this harbor in April, 1892, shows that
nel of 7 feet in depth near the north pier is available for
t draft.

during the fiscal year.—At the close of the fiscal year end-
1891, six sections of pile work, each 32 feet long, being
ngth, had been completed in extension of the north pier,
ng done by hired labor and the purchase of materials in
. Subsequently six more sections, forming an additional
running feet, were built, making a total length of exten-
orth pier of 392 feet, under the provisions of the river and
f September 19, 1890, which appropriated $35,000 for the
t of Waukegan Harbor. This extension was completed on
of August, 1891, when the pile-driver was transferred
th to the south pier for its further extension. Work was
the south pier until November 11, 1891, at which date 202
of extension had been built, and the pile-driver laid up
for the winter.

l fences have been constructed for the purpose of arresting
ft of the beach to the northward of the harbor from being
the channel and basin. One of these is 176 feet long and
8 feet. While they have not completely checked the drift,
ntity of sand has been retained upon the beach through
mentality which otherwise would have been carried into the

received and opened on March 16, 1892, in answer to adver-
February 15, 1892, inviting proposals from contractors for
the entrance channel and harbor basin to a uniform depth
elow datum. The bid of the Green Bay Dredge and Pile
pany was the lowest offer made, and a contract was made
mpany on the 23d day of March, 1892, to dredge and remove
yards of material at 13¾ cents per cubic yard, the work to
d on or before October 31, 1892.

te 9,714.6 cubic yards of material have been removed under
t.

and recommendations.—The satisfactory manner in which the
to the piers were made during the working season of 1891,
rming a total length of 594 running feet, with one pile-driver
f nine men, was partly due to the preparations which were
g the winter of 1890 and 1891 by the purchase and delivery
s, but chiefly to the systematic work done by the overseer
w of men.

0 cords of stone are needed alongside the piers as riprap,
the deficiency caused through a settlement of that material
tion.

ok for a large increase in the commerce and manufactures
an is very encouraging, and, in consequence, the value of
has been greatly enhanced. The facilities rendered by the
bor are not considered by the citizens of the place as being
o the requirements of the growing demands; in view of
tition was circulated among the business men for signature
past winter, and addressed to the honorable the Secretary
king that an ample appropriation be made for extending the
s to the depth of 16 feet of water in Lake Michigan. A
this subject was called for, and made by me, dated February

Arrivals and departures of vessels.

Description.	Arrivals.		Departures.	
	No.	*Tons.*	*No.*	*Tons.*
....	203	20,811	203	20,811
....	165	31,740	165	31,740
....	368	52,551	368	52,551

Principal articles of export and import.

	Tons.
....	75
....	1,575
....	150
een trees	500
....	500
r........	150
oors, and blinds........	400
....	1,200
vorks........	75,000
....	12½
l	79,562½
tan)	440
....	176
....	1,750
....	18,000
nd coke........	116,000
....	28,000
....	1,935

Imports—Continued.	Tons.
Furniture........	562½
Hides........	300
Hops........	10
Lime and cement........	972
Lath........	825
Lumber........	21,000
Malt........	325
Merchandise (general)........	25,000
Oil........	675
Pork and beef........	1,200
Posts (fence)........	114
Potatoes........	180
Salt........	750
Shingles........	900
Ties (railroad)........	700
Wire-work products........	75,000
Wood........	10,000
Zinc ore........	4,650
Total........	309,464½

I I 21.

IMPROVEMENT OF FOX RIVER, WISCONSIN.

—Originally to secure a cheap route of water transportation Mississippi River to the Great Lakes and Atlantic seaboard. ovement of the Wisconsin River having been abandoned, the bject is to obtain a navigable channel, as far as existing works nit, from Portage, on the Wisconsin River, to the harbor of ay, a distance of 160 miles.

.—The original project called for slack-water navigation on River by means of locks and dams as part of the through tation route. The present modified project is that recom- by the Board of Engineers of May 14, 1886, and is to deepen River by rock excavation and dredging from Montello to Green 6-feet depth and from Portage to Montello to 4 feet depth; to e river channels to 100 feet throughout; to deepen the channel De Pere and Green Bay; to dredge the channel in the Neenah nd to remove the bar at the mouth of the Fond du Lac River.

t works.—The present works are as follows:

	Upper Fox.	Lower Fox.	Total.
....	9	18	27
....	7	10	17
....	4	8	12
walls........	....	2	2
....	20	38	58

Money statement.

ce unexpended ....
unt expended during fiscal year....................

ice unexpended......................................
anding liabilities...................................

ice available ....
ted by act approved July 13, 1892 ....

for fiscal year ending June 30, 1893...................

ted) required for completion of existing project.....
be profitably expended in fiscal year ending June 3(
mpliance with requirements of sections 2 of rive.
f 1866 and 1867.

ORT OF MR. SAMUEL WHITNEY, ASSISTANT ENGINEER.

UNITED STATES FOX RIVER IMPROVEMENT,
ENGINEER OFFICE,
Oshkosh, Wis., June 30,

the honor to submit the following report of operations on tl. ox , from Portage to Green Bay, for the fiscal year ending June 30, ..2. he year consisted principally in excavating a channel through the e river outlet of Depere Lock, in completing the guard-gates at mpleting by dredging of a 6-foot channel in the Neenah River and from Scott Street Bridge at Fond du Lac to the 7-foot curve in Lake redging the channel at Grignon Rapids (lower Fox), in completing scows, and making repairs of Dredge No. 3.

Fox the water became so low during the month of September, 1891, lass of boats were obliged to lay up for the remainder of the season. closed by ice November 17, 1891, and resumed April 10, 1892.

Fox boats drawing 5 feet of water could run from Green Bay to bout August 1, 1891, when the mills at Neenah, Menasha, Appleton, ad drawn the water so low below the crests of the dams that there et of water in the channel, and at times there was a depth of but 6 east wall of the Kaukauna, first lock. Navigation was closed by ice 91, and resumed April 15, 1892.

ontline of work done at the different points between Portage and r separate headings, viz: "Improving Fox River," and "Improv- sconsin rivers, Wisconsin," is respectfully submitted.

IMPROVING FOX RIVER, WISCONSIN.

redging channel through rock bar at river outlet of De Pere Lock.—The ing a channel 75 feet wide and 450 feet long, through the ledge of r outlet of the lock, was begun in November, 1891.

lant was put in good repair, placed on a scow and housed in. Drill- commenced on December 2 and completed February 10. One thou- ty-five holes, 2 inches in diameter, were drilled to a depth of about ed. The total depth of holes drilled was 4,227 feet.

was fitted out, and on February 19, 1892, commenced the removal of ousand one hundred and seventeen cubic yards in place were ex- iked at the left side of the channel, and as that side of the channel ace where the rock could be dumped, a large portion of it had to be e dredge. The rock is of a good quality of limestone suitable for l banks, etc. One thousand one hundred and ten cubic yards of , were dredged from a point just below the lower end of channel, scows, towed to deep water in the river by the tug *General G. K.* mped. The dredging of the channel was carried to a depth of 4 to the level of the top of the lower miter sill of the lock. The work May 3, 1892.

[illegible]

[illegible]

[illegible] the bottom [illegible]
[illegible] engine [illegible]
[illegible] in the hold [illegible]
[illegible] New deck planks [illegible]
[illegible] good repair. [illegible]
[illegible] commission May [illegible]
[illegible] scows [illegible]
[illegible] and spiked [illegible]
[illegible] hatch cover [illegible]
[illegible] the [illegible] of July.

[illegible]

[illegible] upper dam at Appleton.— [illegible] the fiscal year until [illegible] time she w[illegible] [illegible] work [illegible] the last [illegible] hauled out for rep[illegible]

[illegible] width, a distance of [illegible] across the river; [illegible] feet above the left end [illegible] feet in wid[illegible] [illegible] end of [illegible] yards [illegible]

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List of boats navigating Fox River, between Portage and Green Bay, Wis., June, 18

Name of boat.	Draft.	Tonnage.	Steam or sail.	Name of boat.	Draft.	Tonnage.	Ste
	Feet.				*Feet.*		
Portage*	2	75	Steam.	D. W. Libbey (tug)†	3½	60	Ste
S. D. Arnold*	4½	93	Do.	Oshkosh (tug)†	3	46	D
City of Berlin	3	150	Do.	Thos. Spear (tug)‡	10	41	D
B. F. Carter†	5	125	Do.	Time (tug)	(§)	(§)	D
Ossian Cook†	5	175	Do.	M. Brunette (barge)	(§)	(§)	D
John Dennessen	4½	15.40	Do.	Emma (scow)	4½	45	Sail
Evalyn†	5½	150.66	Do.	Eclipse	3½	60	D
Fashion‡	3½	70	Do.	Georgie (scow)	5½	82	D
City of Fremont*	3½	100	Do.	Topsy (scow)	4½	72	D
K. M. Hutchinson	4½	189.96	Do.	Juilia (scow)	5	44	D
George Lacy	(§)	25	Do.	Sassy Jack (scow)	4	26	D
Lilly	4	4	Do.	Rose Bud (scow)	5	75	D
Laura May†	3	5.91	Do.	Venture (scow)	5½	91	D
J. H. Marston†	4½	150	Do.	Red Fox (scow)	3	40	D
Mark*	2½	30	Do.	Newbauer (scow)	2½	20	D
Henrietta†	5	125	Do.	Barge (Morning Bell)	3½	70	Tow
John Lynch*	3	50	Do.	Barge (Mark)*	2½	90	D
Schiller (tug)	5½	13.60	Do.	Barge (D. W. Cady)*	4	75	D
O. B. Reed†	3½	75	Do.	Barge (Indian Queen)	4	45	D
Morning Bell (tug)	5	9	Do.	Barge (Jumbo)‖	4½	97	D
Viola (tug)	3½	7	Do.	Barge No. 1‖	5½	145	D
Agnes C. (tug)	6	10	Do.	Barge No. 2‖	5½	145	D
D. W. Cady (tug)*	2	*20	Do.	Barge No. 3‖	5½	145	D
W. W. Neff (tug)†	3½	46.44	Do.	Barge No. 4‖	5½	145	D
M. D. Moore (tug)†	3½	60	Do.				

* Boats that run above Oshkosh.
† Boats that run to Winneconne occasionally.
‡ Runs between De Pere and Green Bay.
§ Not given.
‖ H. Collette.

Number of lockages on Fox River, Wisconsin, for the calendar year 1891.

No.	Lock.	Lockages.	No.	Lock.	L
1	De Pere	634	16	Appleton, second	
2	Little Kaukauna	462	17	Appleton, first	
3	Rapid Croche	429	18	Menasha	
4	Kaukauna, fifth	482	19	Eureka	
5	Kaukauna, fourth	476	20	Berlin	
6	Kaukauna, third	538	21	White River	
7	Kaukauna, second	555	22	Princeton	
8	Kaukauna, first	551	23	Grand River	
9	Little Chute, fourth } Combined	{ 342	24	Montello	
10	Little Chute, third }	} 342	25	Governor Bend	
11	Little Chute, second	328	26	Fort Winnebago	
12	Little Chute, first	328	27	Portage City	
13	Cedars	334			
14	Appleton, fourth	337		Total	
15	Appleton, third	376			

I I 22.

OPERATING AND CARE OF LOCKS AND DAMS ON FOX RIVER, WISCON

The expenditures for maintaining the existing depth of naviga throughout the Fox River and canals; for repairs to mechanical structions that have been completed and in use, but afterward inj by flood or otherwise; for current repairs to old locks and dams lock houses, and for lock tenders' services, have been paid from th definite appropriation for "operating and care of canals and other w of navigation" provided by section 4 of river and harbor act of Jul 1884.

In accordance with this section an itemized statement of the penditures is appended herewith.

work during the last fiscal year has consisted principally in ...ing the channel of the upper Fox River and in making repairs of dredges, lock houses, locks, dams, and canal banks.

...details of the work, attention is invited to the appended report ...sistant Engineer Samuel Whitney.

Money statement.

...1, 1891, balance unexpended	$63,998.29
...1892, amount expended during fiscal year	55,989.98
...1, 1892, balance unexpended	8,008.31
...1, 1892, outstanding liabilities	6,176.96
...1, 1892, balance available	1,831.35
...t allotted for expenditure in fiscal year ending June 30, 1893	40,000.00
...t available for fiscal year ending June 30, 1893	41,831.35

REPORT OF MR. SAMUEL WHITNEY, ASSISTANT ENGINEER.

UNITED STATES FOX RIVER IMPROVEMENT, ENGINEER OFFICE,
Oshkosh, Wis., June 30, 1892.

MAJOR: I have the honor to submit the following report of operations under the ...d of "Operating and care of canals and other works of navigation on the Fox ...ver" for the fiscal year ending June 30, 1892.

Work during the year consisted principally in dredging the channel of the Upper ...x River; in making repairs of boats, dredges, lock houses, and in making inci...tal repairs of locks, dams, and canal banks.

...e Pere Lock.—Four cords of loose rock were removed from the lock chamber by ...s and a hand dredge.

De Pere Canal Banks.—A revetment wall of cement masonry, 46 feet in length and ...feet in height, was built to sustain a portion of the left bank of the canal imme...ately above the lock. The slope of the bank was raised to a level of the top of the ...ll with 340 cubic yards of clay, and the canal face of the bank for a distance of ... feet above the head of lock riprapped with 10 cords of stone brought from the ...k cut below the lock.

Lock house at De Pere.—The old wooden foundation walls, which were badly de...ayed, were replaced by masonry walls, the roof reshingled, a new floor laid in the ...llar, new stairs built to cellar and loft, front room replastered and papered, a porch ...uilt at the front of house, two new doors were fitted and hung in place; a foot walk ...uilt from the front to rear of house, and the woodwork of house, both inside and ...t, painted two coats. A new vault was made for the outhouse, and the outhouse ...t in good repair.

Little Kaukauna Lock.—Four solid timber gates were made, the old gates taken out, ...alves and gate hangings taken off and fitted to the gates, and the gates hung in place.

Little Kaukauna Dam.—No repairs were needed during the year.

Rapid Croche Lock.—The upper right gate having been knocked off its step by a ...ssing boat, the gate was taken out, the step replaced and the gate rehung. Slight ...pairs were made to hangings of the other gates.

Rapid Croche Dam.—Four hundred and eighty-five cubic yards of clay were wheeled ...m the bank of the river and placed to repair the embankment at the rear of the ...ght abutment that had been cut away by water passing through the sluice way; ...d to prevent further damage the foot of the embankment was well riprapped with ... cords of large stone boated from the quarry at Kaukauna.

Kaukauna Fifth Lock.—The upper left gate was removed, one of the valve rods re...aired, and the gate replaced. New racks were put on the valve rods of the upper ...ght gate.

Kaukauna Fourth Lock.—The valve chains of the platform valves were repaired.

Kaukauna Third Lock.—Slight repairs were made to the valve chains.

Kaukauna Second Lock.—Eight new iron rollers were put in place under the gate ...ars.

Kaukauna First Lock.—During the winter of 1891-'92, four new solid timber gates were made, and early in the spring the old gates were removed from the lock to the ...nal bank; the valves, gate hangings, etc., were taken off, fitted to the new gates

ppleton Third Lock.—The house was moved from the head of the lock
nient place near the foot of the second lock; a cellar built under the
de newly clapboarded; a porch built at the front side, and the outside
l two coats.
:—The suspension rods of the lower left gate were repaired and tim-
te bars were purchased.
al Bank.—No repairs required.
.—Slight repairs were made to the hoisting chains of the sluice gates.
—During July, 1891, a washout at the rear of the left abutment was
cubic yards of clay boated from a dredged bank 2 miles above the
ubic yards of gravel boated from Berlin was placed along the river
tment. A break underneath the dam, at a point near the right abut-
aired by sinking 90 brush mats, 10 inches by 4 feet by 10 feet with 10
, and placing over the mats 1,327 cubic yards of clay and gravel. A
nks were removed from the apron and the washout underneath apron
cords of stone, 17 cords of which were boated from Menasha and 12
rlin. Seventeen broken apron planks were replaced by new plank.
892, the drawbridge over the navigable pass was entirely rebuilt and
coats. All of the posts and valves in the sluice way under the bridge
l, new posts and valves framed and put in place, and low places in the
e dam were filled with 160 cubic yards of gravel, completing the repairs.
built of piles and timber on quicksand foundation, and needs frequent
vent its being entirely washed away.
:—Four gates, built at Oshkosh in the spring of 1891, were taken to the
following and hung in place of the old ones. Four new capstan plat-
uilt, new gate spars were made, and four new tripod capstans, for
the gates, set in place, completing the repairs.
(brush).—During the months of August and September, 1891, low
dam were raised to the original height of dam by placing 373 brush mats
of stone; and the shore protection at the ends of dam repaired with 48
nd 15 cords of stone.
—No repairs needed.
House.—The kitchen floor was painted one coat and the eaves spout

Lock.—The fence around lock site was put in good repair.
Lock House—No repairs needed.
Dam (brush).—Low places in the dam were repaired with 138 brush
ords of stone.
f River Banks.—A pier composed of piles, brush mats, and stone, was
o prevent the further washing away of the right bank of the river
River Lock. From a point about 200 feet below the lock, the pier
ance of 384 feet. Two rows of piles were driven at a distance of 12
e piles in the front row were driven at distances of 8 feet, and those
w 16 feet from centers. A wale, 10 inches in diameter, was placed along
the back row of piles below the water surface; through the wale and
piles tie-rods of 1-inch round iron were placed and the pier then filled
ats, sufficient stone being placed on each layer of mats to sink them in

the further caving into the river of the higher portion of the sand bank
head of White River Lock and right end of dam, piles were driven at
feet from centers; between the row of piles and the face of the bank,
about 5 feet, brush mats were placed and covered with stone. The
nk was then graded to a proper slope and riprapped with stone. The
ection is 531 feet.
am (brush).—Repairs of the dam were commenced on May 11, 1892, but
high stage of water in the swamps, making it difficult to obtain the
ush, etc., work was suspended on June 15. Up to the time work was
ush had been cut, 1,016 mats, 10 inches by 4 feet by 10 feet made, and
ts sunk in place.
ock.—No repairs required.
ock House.—No repairs needed.
Lock.—No repairs needed.
Lock House.—No repairs needed.
Dam.—No repairs made.
m.—No repairs made.
k.—A gate spar was made and placed.
–Dredge No. 5 commenced the work of strengthening the levee on
56 cubic yards of material have been excavated from the bed of
placed at the sides and top of the embankment.
Lock.—No repairs required.

. 7.—A broken plank in the bottom of the hull was replaced by a new rboard spud guides rebolted to hull, the old dipper handle repaired, and de ready for the iron work. A new door was put on the dipper and the repaired and reriveted in place.

hinery was cleaned and put together, the outside of cabin and the tin nted one coat, completing the repairs. The dredge was put in commis- 25, 1892.

 Scow No. 1.—The scow was hauled out in May, 1892; eleven graving in the bottom, side fenders and pocket door hinges repaired; two new nks fitted and spiked in place, and the seams at the lower end of the pocket d both rakes were recalked, completing repairs.

 Scows.—The rakes and the top sides of the two center dump scows were during the month of May, 1892.

ws.—The construction of five scows, 16 by 15 by 3 feet, to be used as tenders dredges, was commenced in May, 1892, and at the date of this report three ere about half built and the framework of the other two commenced.

DREDGING UPPER FOX RIVER.

dge No. 4.—The work of rebuilding the dredge having been completed on of July, 1891, she was put in commission on the same date and employed close of the season in dredging bars between Omro and the Berlin Bridge, rs, viz: From a bar opposite the mouth of Waukau Creek 8,137 cubic yards ial were removed; bar 5 miles below Eureka Lock, 11,015 yards; bar at ricks Bend, 4,258 yards; two bars near the village of Eureka, 8,883 yards; bar ower end of cut-off below Eureka Lock, 4,683 yards; bar at Sacramento, rds, and bar one-half mile below Berlin Bridge, 4,419 yards. The dredge ed work November 16, and was towed to Eureka Lock and laid up for the

 was resumed April 21, 1892, at the point where it was suspended in Novem- 88 cubic yards of sand and gravel were removed, completing the work of g a channel through the bar. On May 30 the dredge was towed to a point 3 bove Berlin Lock by the steamer *Fox*, where the removal of a bar was com- , and by the end of the fiscal year 5,282 cubic yards of sand had been removed. number of cubic yards of material removed by the dredge during the fiscal ,369.

redge No. 5.—Dredge No. 5 continued the work of dredging bars between o and a point one mile below White River Lock, and removed material as , viz, from bars between Grand River Lock and the head of Lake Apuck- ,448 cubic yards; from bars between the point where Mechan Creek enters River and the head of Princeton Lock, 10,191 yards; bar at the lower end eeton Lock, 1,301 yards; bar one and a half miles below Princeton Lock, ards; bar one and a half miles below Princeton Bridge, 5,740 yards; bar 3 bove White River Lock, 5,901 yards; bar below White River Lock, 12,145 Work was suspended at White River Lock on Nov. 27 and the dredge laid up winter.

dredge was put in good repair during the winter, and dredging resumed 7, 1892; 4,669 cubic yards of sand were removed, completing the dredging of nel through the bar below White River Lock. On the 8th of May the dredge wed by the *Boscobel* to a point about 4 miles above Princeton Lock, where 50 cubic yards of scattering bowlders were removed from the channel of the The work was completed on the 17th of the month, and on the following day dge was towed by the *Boscobel* to Montello; 9,794 cubic yards of sand were d from the bar just below the lock by the 2d of June, and the dredge then above the lock and commenced the work of strengthening the levee at the Buffalo Lake; 3,456 cubic yards of sand and mud were taken from the bed of e and placed on the levee.

l number of yards removed from bars during the year, 81,561.

l number of yards placed on the levee, 3,456.

redge No. 7.—August 25, 1891, Dredge No. 7 was transferred from Fond du Lac r at the entrance of Fox River into Lake Buttes des Morts. A cut 1,942 feet th and 30 feet in width was made through the bar, from which 9,231 cubic of sand were removed. The work was completed on the 10th of September, the following day the dredge was towed back to Fond du Lac.

ng the month of April, 1892, the dredge was put in good repair, and on the f the month was towed from Oshkosh to Preachers Bend to widen the channel h the bar at that place; 8,456 cubic yards of clay were removed from the l, which work having been completed on May 14 the dredge moved up to a ow Omro and took out 4,029 cubic yards of sand. The dredge was then towed *tement of expenditures for fiscal year ending June 30, 1892, etc.*—Continued.

Character of work, etc.	Item of expense.	Amount.	Total.
aukauna Canal	Labor	$39.50	$39.50
arehouse, Kaukauna Lock	Materials	336.40	
	Labor	193.96	530.36
apid Croche Lock	do	27.00	27.00
apid Croche Dam	Labor and transportation.	154.75	154.75
aukauna Fifth Lock	Materials	7.10	
	Labor	20.06	27.16
aukauna Fifth Level	do	279.86	279.86
aukauna Fourth Lock	do	15.50	15.50
aukauna Fourth Level	do	87.17	87.17
aukauna Third Lock	do	4.00	4.00
aukauna Second Lock	Materials	24.00	
	Labor	4.50	28.50
ock house, Kaukauna Second Lock	Materials	511.05	
	Labor	531.21	1,042.26
Kaukauna First Lock	Materials	953.69	
	Labor	512.04	1,465.73
Kaukauna Canal Banks	Materials	63.46	
	Labor	141.75	205.21
ock house, Kaukauna First Lock	Materials	469.67	
	Labor	310.26	779.93
Little Chute Combined Locks	Materials	55.03	
	Labor	111.43	166.46
Little Chute Combined Locks Level	do	165.44	165.44
Little Chute Second Lock	Materials	14.00	
	Labor	4.00	18.00
Little Chute Dam	Materials	3,786.25	
	Labor	1,561.94	5,348.19
Cedars Lock	Materials	3.60	3.60
Cedars Dam	Labor and transportation.	1,035.47	1,035.47
Appleton Fourth Lock	Materials	173.10	
	Labor	150.87	323.97
Appleton Fourth Level	do	111.37	111.37
Appleton Canal Banks	Labor and transportation.	272.34	272.34
ock house, Appleton Third Lock	Materials	134.61	
	Labor	285.30	419.91
Appleton Second Level	do	23.00	23.00
Appleton First Lock	Materials	2.20	
	Labor	333.00	335.20
Menasha Dam	Materials	4.38	4.38
Menasha Lock	do	1.25	1.25
ka Lock	do	97.77	
	Labor	159.39	257.16
a Dam	Materials	578.19	
	Labor	1,214.20	1,792.39
am	Materials	123.82	
	Labor	682.76	806.58

nt of expenses made from appropriation for operating and care of canals ks of navigation, indefinite, act of July 5, 1884, applied to Fox River, Wis-

No.	To whom paid.	For what paid.	Amount.
	Jones & Laughlins, Limited	Chain	$355.24
	A. L. Smith	Hire of house	45.00
	Green Bay and Mississippi Canal Co.	Rent of quarry	75.00
	Hired men	Services	93.56
5	John Jansen	Lumber	11.11
6	Butler Bros	Shovels, etc	14.75
7	L. Lindauer	Coal	35.61
8	M. V. Morehouse	Boiler covering, etc	86.94
9	Battis Bros	Labor	1.20
0	George F. Strond estate	Cotton waste, etc	14.21
1	Doman & Manuel	Iron castings	16.32
12	Gillingham & Son	Iron, etc	19.99
13	D. P. Sanford	Oil, etc	21.56
14	F. H. Josslyn	Sheets, etc	20.48
15	McKenzie & Crawford	Wood, etc	67.65
16	J. A. Barnes	Iron castings, etc	95.38
17	K. M. Hutchinson	Rope, etc	114.13
18	W. H. Crawford	Iron pipe, etc	183.18
19	Coulee Lumber Co	Lumber	864.30
20	C. A. Peck	Oil, etc	15.73
21	H. Stedman	Lumber	25.81
22	Niels Johnson	Boiler rivets, etc	41.69
23	William Bannerman	Stone	60.00
24	The Morgan Co	Lumber, etc	36.60
25	A. Ross Houston	Services	200.00
26	James Clear	......do	30.00
27	John M. Paige	......do	30.00
28	Jerry Parkinson	......do	25.00
29	John Lewis	......do	25.00
30	George T. Allanson	......do	30.00
31	Alexander Sims	......do	25.00
32	John A. Banker	......do	25.00
33	Gottlieb Jahnke	......do	25.00
34	George Gifford	......do	25.00
35	Gabriel Wick	......do	25.00
36	John Baeten	......do	25.00
37	Richard E. Rice	......do	25.00
38	C. L. Neumann	......do	10.00
39	Joys Bros. & Co	Rope	11.41
40	Des Forges & Co	Stationery	34.28
	Samuel Whitney	Services	200.00
	Hired men	Services, July, 1891	2,311.97
	Jones & Laughlins, Limited	Chain	41.20
	Julius Lando	Tapelines	15.50
	J. M. Harford	Services	14.43
	Louis Clairmont	Moving stone	225.00
	Paul E. Thomas	Services	65.00
	Samuel Whitney	......do	200.00
	John M. Paige	......do	30.00
	Alexander Sims	......do	25.00
	George T. Allanson	......do	30.00
	George Gifford	......do	25.00
	Jerry Parkinson	......do	25.00
	John Lewis	......do	25.00
	James Clear	......do	30.00
	John A. Banker	......do	25.00
	John Baeten	......do	25.00
	Gabriel Wick	......do	25.00
	Richard E. Rice	......do	25.00
	Hired men	......do	256.11
	Gottlieb Jahnke	......do	25.00
	Butler Brothers	Nails	6.90
	Kramer & Knitter	Bolts, etc	12.37
	John Jansen	Lumber	129.70
	Schlafer, Barrett & Tesch	Drift bolts, etc	258.96
	K. M. Hutchinson	Rope	4.20
	Gillingham & Son	Lumber	6.00
	McKenzie & Crawford	Coal	13.01
	Ole Olson	Towing	24.00
	Coulee Lumber Company	Lumber	876.75
	Mitchel Garrow	Clam poles	20.00
	C. A. Peck	Lye, etc	16.71
	Neils Johnson	Iron, etc	111.57
	Charles S. Morris	Coal	209.15
	Priest & Garrow	Wood	263.90
	. Neumann	Services	10.00
	[illegible] men	Services, August, 1891	2,316.34
	& Tate	Paper	1.50

15	[illegible]		
16	[illegible]		
17	[illegible]		
18	A[illegible]		
19	[illegible]		
20	D. T. H. M[illegible]		
21	J. C. K[illegible]		
[illegible]	W. E. W[illegible]		
[illegible]	William K[illegible]		
[illegible]	Battle Bros		
[illegible]	D. P. Sanford		
[illegible]	Combs Lumber Co.		
[illegible]	Oodun Cook		
[illegible]	McKenzie & Crawford		
[illegible]	C. A. Peck		
[illegible]	William Bannerman		
[illegible]	[illegible] Swanke		
	[illegible] & Garrow		
	[illegible]	[illegible]	
	[illegible] & Lake Co.	[illegible]	
	[illegible] M. [illegible]	[illegible]	
	[illegible]	do	
	[illegible]	do	
	[illegible]	do	
	[illegible]	do	
	[illegible]	do	
	[illegible]	do	
	[illegible]	do	
	[illegible]	do	
	[illegible]	do	
	[illegible]	do	
	[illegible]	Wood	
	[illegible]	Brick	
	[illegible]	Screw bolts, etc	
		Boat spikes, etc	
		Plastering, etc	
		Lumber, etc	
	[illegible] & [illegible]	Drift bolts, etc	
		Lumber	
		[illegible]	
		Glass, etc	

Itemized statement of expenses, etc.—Continued.

Date.	No. of voucher.	To whom paid.	For what paid.	Amount.
1891.				
Nov. 16	74	John Schwark	Brush	$5.00
30	75	Samuel Whitney	Services	200.00
30	76	John M. Paige	do	30.00
30	77	Alexander Sims	do	25.00
30	78	John Baeten	do	25.00
30	79	George T. Allanson	do	30.00
30	80	George Gifford	do	25.00
30	81	John A. Banker	do	25.00
30	82	Gabriel Wick	do	25.00
30	83	Gottlieb Jahnke	do	25.00
30	84	Jerry Parkinson	do	25.00
30	85	John Lewis	do	25.00
30	86	Richard E. Rice	do	25.00
30	87	James Clear	do	30.00
30	88	C. L. Neumann	do	10.00
Dec. 3	89	Samuel Whitney	Traveling expenses	10.50
3	90	Elwin Bauter	do	3.62
3	91	Hired men	Services, Nov., 1891	1,638.88
4	92	Charles M. Cole	Traveling expenses	9.94
4	93	W. M. Bambert	Labor	2.00
4	94	Jno. Jansen	Lumber	11.64
4	95	Butler Bros	Paint, etc	16.72
4	96	J. H. Marston & Co	Mortar	1.20
4	97	Schlafer, Barrett & Tesch	Paint, etc	24.75
4	98	Gerry Lumber Co	Lumber, etc	55.12
4	99	Ryan Brothers	Hauling out boat	60.00
4	100	H. Stedman	Lumber	1.56
4	101	C. A. Peck	Lath yarn, etc	18.25
4	102	Chas. S. Morris	Coal	83.54
4	103	Priest & Garrow	Wood	98.60
4	104	George Zuehls	Depositing dredged material	8.05
5	105	John Flynn	Services	8.43
9	106	Henry Weber	do	5.25
31	107	Ramsay & Jones	Lumber	793.38
31	108	John M. Paige	Services	35.00
31	109	Alexander Sims	do	35.00
31	110	James Clear	do	30.00
31	111	Gottlieb Jahnke	do	25.00
31	112	John Lewis	do	25.00
31	113	Gabriel Wick	do	25.00
31	114	George Gifford	do	25.00
31	115	Jerry Parkinson	do	25.00
31	116	John Baeten	do	25.00
31	117	John A. Banker	do	35.00
31	118	George T. Allanson	do	30.00
31	119	A. L. Smith	Hire of house	45.00
31	120	Ramsay & Jones	Lumber	873.28
31	121	Ossian Cook	Rent of office	66.00
31	122	A. Sanford Logging Tool Co	Cant hooks, etc	5.38
31	123	C. A. Peck	Sole leather, etc	3.95
31	124	Warner Hardware Co	Nails, etc	8.69
31	125	A. J. Wier	Lumber, etc	129.55
31	126	Eugene Dietzgen & Co	Tracing cloth, etc	8.56
31	127	The Keith Lumber Co	Timber	274.40
31	128	Samuel Whitney	Services	200.00
31	129	Richard E. Rice	do	25.00
31	130	Samuel Whitney	Traveling expenses	10.52
1892.				
Jan. 4	1	Jones & Laughlins, limited	Bolts	244.56
4	2	Hired men	Services, December, 1891	884.11
5	3	Elwin Bauter	Traveling expenses	7.86
5	4	E. O. Hoffmann	do	6.94
8	5	Des Forges & Co	Stationery	8.45
30	1	A. J. Weir	Lumber	40.23
31	2	John M. Paige	Services	35.00
31	3	Alexander Sims	do	35.00
31	4	George Gifford	do	25.00
31	5	James Clear	do	30.00
31	6	George T. Allanson	do	30.00
31	7	John Baeten	do	25.00
31	8	Gottlieb Jahnke	do	25.00
31	9	John Lewis	do	25.00
31	10	Gabriel Wick	do	25.00
31	11	Jerry Parkinson	do	25.00
31	12	Richard E. Rice	do	25.00
31	13	John A. Banker	do	35.00
31	14	Samuel Whitney	do	200.00
3	15	E. O. Hoffmann	Traveling expenses	1.51
[illegible]	16	[illegible]uter	do	10.37
	[illegible]	[illegible]	Services, January, 1892	1,655.73
		[illegible]mith	do	13.12

Itemized statement of expenses, etc.—Continued.

No. of voucher.	To whom paid.	For what paid.	Amount.
25	Alexander Sims	Services	$29.66
26	John A. Banker	do	30.00
27	James Clear	do	30.00
28	Richard E. Rice	do	25.00
29	John Lewis	do	25.00
30	Jerry Parkinson	do	25.00
31	Gottlieb Jahnke	do	25.00
32	Gabriel Wick	do	25.00
33	George Gifford	do	25.00
34	George T. Allanson	do	30.00
35	John Baeten	do	25.00
36	Joys Bros. & Co	Rope, etc	82.81
37	Samuel Whitney	Traveling expenses	9.34
38	Elwin Bauter	do	2.06
39	Eugene Dietzgen & Co	Tracing cloth	8.40
40	Doman & Manuel	Marine boiler	104.09
41	Excelsior Iron Works	Dipper-handle, shaft, etc	260.26
42	Samuel Whitney	Services	200.00
43	Des Forges & Co	Stationery	28.04
44	Hired men	Services, March, 1892	2,713.60
45	John Gevers	do	18.00
46	Burdick, Armitage & Allen	Notices of law	7.00
47	Hired men	Services	245.00
48	Samuel Whitney	do	200.00
49	John M. Paige	do	35.00
50	Alexander Sims	do	25.00
51	John A. Banker	do	25.00
52	James Clear	do	30.00
53	Richard E. Rice	do	25.00
54	John Lewis	do	25.00
55	Jerry Parkinson	do	25.00
56	Gottlieb Jahnke	do	25.00
57	Gabriel Wick	do	25.00
58	George Gifford	do	25.00
59	George T. Allanson	do	30.00
60	John Baeten	do	25.00
61	William Jansen	Sand	30.75
62	Louis Clairmont	Moving stone	579.70
63	Hubert Zegers	Lime	11.50
64	Luther Lindauer	Tile, etc	4.60
65	Charles Wheaton	Plastering, etc	80.13
66	Butler Bros	Locks, knobs, etc	25.75
67	Kaukauna Lumber and Mfg. Co	Lumber, etc	95.29
68	Schlafer, Barrett & Tesch	Nails, etc	13.60
69	J. H. Marston & Co	Moving stone	76.47
70	Gerry Lumber Co	Lumber	159.50
71	Julius Fieweger & Sons	Iron, etc	1.25
72	B. H. Soper & Co	Window shades	5.00
73	August Schroeder	Hire of jackscrews	7.25
74	Gillingham & Son	Screw bolts, etc	17.66
75	Hay Hardware Co	Files, etc	13.07
76	C. W. Johnston	Towing	18.00
77	Orville Beach	Rent of land	25.00
78	W. H. Crawford	Washout closet, etc	33.30
79	F. H. Josslyn	Carpet, etc	33.47
80	Stond & Thomson	Oakum, etc	35.50
81	Doman & Manuel	Iron castings, etc	36.11
82	The Morgan Co	Lumber, etc	39.23
83	D. P. Sanford	Oil	58.71
84	McKenzie & Crawford	Wood, etc	63.75
85	Hay Hardware Co	Rope, etc	89.31
86	W. H. Nichols and S. E. McPartlin	Boiler covering	84.41
87	H. M. Harmon	Painting	94.99
88	Doman & Manuel	Iron castings, etc	158.77
89	McKenzie & Crawford	Moving stone	455.77
90	Doman & Manuel	Horizontal engines, etc	1,937.00
91	August Ziemer	Lumber	3.28
92	John W. Slater	Oil, etc	8.27
93	Niels Johnson	Packing, etc	26.81
94	C. A. Peck	Soap, etc	32.87
95	H. Stedman	Coal, etc	179.42
96	F. T. Yahr	Lath, yarn, etc	27.01
97	Priest & Garrow	Wood	423.87
98	C. L. Neumann	Services	10.00
99	Samuel Whitney	Traveling expenses	5.32
100	Des Forges & Co	Stationery	13.80
101	Excelsior Iron Works	Steel pinions	30.40
102	Hired men	Services, May, 1892	3,871.17
	James F. Gregory	Mileage	17.44
	[illegible]d men	Services, May, 1892	577.88
	[illegible] Zuehls	Depositing dredged material	14.00

APPENDIX J J.

IENT OF CHICAGO AND CALUMET HARBORS, ILLINOIS; OF
T RIVER, ILLINOIS AND INDIANA; AND OF ILLINOIS RIVER,
; ILLINOIS AND MISSISSIPPI CANAL.

*F CAPTAIN W. L. MARSHALL, CORPS OF ENGINEERS, OFFICER
RGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892, WITH
DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

Harbor, Illinois.
Harbor, Illinois.
River, Illinois and Indiana.
River, Illinois.
5. Operating and care of La Grange Lock and Dam, Illinois River, Illinois.
6. Illinois and Mississippi Canal.

UNITED STATES ENGINEER OFFICE,
Chicago, Ill., August 18, 1892.

AL: I have the honor to transmit herewith annual reports **works** in my charge for the fiscal year ending June 30, 1892.

* * * * * *

ry respectfully, your obedient servant,

W. L. MARSHALL,
Captain, Corps of Engineers.

en. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

J J 1.

IMPROVEMENT OF CHICAGO HARBOR, ILLINOIS.

sent project was adopted in 1870 and modified in 1878, and **ites**—

formation of an outer harbor or basin by inclosing a portion Iichigan just south of and adjoining the entrance to the river, irpose of increasing the harbor facilities of Chicago and to f to the overcrowded river.

construction of an exterior breakwater of crib work filled with side the outer harbor and north of the entrance to Chicago p water, to shelter the entrance to Chicago River (which ie harbor of Chicago) and the outer harbor from northerly

2,542.5 linear feet of superstructure 6 feet in feet 8 feet in height were completed at the close the north pier of Chicago Harbor and the its return, 5,240.3 linear feet, are in fine order

Engineer Liljencrantz herewith gives the

water, outer harbor, and the south pier at the are in bad condition and now require renewal. —This work is situated 1 mile northeast of the the entrance to which it covers from northerly in length.

begun in 1881 and completed in 1890. The the outer 1,200 linear feet, is of crib work 30 the natural b n in water varying from 18 to outer 1,200 lin et are built upon a stone foun- answers t urpose for which it has been as formin safe harbor of refuge during affording a tered entrance to the harbor of all parties in ed in the commerce of this

year no wo as done upon this breakwater, necessary to ren the superstructure over three- for that pur an estimate is herewith sub-

River.—The go River constitutes the inner it has hither en customary to periodically it lying between e bridge nearest the lake and at the pier heads. The last dredging was done date no further dredging has been necessary, and done.

CATION OF FUNDS NOW ON HAND, AND THOSE ASKED FOR THE FISCAL YEAR ENDING JUNE 30, 1893.

on hand will be applied to the survey of Chicago Har- completed works, the harbors created thereby, and the thereto. The funds asked for are to be applied as follows: the river and harbor bill now pending, to the completion project as far as advisable and to renewing superstruc- 25 feet of the South Pier, Chicago Harbor entrance, and parts of the southerly breakwater. outer basin, and $80,000 superstructures over 3,140 linear feet exterior breakwater engineering and contingent expenses.

Money statement.

, balance unexpended	$96,003.20
, amount expended during fiscal year	94,393.43
ended	1,609.77
abilities	184.76
la	1,425.01
pproved July 13, 1892	72,000.00
nding June 30, 1893	73,425.01

were 10 by 12 inches by 28 feet.
placed between the cross-ties in juxtaposition to the side walls and in corresponding to the end walls of the 50-foot cribs of the substructure. ecured to the cross-ties in same manner as the timbers are in the side forming solid walls.
udinals were made of 10 by 12 inch timber. They were placed between s, running continuously through the length of the work, with 16 inches so placed as to come between two ties, and with drift-bolts passing two parts of the scarf and the tie below.
r shimming pieces.—Before placing the first or lowest cross-ties it was und that the top of the tie of the substructure was in the same plane as ts side timbers, leaving thus an insufficient space for the bottom longi- provided by the plans. These were therefore omitted and short blocks in their places under the bottom ties. Owing to irregular settling of the in most places, wedge-shaped sticks had to be resorted to frequently to izontal bearing for the new work. All these and other pieces required he effects of irregularities of the old work were counted under this head. olts were of round iron, 1¼ inches in diameter. Thirty-two-inch bolts the side timbers and solid cross walls; 20-inch bolts in ties and longi- l partly in the top timbers of side and cross walls.
cking consisted in 6 by 10 inch timbers laid lengthwise and spiked with wrought-iron spikes to the ties.
ends, most subjected to the process of decay, were protected by 3 by 12 spiked down crosswise, covering the joints.
illing.—The new work was filled to within 3 feet of the top, which was sufficient for safety now, since these works are protected against north- by the exterior breakwater.
e progress of the work stone removed from the old work was transferred d portions and thus no new stone was required for the part—the northerly easterly breakwater—which was first completed, and the north pier, finished last, required the greatest amount of new stone.
t the easterly end of the north pier and the westerly end of the "return," places had for a number of years been in a deplorable condition, from stained by vessels running into them, these places were surrounded by consisting of single closely driven rows of piles, held together with wal- on either side of the piles and screw bolts through both, and attached to means of 1¼-inch iron tie-rods.
sure was filled with stone, and riprap was placed outside the piles to coun- the pressure of the stone filling. Clumps of 7 piles in each, held together by and 2 rounds of iron dredge chain, were placed as additional protection pier heads just described and around the north end of the easterly break- ch clump, when constructed, was surrounded by riprap to within 18 feet r surface.
on to work done under the terms of the contract some materials were fur- secured in the work under a special verbal agreement, viz. 10,348 feet B. ber, 10 turnbuckles, and 3 piles of special length, 2 being 44 feet each rd 43 feet long.
timber was used for waling pieces in the pier heads and for snubbing posts h pier. The turnbuckles were used on the tie-rods in the pier heads, and the clumps.
ing was done during the year and none is required for the present.
of the works.—The easterly breakwater and the north pier, as well as the eet of the southerly breakwater, which were rebuilt in 1889, are now in tion. So are the pier heads and most of the clumps of piles built during One of the latter, at the end of the north pier, has been broken up, pre- some vessel having run into it.
frequently found a very strong current at the different pier ends, which, ien claim, makes their boats at such times unmanageable. This is the ble excuse for the many collisions of this kind in times past, and the pro- ilt during the year were much needed and are of considerable value as

h pier is in extremely bad condition. The greater part of the timbers in ructure are rotten and numerous pieces even detached from the main work ow the stone filling to issue forth into the river channel. The cribs of this sunk in 1869 and 1870 and the superstructure was built in the latter year, rdingly fully 22 years old. Considering its age it has held out well, no ccount of not being, like the breakwaters, exposed to severe winds.
y breakwater was built in 1879 to 1880. This work is 3,000 feet in ws the effect of southerly or southeasterly gales and of general decay

COMMERCIAL STATISTICS.

t of revenue collected at nearest port of entry (Chicago) during fiscal year,
).17.

Arrivals and clearances of vessels during the year, port of Chicago.

	Arrived.		Cleared.	
	No.	*Tons.*	*No.*	*Tons.*
....	5,222	3,581,859	5,351	3,702,645
....	3,768	1,123,788	3,815	1,144,157
al........	8,990	4,705,647	9,166	4,846,802

Receipts and shipments by lake during calendar year 1891.

s:	Tons.
l	1,246,106
and iron ore........	90,871
ne	12,590
r	2,510
nber	2,746,219
ır, salt and sugar........	132,032
ient	26,441
atoes	6,613
cellaneous merchandise	281,956
otal	4,545,338

Shipments:	Tons.
Flour	172,150
Grain	2,061,251
Lard	21,463
Meats........	3,036
Lead........	70,028
Seed	155,196
Oil and oil cake	36,013
Hay	9,647
Iron	4,077
Miscellaneous merchandise	136,566
Total	2,669,427

J J 2.

IMPROVEMENT OF CALUMET HARBOR, ILLINOIS.

object of this work is to provide a deep entrance to Calumet and the port of South Chicago, Ill.

is effected in the usual manner by dredging a channel and pro- the dredged area by parallel piers, 300 feet apart, projecting into e from the river's mouth.

CONDITION OF THE WORK JUNE 30, 1892.

k was begun on this harbor in 1870, and at the beginning of the ear 2,020 linear feet of the south pier, and 3,640 linear feet of the ier had been constructed, which completed the existing project s pier work is concerned, but the south pier should be prolonged to protect the channel from drifting sands.

ccount of the present urgent necessity for maintaining the eady done, the superstructure of the piers being rotten over an ?,300 linear feet and in bad condition over 600 feet in addi- imate herewith submitted is entirely for maintenance, and no further extension of piers at the present time.

ıd harbor act of September 19, 1890, appropriated $20,000 ınd at the beginning of the fiscal year work was in prog- with W. A. McGillis & Co., of South Chicago, Ill., *contracts for improving Calumet Harbor, Illinois, in force during the fiscal year ending June 30, 1892.*

ddress of contractor.	Nature of contract.	Date.	To expire.	Contract extended to—
s & Co., South	Dredging 90,000 cubic yards at 13½ cents per cubic yard.	Dec. 10, 1890	Aug. 31, 1891	Nov. 30, 1891

completed October 16, 1891.

REPORT OF MR. G. A. M. LILJENCRANTZ, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Chicago, Ill., June 30, 1892.

: I have the honor to submit herewith a report of operations in Calumet inois, during the fiscal year ending June 30, 1892.

: done during the year consisted in continuing dredging between the haro a depth of 17 feet below the United States harbor datum, under conW. A. McGillis & Co., of South Chicago, Ill., dated December 10, 1890, at 13½ cents per cubic yard.

der the contract commenced on the 27th of April, 1891, and was comhe 16th of October following.

beginning of the fiscal year, 57,930 cubic yards of material were removed annel, which, together with the 29,087 cubic yards removed during the April 27 to June 30, 1891, or in all 87,017 cubic yards, constituted the total material dredged under the contract.

: was done with the contractors dipper dredge *A. B. Stetson*, a strong and achine, with a dipper of 2½ cubic yards capacity. It was built two years

l time devoted to this contract was 129.8 working days of 10 hours each, urs.

iese 1,298 hours, 1,024 hours 20 minutes were spent in actual work, the 3 hours 40 minutes representing time lost on account of repairs to plant, er, and other causes. The proportion of time utilized and time lost to ble time is accordingly:

	Hours.	Per cent.
tual work	1,024⅓ =	78.92
	273⅔ =	21.08
lable time	1,298 =	100.00

age daily work amounted to 87,017 ÷ 129.8 = 670.4 cubic yards.

f 87,017 cubic yards having been dredged in 1,024⅓ hours of "actual licated a capacity of this dredge of 84.95 cubic yards per hour, or 849.5 s per day of 10 hours of uninterrupted work.

ract should have expired on the 31st of August, 1891, but an extension of 30th of November of the same year, was, at the request of the contracer dated August 31, granted by the Chief of Engineers, U. S. Army, on August, 1891.

nnel has now, as indicated on a map respectfully submitted herewith, a t least 17 feet below the United States harbor datum, and a width of

e Illinois Steel Company's slip eastward to Lake Michigan, periodical has been done by the Steel Company, at their own expense, to secure a r deep channel for the heavily laden ore vessels entering the slip at their

: was done during the year, for want of funds, to the westerly ends of the but this is very much needed. Neither was any new work done in exthe south pier, as per project heretofore submitted.

s of the piers.—The stone filling placed in the outer, more exposed portions ers in 1888 is yet in very good condition, having settled but slightly.

n the approved dock lines have been dredged out and the proved, and it is understood that the ejectment suit has been

r the specifications to the contracts heretofore made it has l that the material to be encountered is mud, sand, and clay. dging progressed, however, the clay became more and more until finally it became so hard as apparently to require r its removal. Solid rock, apparently part of a narrow reef e channel, was also encountered. After repeated vain at- remove this material, a supplementary agreement was made 892, by authority of the Secretary of War, by which the reement was modified so far as to require the contractors to e dredgeable material only, within the proposed channel way. supplementary agreement a section of the channel 650 feet s not excavated to the full width and depth, but there is a feet in depth at shoalest and narrowest point, 80 feet in remainder of the 200-foot wide channel being from 11 to 16 th, as shown upon the map accompanying this report. This sufficient for all present requirements of navigation on this or probably many years in the future. The amount of hard- ck so far revealed is too small to justify special appliances ts for its removal, and in the further prosecution of the work lvisable to continue the dredging of all dredgeable material, ely define the hardpan and rock within the proposed chan- ther material requiring blasting be discovered contracts may ased upon definitely known material and definite quantities. elieved that the rock and hardpan is of great extent, but it vantageous to the work to uncover it by dredging than to locate the limits of probably small areas of hard material ive borings indefinitely multiplied over such an extent of It will be recommended, therefore, that future contracts shall dredgeable material, or such that may be removed without , until a sufficient amount of hard material to justify special for its removal is discovered, or it is definitely ascertained mount now in sight covers all such material to be removed.

rovement of this river is attended by a gratifying increase in rce of the port of South Chicago and by the rapid increase of ring and shipping interests along its borders, and the influ- ork demanding either a radical widening and deepening of other entrances to) Chicago River, which constitutes the inner Chicago, or a diminution of its commerce by water, seem to still more rapid development of the uses of Calumet Harbor for commerce by water.

eral previous years the returns of the collector of customs ated an annual increase in the tonnage of the port of South f about 30 per cent per annum. During the past fiscal year rns indicate an increase of 47 per cent in tonnage, but only er cent in the number of arrivals and departures of vessels, rly indicates the value and effect of the increased depth of rovided in the harbor and river, especially by increasing the raft of vessels trading here. Much of this increase, however, he great improvements in plant and otherwise of the Illinois pany's works near the mouth of the Calumet and to the con- of their own harbor north of the entrance to the Calumet which increased facilities for handling ores shipped by water ained.

ıel, exclusive of superintendence and all incidental expenses, was king an average cost per mile of $44,197.42.
der the last contract has proved a very unprofitable one for the con- r on account of the loose, slushy material from the marshes adjacent running into completed sections of the same, requiring repeated dredg- e place, frequently two and three times after having been completed ınd partly by the interference of one A. A. Westengard, who brought ıe contractors *et al.* for trespass on his alleged property, a great por- was located in the natural river bed and covered by 12 feet of water at ;age of the river.
t drawback, however, was the encountering of a stretch of hardpan places, underlying rock, which was found in the neighborhood of One twelfth street and for a distance of 800 feet along the channel. For f of this distance, the northerly half, the hardpan reached across the he channel, diminishing gradually in extent southward.
ı was struck at an average depth of 12 feet below the United States , underlying rock being found in patches, rather irregular both in ith.
:tors labored faithfully with the removal of the hardpan, applying that could be devised and applied to either the elevator or the dip- ıgaged in this work, but with the most discouraging results. The both of these dredges was repeatedly broken, and much more time riod spent in repair of machinery than in doing actual work, until ıtractors asked, in a letter dated May 5, 1892, to be relieved from re- ck and hardpan found in the section covered by the contract, which ranted by the honorable the Secretary of War on the 4th of June fol-

tion of the bottom of the river, to ascertain as near as practicable the k and hardpan to be found within the limits of the area contracted for, April by Mr. Paul Heinze, overseer.
:cated the existence of 1,332 cubic yards of rock and 14,459 cubic yards The hardpan was extremely hard to penetrate with the pointed steel he purpose, and it was only with the utmost exertions that it could be ed.
ratively low price at which the dredging was done, 12½ cents per cubic ıe difficulties encountered by the contractors felt all the more.
relieved of the removal of rock and hardpan, the contractors have in excavating the overlying strata of mud, sand, and clay. Even this ı expensive. The elevator dredge did the greater part of this work, pan being impenetrable by the spud of that dredge, around which it ı working, it was found necessary to make use of the dipper dredge ırpose of holding it in position while working.
ısing the strength of and otherwise modifying various parts of the ge, as has been from time to time suggested by the experience of two g, this dredge has done very good work.
ınately impossible, however, to present any data indicating its actual the following reasons:
ədges have worked at times alternately, at other times simultaneously, ection of the river. The material removed has been measured "in t in scows, in which latter case, if used, the work done by each dredge en estimated separately.
ıaterial running into a completed portion of the channel to a very great ecessitated (1) the redredging of such portion on some occasions as o three times, the dredge thus handling the same material several the dredging to a depth of generally not less than 2 feet below that ıe contract, to make sure of leaving the required depth at the comple- ion reported for examination. Besides these reasons it may also be equently, after the material along the sides of the projected channel oved by the elevator dredge, the dipper dredge was employed in trans- aterial from the center of the channel to the excavated trenches on the it was afterwards rehandled by the former dredge, which, by means veyor and a powerful stream of water, would remove it far enough be- ınel lines to prevent its returning into the completed channel.
the experience of the last year, it is reasonable to expect that no such dredging in this river will be obtained as has been heretofore, unless provision is made in the next specifications, which will hold the con- rom excessive loss, should rock and hardpan be encountered again, h not probable according to appearances, still must be (and certainly will be) considered as possible.

COMMERCIAL STATISTICS.

…river and harbor are so closely connected in their commercial …mercial statistics are given in this place, but will be found under …ord Harbor. There is practically no navigation on the river be…harbor. As soon, however, as the river channel is opened by …tion and business along the river will develop very fast. It awaits …

J J 4.

IMPROVEMENT OF ILLINOIS RIVER, ILLINOIS.

…nate object of this improvement is to furnish a through route …tation by water from the southern end of Lake Michigan to …ssippi River, of sufficient capacity for its navigation by the …lass of Mississippi River steamboats that can reach the mouth …linois River.

…mensions that have been adopted for the locks to meet this re…nt are:

	Feet.
…f lock chamber	350
…f chamber	75
…low water over sills	7

…roject now under execution is for the improvement of the lower …of this route, extending from the mouth of Copperas Creek to …ssippi River, a distance of 137 miles. Another section of the …8 miles in length, from the mouth of Copperas Creek to La Salle, …n improved by the State of Illinois by the construction of two …nd dams, one at Copperas Creek and one at Henry, Ill.

…this latter section the State still collects tolls, the United States …having accepted the conditions imposed by the act of cession of …nois legislature, which conditions are such as to deprive the works …alue while demanding a great expenditure by the United States …ment for works to be substituted therefor.

…regard to this subject reference is made to the Annual Report …Chief of Engineers for 1889, page 2121, *et sequitur.*

…r the act of Congress of August 11, 1888, surveys and separate …es have been made, based upon low-water depths of 8 and 14 … carrying the improvement from La Salle to Lake Michigan via …nois and Desplaines Rivers, and a cut across the Chicago divide, …hich section there is a fall in water surfaces, Lake Michigan being …mit, of about 141 feet.

…eport upon this survey and estimates has been printed as House …. No. 264, Fifty-first Congress, first session, and is also published …Annual Report of the Chief of Engineers for 1890, page 2419 and …g pages.

… surveys and estimates have also been made by the trustees of …itary district of Chicago, organized under laws of the State of …f…tting a capacious channel carrying a large discharge from …to the Illinois River for drainage and sanitary pur…f the Chief of Engineers, U. S. Army, for the … reports and estimates of engineers acting …r of Chicago, and later under the trustees of …cago, relating to this matter will be found.

tc. Twelve thousand five hundred cubic yards of material were d from the approaches to the lock. The completion of this lock oled the tonnage passing this point, even with a less number of

t Kampsville.—The remainder of the mud overlying the founda- structed in 18 was removed, i. e., 9,000 cubic yards; making in 14 cubic yards of deposit removed since 1883. Trestles 1,170 eet in length for stone travelers for laying the lock walls were cted. Also trestles for tramway track for delivering stone at k walls 1,260 linear feet in length were constructed.

laying of masonry began September 5, 1891, and was prosecuted ovember 30, 1891. A greater part of the time work was prose- lay and night in laying masonry. Ten thousand one hundred ty-five cubic yards of masonry were laid in the lock walls, com- course L and lower courses of the lock. The foundation (pile, te, and grillage) for the abutment of the dam was constructed e abutment laid to a height of 10 feet above the foundation. y-seven thousand four hundred and seventy-nine cubic yards of al were dredged above and below the lock pit. One thousand ndred and fifty-four cubic yards of cut stone were purchased contract, of which 788 cubic yards have been delivered at the e; 6,915 cubic yards of rubble stone for the dam were purchased livered.

of the timber, iron and steel for the lock gates and maneu- gear of the lock has been contracted for. Also, one-third of the al for the dam, but none of this material has yet been delivered. plant has been kept in repair as well as may be, but it is nearly iceable as far as floating plant is concerned. The appropriations work have been so small and made at such intervals that the as decayed, but not worn out, before the work for which it was l, i. e., the dredging and channel work, has been more than

re the dredging required can be done a complete new dredging nust be purchased as far as hulls of floating plant is concerned. eater part of the machinery is good.

s been necessary to begin the construction of new dump scows, which is practically completed and the other under way. Six will also have to be built before the dam can be constructed.

river during the past spring, and until now, has attained and s at an unusually high stage, above all stages recorded since The water still remains above the banks and nearly daily rains nall hope of a speedy decline.

PROPOSED APPLICATION OF FUNDS NOW ON HAND.

funds on hand will be expended in completing the lock masonry, y floor, and lock gates, and purchasing the material for the dam.

SED APPLICATION OF FUNDS ASKED FOR, FOR FISCAL YEAR ENDING JUNE 30, 1894.

ly the funds asked for herein to the completion -Lock, and to dredging the river between the River, and as far as practicable the pools Grange and Kampsville.

third time a
step in ad-
tion of their
Springs and
ntract has not
nt by the trus-

C. V. Brainard
past fiscal year:

....		$159,304.43
....		5.50
		159,309.93
....		103,999.07
		55,310.86
....	$340.45	
	24,715.57	
		25,056.02
		30,254.84
....		100,000.00
....		130,254.84
...ing project........		112,500.00
...nding June 30, 1894		112,500.00

...ons 2 of river and

...ompsville Lock Gates, received and ... Marshall, Corps of Engineers.

...ht iron (ap-...mate quan-...), 40,200 pounds.		Cast iron (approximate quantities), 112,500 pounds.		Grand total.
...ound.	Total.	Rate per pound.	Total.	
...nts.		*Cents.*		
[illegible]	$2,452.50	4.45	$5,006.25	$9,850.65
10.00	4,500.00	6	6,750.00	17,280.00
4.95	2,227.50	4.95	5,568.75	10,147.95
8.913	4,010.85	5.589	6,287.62	12,737.40
6.09	3,145.50	4.88½	5,495.62	11,032.02

...idder.

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effect still ·
Illinois Riv·
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sanitary pu
ment pract·
· est econo·
· that by ·
[illegible]

...ucting Kampsville Lock and Dam, Illinois River, in force ... the fiscal year ending June 30, 1892.

Nature of contract.	Date.	To expire.
Furnishing and delivering at lock site 1,254 cubic yards of stone.	Feb. 10, 1891	*Nov. 30, 1891
Furnishing 197,700 pounds iron and steel fittings for lock gates.	Apr. 11, 1892	Aug. 1, 1892
Furnishing 246,722 feet, B. M., lumber.	May 31, 1892	Sept. 1, 1892
Furnishing 66,986 feet, B. M., lumber..	June 15, 1892	42 days subsequent to notification.

*Contract extended to August 31, 1892.

...OF MR. C. V. BRAINARD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Kampsville, Ill., June 30, 1892.

...honor to submit the following report of operations for im... for the year ending June 30, 1892.

...At the beginning of the fiscal year about 9,000 cubic yards of ...cleared off the foundation. After removing 1,350 cubic yards ...p in the side of the cofferdam was closed and the water pumped ...ining on the wall sites was then removed. A part of this was ...it over the cofferdam. The most of it, however, was wheeled ...into scale boxes, and hoisted outside. About 1,650 cubic yards ...way. After the walls were partially up about 3,000 cubic yards, ...in the center of the foundation, was wheeled back of the land ...together about 34,000 cubic yards of dirt removed from the lock

...fifty-four piles and 54 sheet piles were driven. Sixteen piles and ...ing the opening in the cofferdam, 228 piles for the traveler and ...d 6 piles for a derrick support. There was built 1,170 linear feet ...for laying the lock walls and 1,260 linear feet of railroad trestle ...at the walls.

...stle at the stone pile 16 of the old elm piles were replaced by ...timbers.

...t of railroad track with the necessary switches were laid from ...the walls for the delivery of stone at the work.

...hundred and twenty-six square yards of the foundation were ...r of concrete varying from 0.1 foot to 0.25 foot in thickness.

...ing the walls was begun September 5, 1891, and continued until ...on the "L" course, making the walls 20 feet and 3 inches high, was ...ding both miter sills and the breast wall, except the coping of the ... From September 29 until November 18 the work was carried on ...and night. Night work on the walls was stopped at this time on ...reezing weather at night. During this time, 4,610 cubic yards of ...bic yards of backing stone were set.

...yards of broken stone were used for concrete in filling the joints

...walls three overhead travelers were used, one over each wall and ...f cut stone. Two derricks with a steam hoist handled the backing ...l. A railroad track about 10 feet above the foundation runs along ...ach wall for its entire length, the stone being brought down on cars ...posite where it belongs in the wall. It was unloaded by the traveler ...he wall to be used when needed.

...k was carried on by the aid of nine Wells lights of 1,200 candle power ...he time these lights burned they averaged 2 barrels of coal oil each

...and ninety-one pieces of quarry stone for the river wall were recut giving them a batter of 3 inches to the foot. Twenty-four pieces of ... This recutting was made necessary by a change in the plans of ...r a part of the stone had been delivered. The lower miter sill ...ed and bolted into position.

...dredging above and below the lock was begun and continued ...which time no dredging has been done because of high water. ...rk was carried on day and night. From the 20th to the

18

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m. A

for the

roperty,

28, Assist-
ead with a
11, James
g crushed.
rd and was

AINARD,
ant Engineer.

1891.

Remarks.

uge.—7 a. m. 0.15 foot;
0.15; 6 p. m. 0.15. Strong
wind down stream.
Time, 10 to 11 a. m. C. A.
Brainard, observer.

1

0

62.9

50.1

84.2

144.5

232.0

259.3

170.2

122.3

77.2

23.6

.........square feet .. 2320.65
cubic feet per second .. 1878.0
......feet per second .. 0.809

ge of Illinois River at Kampsville, Ill., October 20, 1891.

[illegible]	Partial areas.	No. of registrations. For 300 seconds. Seconds.	No. of registrations. For 300 seconds. Registrations.	No. of registrations. Per second.	Mid-depth velocities.	Mean velocities.	Partial discharges.	Remarks.
Shore.								
.9	94.40	158	12	.076	.329	.309	29.2	Gauge.—7 a. m., —0.25; noon,—0.25; 6 p. m.,—0.25. Time, a. m. From west to east. Brisk breeze upstream. W. M. Childs, observer.
.1	88.50	99	19	.192	.866	.857	75.8	
.1	91.50	125	24	.192	.866	.857	78.4	
.0	92.25	110	20	.182	.820	.810	74.7	
.1	94.50	109	18	.165	.741	.729	68.9	
.1	93.00	122	18	.148	.662	.647	60.2	
2.6	79.50	138	20	.145	.649	.635	50.5	
2.3	69.75	126	15	.119	.528	.508	35.4	
2.1	63.00	117	16	.137	.612	.592	37.3	
2.2	73.50	136	13	.096	.422	.401	29.5	
4.2	128.25	116	10	.086	.376	.359	46.0	
6.9	199.50	122	15	.123	.547	.539	107.5	
9.7	276.75	140	22	.157	.704	.704	194.8	
10.1	285.75	108	19	.176	.792	.795	227.2	
6.0	189.00	131	26	.199	.898	.899	169.9	
4.6	138.75	125	21	.168	.755	.747	103.6	
4.2	118.50	121	15	.124	.552	.538	63.8	
1.8	47.10	120	....	....	....	....	....	
Shore.	-							

f cross section..............................square feet.. 2,223.5
rge ....cubic feet per second.. 1,452.7
y...feet per second.. 0.653

NEERS, U. S.

Readings of the upper gauge at Copperas Creek Lock, 1891.

[Plane of reference: Top of lower miter sill.]

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
12.18	11.80	13.78	14.88	17.70	12.20	13.40	11.70	11.60	11.50	11.40	12.10
12.20	11.80	13.85	15.02	17.55	12.15	13.22	11.75	11.60	11.50	11.40	12.10
12.25	11.85	13.93	15.20	17.35	12.25	12.97	11.75	11.60	11.50	11.40	13.10
12.30	11.95	13.95	15.33	17.10	12.30	12.80	11.75	11.60	11.45	11.40	12.10
12.30	11.98	13.88	15.45	17.02	12.27	12.75	11.70	11.60	11.40	11.40	12.10
12.30	12.00	13.78	15.55	16.85	12.25	12.60	11.70	11.60	11.40	11.40	12.20
12.30	12.00	13.72	15.72	16.60	12.37	12.50	11.70	11.60	11.40	11.40	12.40
12.30	12.00	13.70	15.80	16.23	12.37	12.55	11.70	11.60	11.40	11.60	12.40
12.30	12.00	13.67	15.83	16.07	12.55	12.45	11.70	11.55	11.40	11.60	12.40
12.30	12.00	13.40	16.07	15.87	12.65	12.45	11.70	11.50	11.40	11.60	12.40
12.30	12.00	13.40	16.10	15.68	12.80	12.35	11.70	11.45	11.40	11.60	12.40
12.22	12.00	15.40	16.57	15.53	12.85	12.30	11.70	11.45	11.40	11.60	12.40
12.20	12.00	13.40	16.93	15.33	12.90	12.20	11.70	11.50	11.40	11.60	12.40
12.15	12.00	13.33	17.17	15.12	12.90	12.17	11.78	11.50	11.40	11.60	12.45
12.10	12.00	13.35	17.53	14.87	13.00	12.02	12.00	11.50	11.40	11.60	12.45
12.05	12.00	13.35	17.75	14.68	13.00	12.00	11.70	11.50	11.40	11.60	12.50
12.05	12.00	13.35	18.05	14.37	13.07	11.97	11.70	11.50	11.40	11.60	15.50
12.05	11.95	13.48	18.25	14.07	13.53	12.00	11.70	11.50	11.25	11.60	12.50
12.00	12.00	13.62	18.45	13.83	13.55	12.00	11.70	11.50	11.20	11.60	12.50
12.00	12.32	13.73	18.57	13.68	13.70	12.00	11.70	11.50	11.15	11.67	12.50
12.00	12.40	13.77	18.70	13.45	13.72	12.00	11.70	11.50	11.15	11.72	12.50
11.90	12.57	13.80	18.73	13.42	13.80	12.00	11.60	11.50	11.20	11.80	12.53
11.90	12.68	13.80	18.80	13.20	13.90	12.00	11.60	11.55	11.20	11.85	12.50
11.90	12.85	13.92	18.77	13.10	13.95	11.90	11.60	11.60	11.30	11.95	12.55
11.85	13.20	14.02	18.73	13.00	14.00	11.90	11.60	11.65	11.30	12.00	12.55
11.85	13.43	14.07	18.57	12.70	13.80	11.90	11.60	11.65	11.30	12.05	12.55
11.85	13.62	14.37	18.50	12.50	13.75	11.85	11.60	11.60	11.35	12.05	12.55
11.85	13.75	14.45	18.37	12.50	13.70	11.80	11.60	11.60	11.35	12.05	12.60
11.80	....	14.52	18.17	12.45	13.60	11.75	11.60	11.60	11.40	12.05	12.60
11.80	....	14.70	17.92	12.37	13.50	11.70	11.60	11.50	11.40	12.08	12.60
11.80	....	14.75	....	12.23	....	11.70	11.60	....	11.40	....	12.60
12.07	12.29	13.81	17.18	14.72	13.07	12.23	11.68	11.55	11.36	11.68	12.42

Readings of the lower gauge at Copperas Creek Lock, 1891.

[Plane of reference: Top of lower miter sill.]

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
8.65	8.00	12.72	14.53	17.58	10.25	12.53	7.50	7.78	7.08	6.95	8.65
8.70	8.00	12.85	14.67	17.40	10.10	12.25	7.58	7.70	7.00	6.95	8.65
8.80	8.10	12.98	14.82	17.23	10.73	11.93	7.62	7.73	7.00	6.95	8.70
8.87	8.20	13.05	15.00	17.03	10.95	11.75	7.65	7.70	7.00	6.95	8.80
8.93	8.33	13.05	15.10	17.00	10.75	11.60	7.55	7.70	7.00	6.95	8.90
9.00	8.40	13.00	15.22	16.97	10.30	11.50	7.55	7.70	7.00	6.95	8.95
9.10	8.40	12.87	15.38	16.60	15.30	11.20	7.55	7.65	7.00	6.95	9.00
9.17	8.38	12.80	15.40	16.13	10.42	11.23	7.55	7.57	7.00	6.98	9.10
9.20	8.35	12.80	15.45	15.73	10.60	11.00	7.53	7.55	7.00	7.00	9.10
9.20	8.30	12.60	15.75	15.40	10.77	10.87	7.52	7.50	7.00	7.00	9.10
9.20	8.28	12.50	15.80	15.10	11.00	10.47	7.55	7.40	7.00	7.00	9.10
9.17	8.20	12.40	16.23	14.83	11.15	10.38	7.55	7.40	7.00	7.05	9.10
9.10	8.13	12.40	16.55	14.70	11.42	10.18	7.60	7.40	6.97	7.08	9.10
9.07	8.10	12.40	16.93	14.40	11.50	10.08	7.93	7.40	6.95	7.13	9.17
9.00	8.10	12.40	17.33	14.30	11.73	9.67	8.60	7.40	6.88	7.20	9.15
8.83	8.10	12.40	17.60	14.20	11.85	9.37	9.00	7.37	6.77	7.20	9.15
8.80	8.10	12.40	17.90	13.93	11.85	9.25	9.50	7.30	6.80	7.18	9.27
8.75	8.10	12.62	18.17	13.78	12.83	9.25	9.50	7.30	6.80	7.15	9.40
8.65	8.13	12.75	18.35	13.48	12.80	9.18	9.40	7.30	6.80	7.17	9.40
8.60	8.73	13.03	18.42	13.28	12.90	9.03	9.30	7.27	6.80	7.35	9.40
8.47	9.47	13.02	18.50	13.15	12.98	8.90	9.17	7.25	6.85	7.77	9.40
8.40	10.13	13.00	18.55	13.00	13.20	8.73	9.00	7.25	6.90	8.00	9.45
8.32	10.70	13.00	18.60	12.80	13.30	8.47	8.77	7.25	6.90	8.05	9.50
8.22	11.02	13.12	18.55	12.73	13.33	8.20	8.57	7.25	6.90	8.20	9.60
8.20	11.58	13.35	18.50	12.52	13.33	8.00	8.25	7.25	6.90	8.35	9.60
8.18	11.93	13.42	18.40	12.22	13.20	8.00	7.92	7.25	6.90	8.50	9.60
8.10	12.28	13.75	18.35	11.80	13.15	7.93	7.72	7.20	6.95	8.50	9.60
8.05	12.63	13.87	18.22	11.47	13.10	7.80	7.80	7.20	6.95	8.50	9.60
8.00	....	13.97	18.03	11.12	12.95	7.75	7.80	7.15	6.95	8.50	9.60
8.00	....	14.10	17.78	10.73	12.72	7.65	7.80	7.13	6.95	8.63	9.60
8.00	....	14.28	....	10.47	....	7.50	7.80	....	6.95	....	9.60
.67	9.08	13.00	16.94	14.23	11.85	9.73	8.13	7.41	6.93	7.47	9.24

Readings of the gauge at Kampsville Lock.

[Plane of reference: Low water of 1879.]

Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
0.57	0.82	3.68	8.97	11.47	3.98	4.65	1.05	0.93	0.00	—0.20	1.40
.65	.82	3.80	8.97	11.42	3.67	4.80	.95	.92	0.00	— .25	1.38
.78	.92	3.85	8.78	11.35	3.40	5.00	1.17	.88	0.00	— .20	1.15
1.17	1.15	4.17	8.67	11.28	3.43	5.20	1.32	.77	—0.02	— .15	1.30
1.42	1.17	4.07	8.65	11.17	3.65	5.23	1.30	.68	— .10	— .10	1.12
1.60	1.10	4.10	8.72	11.00	3.92	5.03	1.10	.62	— .10	— .08	1.12
1.65	.95	4.10	8.83	10.87	3.88	4.52	.90	.58	— .05	— .10	1.32
1.57	.82	4.17	8.98	10.70	3.87	4.17	.75	.53	— .05	— .05	1.40
1.55	.88	4.22	9.08	10.50	4.13	3.95	.63	.50	0.00	.05	1.50
1.45	.93	4.27	9.30	10.25	4.55	3.90	.53	.45	0.00	.12	1.55
1.35	.88	4.30	9.57	10.03	4.78	3.92	.55	.40	0.00	.15	1.62
1.40	.87	4.30	9.88	9.80	5.08	3.80	.82	.35	— .05	.15	1.63
1.57	.90	4.27	9.95	9.47	4.83	3.52	1.05	.35	— .05	.10	1.70
1.60	.90	4.23	9.83	9.15	4.17	3.18	1.00	.30	— .07	.05	1.75
1.45	.93	4.20	9.63	8.85	3.75	3.02	.97	.30	— .12	.12	1.82
1.46	.95	4.15	9.55	8.45	3.67	3.08	1.15	.23	— .20	.32	1.85
1.38	.95	4.15	9.87	8.00	3.70	2.92	1.80	.20	— .20	.37	1.85
1.30	.90	4.22	10.57	7.53	3.75	2.83	3.10	.20	— .15	.45	1.92
1.23	.92	4.35	10.75	7.07	3.77	2.48	3.35	.18	— .23	.45	1.98
1.15	1.37	4.50	11.12	6.68	3.92	2.20	3.23	.13	— .25	.53	2.03
1.15	1.95	4.75	11.32	6.67	4.28	1.95	3.05	.12	— .23	.60	2.05
1.10	2.40	5.08	11.43	7.47	4.55	1.88	2.90	.12	— .15	.82	2.05
1.02	2.95	5.40	11.68	7.10	4.87	1.72	2.55	.10	— .15	1.55	2.03
.95	3.20	6.10	11.97	6.75	5.18	1.58	2.15	.10	— .15	1.70	2.02
.90	3.30	6.88	12.13	6.20	5.35	1.35	1.77	.10	— .10	1.65	2.12
.90	3.27	7.31	12.15	5.68	5.28	1.23	1.47	.10	— .05	1.55	2.12
.87	3.42	7.57	11.98	5.33	5.02	1.18	1.20	.10	— .05	1.53	2.00
.90	3.52	7.92	11.87	5.07	4.85	1.05	1.02	.10	— .08	1.48	2.00
.92	....	8.38	11.73	4.85	4.72	1.07	1.02	.10	— .05	1.35	2.05
.78	....	8.72	11.57	4.60	4.68	1.17	1.05	.05	— .15	1.20	2.02
.75	....	8.85	....	4.25	....	1.20	1.03	....	— .15	....	2.00
1.18	1.54	5.16	10.25	8.36	4.29	2.99	1.48	0.35	—0.09	0.51	1.74

COMMERCIAL STATISTICS.

owing figures are taken from the annual report of the Merchants' Exchange, Mo., for calendar year 1891:

and departures of steamboats and barges at St. Louis, Mo., via Illinois River.

Month.	Arrivals.	Depar-tures.	Month.	Arrivals.	Depar-tures.
....	....	....	August	20	19
....	....	....	September	11	9
....	9	7	October	3	....
....	22	19	November....................	9	8
....	15	11	December	1	....
....	11	10			
....	14	15	Total	115	98

ceipts and shipments, in tons, via Illinois River, at St. Louis, Mo., 1891.

Month.	Receipts.	Ship-ments.	Month.	Receipts.	Ship-ments.
....	....	....	August	2,675	675
....	....	....	September	880	490
....	3,340	550	October	250	....
....	14,310	670	November....................	1,610	....
....	3,655	620	December	....	....
....	1,300	505			
....	3,170	795	Total	31,190	4,305

2. PRICES FOR WORK.

k in narrow railway cuttings, where disposal of material is difficult, is done at 70 to 90 cents per yard.

now being quarried at Lemont for $2 per cord of 13,000 pounds, or 100 solid. This is at the rate of 54 cents per yard. It is delivered on board 1.08 per yard and has actually been delivered in this city for $1.62 per yard, cord.

r wharves on the Mississippi River is actually delivered on board barges 75 cents per loose yard for quarries on the banks of rivers.

Amsterdam Canal of Holland (1865–'76) 21,000,000 yards of material were t an average rate of about 4 cents per yard.

St. Petersburg Canal (1878–'85) 63,000,000 yards were moved for about 5 cents l.

t. Lawrence has been deepened over a length of 40 miles between Montreal ebec, from a depth of 10½ feet to 27½ feet; material clay, sand, hardpan rs, and some ledge rock. Aggregate cost for last ten years work, 13 cents d. The clay has been down at from 3 to 6 cents per yard.

ecords of several dredges on harbor works in Europe and Australia gives rates 4 to 6 cents per yard in free material and at American prices.

Lake Erie and Ohio River ship canal commissioners of Pennsylvania recently d on a canal 100 miles long from Conneaut on Lake Erie to Beaver on the iver. Total excavation 43,282,475 yards, at $8,656,495, or an average of 20 er yard for all classes of material. Much of the work was estimated at 12 er yard.

Manchester Ship Canal involves 47,250,000 yards, one-sixth of which is rock. ost of canal complete, $30,000,000. Less than half this amount is for excava- it the figures are not reported.

North Sea (Holstein) Canal involves 67,000,000 yards of excavation, and the ost is estimated at $39,000,000. No details as to cost of excavation are given. us harbor work in the United States is being done at 10 to 20 cents in limited ies.

nformation available indicates that with special machinery and full prepara- e work can be done as cheaply as similar work has ever been done, or well he prices of the Hering Commission, viz, 15 cents for clay, 30 cents for diffi- edging, and 75 cents for rock.

nate for various channels.—Channel from Ashland avenue to Lockport, 30 miles.

Capacity per minute.	Width.	Depth.	Grade per mile.	Excavation.	Cost of excavation.
Feet.	*Feet.*	*Feet.*	*Inches.*	*Cubic yards.*	
210,000	160	10	6.84	22,196,000	$9,917,000
300,000	160	10	15.60	32,231,000	15,817,000
300,000	160	14	4.44	22,882,000	9,721,500
600,000	160	18	7.00	29,685,000	13,136,000
600,000	160	21.6	3.62	29,086,000	12,263,000
600,000	200	18	4.00	30,169,000	*14,931,400
600,000	180	18	5.00	37,914,830	†14,228,900

* Hering Commission.
† Worthen-Newton.

s of rock, 75 cents; hard material, 30 cents; clay 15 cents. All the estimates are on the same basis as to prices per yard.

reen Ashland avenue and Lockport, right of way, bridging, and miscellaneous ld $5,000,000 to each of the foregoing estimates for the total. One million may ed for passing the volume of water from Lockport to Lake Joliet.

w Joliet the entire value of landed property throughout the Illinois Valley is ted at less than $3,000,000. Any damage from overflow will be but a fraction ı.

ill be noticed that a channel 10 feet deep for either 210,000 or 300,000 cubic feet s expensive than one 14 feet deep. It will also be noticed that a channel to 600,000 cubic feet and 21.6 feet deep is cheaper than a channel 18 feet deep and same capacity. It will also be noticed that to double the capacity from 300,000 000 only adds $2,541,500, or some 17 per cent to the total between Chicago and

on for these results are due to grade and its effect on the amount of rock at the lower end of the channel.

proportion of channel can only be told after full borings have been made. that the Hering channel, with a width of 200 feet, cost little more than the Worthen-Newton channel with a width of 180 feet. This estimate involves more rock than is since found to exist and is accordingly high.

The actual channel is not likely to exceed these estimates, as the actual rock is less than that assumed.

By comparing the quantities with the total for the Manchester Canal, some idea of outside limit of cost may be obtained. That work involves a vast amount of docking, bridging, and locks, and is greater than a channel 25 feet deep carried clear to Lake Joliet, complete with locks and revetment.

4. CAPACITY FOR DILUTION OF SEWAGE.

The best results of investigation up to the time the law was passed placed the dilution at 20,000 cubic feet for each 100,000 inhabitants, as needed for a sanitary condition, and the probable population at 3,000,000 in 25 years.

During the past season the canal carried about 50,000 cubic feet per minute up to December last. The amount of organic matter carried out by the canal at that time was about 250 tons per day. This was not far from the amount going into the South Fork alone at that time, and was probably less than one-fourth of the total organic waste produced by the city as sew[illegible] an not be definitely known until a sanitary survey is carried over the [illegible].

It may be stated that if all the sewage [illegible] city was made tributary to the canal before decomposition had set in, then a v[illegible] of 200,000 cubic feet per minute sent out of the city would not improve the c[illegible]n now found to exist in the canal.

The provisions of the law do not requ[illegible]ecessary dilution, and it may be wise to provide the full amount of 600,000 cubic [illegible] from the beginning.

No engineer of this Board, nor of any previous investigations, have recorded an opinion that the dilution mentioned is not required for a sanitary condition, and no engineer has said that with this dilution, the Illinois River would be fit to drink.

5. AVAILABLE REVENUE.

Assume that the assessed valuation for 1891 will be $220,000,000, and that the valuation increase at the rate of 5 per cent each year, which is certainly a conservative estimate, at the end of ten years the valuation would be $341,292,000. This would permit a bond issue of about $17,000,000 in ten years were it not limited in the law to $15,000,000.

If these bonds are issued at the rate of $1,500,000 per year for ten years, and the rate of taxation of one-half of 1 per cent is applied, then the total realized during the ten years from bonds and taxation would be $25,535,000 after paying interest currently on bonds issued at the rate of 4 per cent.

If one-twentieth of the bonds are retired each year by money from the tax levy, then the available revenue in ten years will be less, or about $20,000,000 to $22,000,000, according to the magnitudes of the annual issues and the fiscal policy which may be adopted.

It is well not to lose sight of other sources of revenue which may be made available on a broad range policy.

1. Special assessment will be available for lateral channels which seem a local territory, and perhaps to a limited extent on the main channel.
2. Property values may be created by applying the material excavated. The possibility of large resources are covered in this.
3. Coöperation on the part of the United States. This seems to have been lost sight of.
4. The dockage and water power will be sources of revenue in time, though this may be of slow development.

It is impracticable to construct an economical channel for drainage which is not also a good navigable channel, and the United States should be willing to put into this the cost of the 8-foot channel which its officers have estimated and recommended.

A practical fiscal policy should be possible under this law, and relief can never be had sooner than by making a beginning.

The sanitary project of this city is a necessity, and well-considered investigation has determined that the ship-canal solution is the only one practicable and within the financial resources of this city. The problem must be solved or this city must stop growing.

6. LARGE CITY EXPENDITURES

Cincinnati put from twenty-five to thirty million into the Cincinnati railway. So far as direct revenue is concerned, the capital is largely sunk, though indirectly the city is richly repaid.

[Chic]ago has put the same amount in her park system since 1869, and has not felt [bur]den, nor does she begrudge the expenditure.

[The] city expends about twenty-five million each year for all purposes, including [m]oney for special assessments. (See last city report.) This is as much as it [will ne]ver be necessary to raise under this law and is spread over a term of years. [Cons]idering the sums spent by other cities for public works, the sanitary project [and] the cost ought not to be regarded as serious.

[REP]ORT OF COMMITTEE ON ENGINEERING TO BOARD OF TRUSTEES OF THE SANITARY DISTRICT OF CHICAGO, SUBMITTED JANUARY 9, 1892.

[GEN]TLEMEN: On December 12, 1891 (page 298 of proceedings), your honorable [boar]d instructed the engineering committee as follows:

"[R]esolved, That the engineering committee be instructed to carefully examine the [work] of the engineering department and any proposed plan of operations and make [such r]ecommendations as will expedite the beginning of actual construction upon [the m]ain channel between Chicago and Joliet, and secure the completion of the en[tire] channel at the earliest date and with the greatest economy, and that said com[mit]tee report as soon as practicable."

[Th]is resolution calls for a comprehensive review of the work of the district and [the f]ormulation of a policy for the consideration of the board. The committee has [mad]e full use of the time at its disposal, and now submits a general report, re[serv]ing detailed recommendations for further consideration.

[Th]e committee has consulted maps, diagrams, and reports, conferred with the [chie]f engineer, heard experts upon the relative cost of rock excavation under water [an]d by dry quarrying and listened to the objections offered to the Chicago end of [th]e route as adopted, on behalf of the several railway corporations interested. In [ad]dition, each member has used every opportunity to inform himself upon the matter [a]t hand.

PAST POLICY OF THE BOARD.

Your committee can not ascertain from the records or by personal inquiry that [th]e action of the board has been guided heretofore by a definite policy or a specific [pla]n of operations. If so, it was not a matter of general information.

The following have appeared to the committee:

(1) The estimates of the engineer contemplated fixed bridges throughout the route [fro]m Chicago to Lockport. The requirement of swing bridges and a navigabe chan[ne]l was one not anticipated by the railways, as appeared in the hearings by the com[m]ittee.

(2) The channel of a capacity of 600,000 cubic feet per minute through the rock [b]egins at Sag, when the law requires that it should begin at Willow Springs, 5 miles [n]earer Chicago. (See section 23 in regard to "territory with a rocky stratum.")

(3) The dimensions of the channel, its depth at the starting point, and its grade, [a]re not matters of official record, nor are the works proposed for the development [o]f water power below Lockport. In fact there are no proper records which indicate [t]he plans of the board. So far as the committee can infer, one foot only is allowed [f]or fall in a distance of 7 miles from the lake through the river to the stock yards, [a]nd the grades are relatively much less than those adopted by Messrs. Worthen and [N]ewton. It is extremely doubtful if the channel as designed will pass muster under [s]ection 27 of the law.

(4) Every engineer of the board has suggested that work should begin on the rock [cu]t, between Sag and Lockport, as the completion of this section requires the longest [ti]me and is a measure of the period when the entire work may be made available. Statements have been made which led to the inference that condemnation proceed[in]gs here would require one year. It has been ascertained that they can be com[ple]ted for practical purposes in sixty days.

(5) The attention of the Board was largely concentrated on the work between the [st]ock yards and the Desplaines River at Summit, a section that would have been [us]eless for several years until the remainder of the work could be completed. It was [in]tended to erect pumping works at Corwith, and it is inferred that pumping works were also to be erected at Summit to throw water into the Desplaines River, a pur[po]se certainly contrary to the spirit of the law. The report of the engineering com[m]ittee, July 11, 1891 (page 201 of proceedings), seems to contemplate this section as the only work prior to 1893.

The above, and all that has come to the attention of the committee, is in harmony with the following:

That the work immediately contemplated was a channel by the most direct route [fro]m the South Fork to the Desplaines River, near the Ogden-Wentworth Dam, the

1.

2.

3.

sight

4.

may

It

also

thas

ween Chicago and Lockport is crossed at eight points by ten distinct to six corporations, and seven of these points are within the first anta Fe Railway is crossed four times, three crossings of the main the throat of their large yard at Corwith.

selected there will be railway crossings, and the number of these on s can not be reduced below seven lines crossing at four points, to sing at six points.

tive cost of the first 9 miles of feasible routes will not greatly dif-fference in cost of right of way will probably be far less than the ims for railway damages, so this factor becomes of prime importance, y be outweighed by considerations which pertain to the efficiency of

tee finds that the railways are not disposed in any way to needlessly work. They regard a drawbridge as a serious matter and insist that shall not be unnecessarily introduced in their lines and that they be ticable, at such points as to occasion the minimum of inconvenience. opted has been characterized as one that inflicts the maximum possi-ge between the waters of the Chicago River and Summit. At Corwith es the throat of the main yard of the Santa Fe system, the canal, and of three railway lines, all in a short distance. The situation is capable ration. The Santa Fe Railway could be relocated for 5 miles to the roposed channel between Corwith and Summit, thus avoiding two sings, but the position of the yards and junctions would not be ma-ed. It is claimed that the value of this yard would be destroyed and other locality necessitated, the entire cost of which would fall upon item in itself stated at over $1,500,000. This situation may be avoided a route to the south of the yards, by the Illinois and Michigan Canal, e north of the canal.

at Western avenue and Thirty-ninth street is only less serious. Here d the tracks of the Northern Pacific (not yet laid), the Panhandle, Yards Company leading to their railway yard. It is a waiting point bridges would seriously embarrass the business to the stock yards, as w operated. The situation is capable of some amelioration, but not f reducing the point to the status of the main lines without radical . This may be possible, but the situation must be met in any route Fork.

lopted was probably the most available from the South Fork to the mmit, for the purpose of pumping works at the canal crossing and at River, and was not intended for navigation. It certainly could not e objectionably located for the latter purpose. It is suggested by the that the West Fork, to the junction point near Crawford avenue, zed as the navigable connection with the Chicago River, but no record ion is found in any report or proceeding, and this view is not in har-e estimates for fixed bridges over the entire route and with the chan-ion carried through to the South Fork.

uestion of a route at this end should be reconsidered. The construc-ld be reëstimated, the right of way appraised, and the railway dam-r each line that may be available. On any line that may be adopted, mination of the basis of railway compensation is likely to be a matter gation.

ot, however, the only criterion. Within limits of cost, considerations to the efficiency of the channel and its adaptation to future needs vern. Some of these may be stated without further argument at this

nnel should effectively remove the sewage without expensive adjuncts which require large expenditures for operation and maintenance, thus ficiency dependent on the whims of an annual appropriation bill.

n should contemplate the easy development of the water supply in apacity of the Chicago River when the occasion therefor shall arise, ed by the law.

litions should be avoided which will in any way militate against the pment of a navigable route from the lakes to the Mississippi, or the f a deep-water harbor. While these are not issues immediately pend-not be ignored. The only feasible line for a waterway between the awrence and that of the Mississippi is by the Chicago divide, and waterway in this generation is through the operations of this is object we may confidently enlist the aid of the United States he deep-harbor question may be best and most cheaply solved he district when the occasion therefor may arise.

not been given to the Chicago end of the route, and for

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be sufficient for present consideration. The work in the Chicago
certain item, but certainly $1,000,000 will greatly better the stream
the district and for navigation.
:es, bonds, and special assessments not less than $20,000,000 may be
e, so there is no present reason to suppose that the resources will be

in works outlined are completed, any further development will come
progressively, without entertaining any serious financial question, pro-
eral plan is now properly matured.

RECOMMENDATIONS.

ittee has the honor to recommend as follows:
der the route from Sag to Lockport at once and prepare plans for pro-
ame from surface water, with a view to beginning work on this section
st practicable date.
ideration of this section will require little if any field work prior to
the adopted line on the ground. It should be possible to adopt a new
repare plans for the same in sixty to ninety days, and actually begin
ie. Sufficient property can be acquired by that time.
te the route where necessary between Willow Springs and Sag, with a
inning work this season. This may be done in sixty to ninety days after
:kport section.
ider the whole question of route from Chicago to Willow Springs, in the
sent needs and the requirements for future development.
for actual construction on this section should be made not later than
art of 1893.
ider the route and the treatment of the problem below Lockport.
a here may require one year. Work need not begin until early in 1895.
he plans may be matured in harmony with some plan for navigation with
peration.
s conditions to be met through the Chicago River as soon as practicable,
structures and modification in dock line may conform to a general plan.
will doubtless cooperate in this policy so far as it has occasion to deal
ver in the interests of navigation. The work will be fragmentary and
e some tedious litigation, and any opportunity for correcting the river at
hould be availed of. The larger part of the work, however, may be post-
ld financial considerations render this expedient.
mittee is persuaded that every energy should be bent to secure the actual
of work between Sag and Lockport, and that meantime every other con-
should be subsidiary. After this is begun ample time will be available
reful consideration of other sections of the route, without delaying the
of the work as a whole. We are also persuaded that such a course will
esources of the district to the best advantage.

CONCLUSION.

of some current misconceptions, your committee would add the following
upon the character of the project as a whole:
solution of the sanitary problem was adopted because it was much the
nvolved little or nothing for maintenance and operation, and had collateral
s as a waterway.
capacity was fixed by two considerations: (a) That the channel should
e necessary dilution to maintain a sanitary condition for the probable
population during the time for which the bonds are issued, or until the
id for. (b) That it should be adequate, in conjunction with other works,
snow and rain water in floods, and thus prevent contamination of the lake
nes.
not practicable, on account of excessive cost, to make a channel that will
equisite volume of water and at the same time be unnavigable. This is
d by the physical conditions. A channel flowing at a high velocity re-
gh grade, thus increasing the depth of rock-cutting at the lower end.
nnel will be unstable in the clay.
the required capacity a deep channel is less costly than a wide one. It is
ct to less variation in flow, by changes in the level of the lake, by floods,
, and it is more easily regulated at the lower end on account of less fall.
re the substantial considerations which determined the present general
lined in the law. Fortunately, all these conditions are also in the interest
ion. The only incident for actual navigation is proper railway and high-
ngs.

This law was matured after long consideration, and is explicit in its provisions. It lays down the conditions which must be met, and definitely prescribes the limitations upon capacity and size of channel. It is no part of the duty of this board to question these provisions, and it has no option other than to carry them out in accordance with their full spirit.

Very respectfully submitted.

LYMAN E. COOLEY,
WILLIAM BOLDENWECK,
JOHN J. ALTPETER,
Committee on Engineering.

The honorable the BOARD OF TRUSTEES OF THE SANITARY DISTRICT OF CHICAGO.

REPORT OF MR. WILLIAMS, CHIEF ENGINEER, TO THE BOARD OF TRUSTEES OF THE SANITARY DISTRICT OF CHICAGO, SUBMITTED FEBRUARY 17, 1892.

CHICAGO, *February 17, 1892.*

GENTLEMEN: On January 16 you [illegible] board passed an order as follows:

"*Resolved*, That the chief engin[illegible] instructed to submit, as soon as practicable, alternative locations for th[illegible]een Sag and Lockport, with comparative estimates in sufficient detail to de[illegible] the relative cost of the several lines that may be considered, and that he i[illegible]n said estimates all collateral works and damages."

In complying with this order it is foun[illegible] to make a proper preliminary location and estimate for alternate lines [illegible]nts named that will admit of the best method of treatment and be co[illegible] sanitary district law involves a consideration of the work which w[illegible] to improve, for the passage of water, the Desplaines River from some poi[illegible] Lockport to the upper basin at Joliet and that which will be necessary in [illegible] the main channel between Sag and Willow Springs. I have hence excee[illegible]structions to the extent of submitting alternative locations for the route bet[illegible]low Springs and the upper basin, with comparative estimates for quantities an[illegible] for the whole distance, based upon the most economical channel of uniform depth. Within these limits is comprised nearly all the rock excavation on the line of the proposed main drainage channel from Chicago to the upper basin.

Each of the several lines considered in the comparative estimates have received similar treatment, and the estimates are based upon the same method of working, except so far as differences of location compel variations.

There are three distinct routes from Willow Springs to Lockport and four from a point above Lemont to Lockport covered by these estimates. At or about Lockport all four lines merge into one. These various lines are shown upon the accompanying map, which is made in two sections, the estimates being given in Appendix A. The fifth line shown on the map is considered wholly as regards a different method of treatment and receives separate consideration hereinafter.

Line No. 1 follows the location made by Mr. William E. Worthen to a point above Lockport, where there is a deflection into a line common to all routes. This line is situated almost entirely on the north and west side of the Desplaines River, striking the river only at a very few points.

Line No. 2 is on the location made by Mr. Samuel G. Artingstall, intersecting the common line at Lockport. It follows the bed of the river as closely as is consistent with a satisfactory alignment.

Line No. 3 is a new location throughout. As far as possible it lies on the south and east side of the Desplaines River, between the river and the Illinois and Michigan Canal. It necessarily crosses bends of the river in a few places, but in such a manner that with a comparatively small amount of excavation the river channel may be changed so as to protect the new work. It involves a new location of the Chicago, Santa Fe and California Railway for a distance of 22,200 feet, 6,000 feet of which the company is now engaged in making for the purpose of improving their line, leaving 16,200 feet to be changed should the route be adopted.

Line No. 4 and No. 4 A are still other new locations; the former following line No. 3 to a point nearly $1\frac{1}{2}$ miles above Lemont, where it diverges, crossing the Illinois and Michigan Canal one-half mile below Lemont, and again crossing the canal about 1 mile above Lockport. This line involves a shifting of the tracks of the Chicago and Alton Railroad near Romeo, for a distance of 4,000 feet, and either the abandonment of the Illinois and Michigan Canal below the first crossing, or the carrying of that canal across the new channel in flumes, with a waiver of the navigability of the latter.

No. 4 A is a variation of line 4 lying between the two canal crossings. It does not ffer materially from the latter.

Line No. 5, as heretofore stated, is considered wholly with reference to a different atment of the project from that proposed for lines 1, 2, 3, and 4. This difference treatment is described in another place. This line starts at Willow Springs, incident with line 2, and continues in that line a distance of 7,000 feet, thence in e same course to the west line of section 14, below Sag Junction, crossing the Illi-is and Michigan Canal on the way, 3½ miles below Willow Springs. Thence the e deflects northward into the Lemont tangent of the present canal produced; ence it follows the bed of the canal past Lemont, and continues in a straight urse to the Romeo point, which it rounds with an easy curve, thence taking a raight course to Dam No. 1, at the lower end of the upper basin at Joliet. It fol-ws close to line 4, east of the canal, and passes east of the wire mill at Lockport, d under the bridge of the Elgin, Joliet and Eastern Railroad. From Willow rings to Dam No. 1 there are but two curves, the whole distance being accom-ished by three tangents.

The adoption of this line will involve the reconstruction of the present canal in three ctions aggregating a total distance of 26,000 feet. It involves two canal crossings, change in the Chicago, Santa Fe and California Railroad for one-half mile, and a construction of the Chicago, Alton and St. Louis Railroad in two sections aggre-ating in all 28,000 feet of double track. Like No. 4, it necessitates the abandon-ent of the Illinois and Michigan Canal, or the carrying of the same across the pro-sed new canal in flumes.

Within the range of the above described lines, almost the whole of the Desplaines iver Valley is included, that can be said to be available for canal construction.

In the estimates of cost, given in A[illegible]ndix A, for the first four lines that of the ght of way has been excluded, excep[illegible] state approximately the number of acres. he results are peculiarly notable in [illegible] small variation that there is between the west and the highest, viz, No. 3 and [illegible]o. 1, respectively, which is slightly less than per cent. Indeed, this variation is s[illegible]mall that without considering the question right of way, facilities for working [illegible]ich the various lines present, and the prob-ble hazard from floods in the Despl[illegible]iver, one would be in grave doubt as to hich line to recommend. This doul[illegible]ill further increased when we consider at where the surface of the rock is [illegible]id with glacial drift, as it generally is om Willow Springs to Lemont, the [illegible]files of the rock, from which the estimates re made are not absolutely reliable, owing to the incompleteness of the borings, and at this unreliability exists probably to a greater extent with lines 3 and 4 than ith either of the others.

Probably the surer and more conclusive way to arrive at a decision relative to hese lines is by a process of exclusion.

COMPARISON OF 3 AND 4.

Comparing No. 3 and No. 4 it is seen that the estimated cost of the latter line is 271,752 greater than the former; the estimated cost of No. 3 being $11,740,678.

No. 4 for a part of its length has some advantage in the matter of exposure to loods of the Desplaines River, but on the other hand is exposed to all drainage from he south of the line for several miles. It is also 1,000 feet shorter. It will require, n order to prevent damages by overflow, the condemnation of 435 acres of land more han No. 3. It crosses the canal twice, which will be an obstruction in working, and involves the raising, complicated questions with the canal commissioners, since the canal will either have to be abandoned or carried in flumes across the new chan-nel. The estimates are based on the proposition to abandon the canal, as to carry it across the channels in flumes would defeat the purpose of the plan.

In this comparison it should be borne in mind that the doubt which exists as to the relative quantities for some of the lines does not exist as between these two, for the reason that throughout that portion of their length where they follow different routes surveys of the surface of the rock and of the ground have been carefully made. It is only in the section common to each that the profile of the rock is not reasonably reliable. Hence, as between these two lines, I have no hesitstion in pre-ferring No. 3.

COMPARISON OF 2 AND 3.

g lines Nos. 2 and 3 it is seen that omitting right of way No. 3 is ap-ss cheaper than No. 2, and that it is 1,600 feet shorter. It is also in the matter of floods, and is likely to be less subject to water dinary stages of the river. During the construction of forced into a new bed for a considerable part of the way, which will not be thoroughly puddled and comparatively water tight, as the ... in. The levee that must be built along the new channel will for a large part ... way fall in the bed of the old river, and the land will slope toward it rath... from it, rendering it more difficult to exclude water. In some places also th... must be forced into very narrow confines between the new canal and the C... Santa Fe and California Railway. Indeed, in at least one place, either the ... the road will have to be changed.

It has the advantage of saving 600 acres in right of way and in land sub... overflow, which, at $200 per acre, makes it cost but little more than No. ... alignment, however, is inferior, and if selected should be modified in places.

A careful balancing of the arguments for and against each of these tw... makes it clear that line 3 is much to be preferred to line 2, though for reasons ... than those shown in the estimates. Indeed, estimates are incapable of showi... real differences between lines under conditions such as these.

COMPARISON OF 1 AND 3.

The difference in cost between lines Nos. 1 and 3 is apparently $539,375, ou... right of way. Line No. 1 is also 3,000 feet longer than No. 3. In the facilit... which it can be protected from floods in the Desplaines River, line No. 1 is p... slightly superior to line 3; but it has the disadvantage of being on the nor... west sides of the river, and hence exposed to the drainage from all the cree... ravines and drainage areas tributary to the river. On the other hand, the ca... tects line 3 by intercepting the drainage from the south and east, which ... otherwise reach the new channel.

The lands which it will be necessary to condemn for line 3 are in excess o... for line 1 by 663 acres. Giving these lands an extravagant price will still lea... balance largely in favor of line 3. This line also has a better alignment th... that have been considered.

In thus analyzing the advantages and disadvantages of the several routes ... described upon which estimates have been made, I am decidedly of the opinio... line No. 3 is the proper one to adopt for the main drainage channel.

The conclusion reached regarding the merits of the four lines under disc... stands independently of the manner of treating the problem after encounteri... sloping ground just above Lockport.

Though the comparison of cost has been made upon the basis of complete... in each case, from Willow Springs to the upper basin, the fact that all th... merge into one at Lockport, the plan below being common to all, still leav... relative showing correct for any treatment that may be given.

That there may be a full understanding of what this plan is, and its merits, ... it is presented with two other projects that have heretofore been proposed, co... the length of about 28,000 feet lying between the end of the 18-foot channel, ... posed by the late Chief Engineer, and the upper basin.

Plan 1. Mr. Worthen's plan was to continue the main channel with a u... slope along the line shown on the map, to a point opposite the upper basin, an... this point the water was to pass through Joliet by means of a 24-foot steel pi... ... of this the water could be allowed to escape into the upper basin and th... channel from the basin down improved to the proper capacity. If this pla... carried out, the upper or lake level would be maintained as far as the upper ... and incidentally an excellent development of water power secured. On the ... the river valley would be the high level canal, and nearly parallel therewi... from 30 to 50 feet below it the river bed and the upper basin to act as a tail r...

Plan 2. Mr. Cunningstall's plan contemplates an improvement of the river ... ... and erecting the sides, and by building three dams, which will ... descent in as many stages. This plan would allow of a partial utilization ... water power, but without extensive subsidiary canals would not give a full ... ... channel.

Plan 3. The present plan, the cost of which is given in the estimates, is ... ... of the same excavation from the canal between Willow Springs and ... ... to build a ... bank ... to ... feet wide on top, from a point 9,0... ... the water between this bank ... ... to the upper basin ... the river. It is also proposed to waste ... ... on the west side of the river ... channel formed by this embankme... ... This plan will incidentally furnish ... ... of water power ...

... to build ... bank to a height of 8 feet above dat... ... into the upper basin through ... cast-iron pipe sluic... ... Such an arrangement will remove any possible chance ... under the worst conditions.

... as the map to give preliminary and to a c...

nt nearly [merely?] suggestive; it can not be worked out properly in detail territory covered by it has been surveyed.

, it should be said that in this matter of the terminal, below Lockport, there fications which can be made in the plan, and probably will be made on fuller hich it is premature to enter into here.

parison of the cost of covering this stretch of 23,000 feet, by each of the three lans described is given in Appendix B.

ght of way required for plans 1 and 3 is the same, though it is impossible how much it is without considering the question with reference to the legal f the district to water power created by it. Plan 2 does not require so much about 670 acres.

iving at the results in Appendices A and B, it will be noticed that 11,000,000 aste is estimated as being hauled at 7 cents per cubic yard, and that 3,000,000 ards of rock are allowed at a reduced price, and credit given it in Appendix 3.

waste enters into the bank that confines the water below Lockport, into a r the Elgin, Joliet and Eastern Railroad, and into spoil banks west of the pro-anal, thus raising the land and limiting the spread of the water.

the rate of 7 cents per cubic yard, due to the haul of the material from the tion to the place of deposit, it should be said that it has been arrived at by orough investigations and estimates made by Assistant Engineer H. B. Alex-the results of which are embodied in a report from Mr. Alexander, which I herewith as Appendix C.

rate is shown to be the difference in cost between wasting the material adja-the line of the canal, and hauling it into banks an average distance of 10 full allowance being made for cost of track, equipment and operation. In re-o the cost of the road it should be said that the mere building of the roadbed ut track and ballast is a part of the excavation of the canal, material from the el being used to build the bank for the road. Such a bank, or something its alent, is necessary to protect the excavation from the floods in the river, so he bank serves a double purpose.

allowance of 10 cents per cubic yard on 3,000,000 cubic yards of rock is based e theory that if all but this amount of the best quality of rock is permanently sed of from the first, that contractors will be found, who in making bids will e sake of owning this stone, take the work at a very low price.

re are large quantities, running into hundreds of thousands of yards, of just stone quarried and sold every year in and about Chicago, and there seems little t that the reason why this waste rock has heretofore been considered of no im-nce arises from the immense quantity which might belong to a great number of ns and thereby become valueless from its very plentifulness.

incidental advantages which will be derived and the ultimate profits which be reasonably expected to accrue from carrying out this plan, run up into mil-of dollars. Some of these may be summed up as follows:

By permanently disposing of all but about 3,000,000 yards of rock, this amount as heretofore stated, be of value, and the contractor, who may own it after the is done, can dispose of it at remunerative prices, for ballast, for crib work, and e masonry; and will doubtless in submitting a proposition do so with this in making allowances to the benefit of the sanitary district. On the other hand, whole amount of rock is wasted, it will have little or no value to anyone, as arket will be glutted with cheap stone.

As far as possible, it should be the policy of the sanitary district to so dispose of rated material as to leave the banks clear of spoil. Much value will accrue to ght of way for the canal if it is kept clear of waste banks; but if it is encum-with a chain of mountains on each side, its value will be almost destroyed. hundred feet of right of way clear will be of more value than 800 feet cumbered spoil.

By carrying out the proposed plan below Lockport a channel of full depth will tended 4 miles further, and whatever the depth of the waterway which the d States Government may build to the Mississippi River, these 4 miles will be eat benefit, and, in dealing with Congress, as the sanitary district will ultimately should receive recognition to the financial benefit of the district.

This plan furnishes means for the complete control and measurement of the r which passes down the river at all times, and will doubtless prove of great preventing actual damages in the river below in the time of excessive floods, ularly in furnishing a check by which claims for fictitious damages may

rrying out this plan the sanitary district will own the best mill sites, and steadiest and most reliable water power in the Northwest.

feet, which will generally obtain 300,000 cubic feet per minute, will e power, and with 600,000 cubic feet per minute it will furnish

36,000 horse power. At the very low price of $10 per horse power, the first qu[illegible] when leased will bring an annual rental of $180,000, which capitalized at 5 per[illegible] is $3,600,000, while the greater quantity will capitalize at $7,200,000. Tha[illegible] power would be readily taken at these rates admits of little doubt. It sho[illegible] borne in mind that the execution of the proposed plan creates this power wi[illegible] another cent of expenditure other than short flumes and pipes to conduct the w[illegible] to the wheels.

Line No. 5.—Surveys and estimates are being made of Line No. 5, the locati[illegible] which is hereinbefore described.

The estimates, when completed, will show the cost of this line by two metho[illegible] treatment.

1. The main channel proper will terminate at a point above the lower cro[illegible] of the Illinois and Michigan Canal, at which place controlling gates and waste fl[illegible] will be built. Below this point the channel will become a tailrace, and the w[illegible] will be conducted to the lower basin in the cheapest manner consistent with [illegible]

2. Parallel banks will be built—one on each side of the line below the l[illegible] crossing of the canal, and as far down as a point just above the Elgin, Joliet [illegible] Eastern Railroad Bridge. There they will end in a cross bank forming the incl[illegible] space. At this point waste flumes and controlling gates will be provided for.

The banks of the channel will be carried up to a height of 8 feet above d[illegible] This method will accomplish to a considerable extent the same ends accompli[illegible] by the plan heretofore described, and which is included in the estimates for li[illegible] to 4 exclusive.

Work was only begun on this line a few days ago, and as the results are not li[illegible] to affect the conclusions of this report in any way that can not be properly consid[illegible] by the engineering committee as a part of the same, it is thought best to submit [illegible] whole question in its present stage, and let the new data go to the engineering c[illegible] mittee direct and be conveyed by that committee to the Board, rather than to d[illegible] another week.

Respectfully submitted,

BENEZETTE WILLIAMS,
Chief Engineer.

The honorable the BOARD OF TRUSTEES OF THE SANITARY DISTRICT OF CHICAGO.

REPORT OF MR. WILLIAMS, CHIEF ENGINEER, TO THE BOARD OF TRUSTEES OF THE SANITARY DISTRICT OF CHICAGO. SUBMITTED MAY 4, 1892.

CHICAGO, *May 4, 1892.*

GENTLEMEN: [illegible] communication of April 20, relative to a board of consulting [illegible] to me with the direction from your honorable board [illegible] at the next regular meeting the specific points which such [illegible]

[illegible] technically construed, contemplate that all issues shall be [illegible] before the appointment of a board of experts; but as [illegible] that it is fully within the powers of your board to [illegible] capacity which you may see fit to prescribe, the request [illegible] granted it would be upon broad grounds rather than in [illegible] with the rules.

When the [illegible] was submitted no issues had arisen that could be defined, [illegible] whole question is presented in the light of the bids [illegible] The hope was indulged that by the choice of engineers of [illegible] consider the subject in all its bearings, it might [illegible]

[illegible] before they exist, it is not impossible to state the [illegible] in certain contingencies.

[illegible] invited on three propositions, and a comparison [illegible] before awards can intelligently be made.

[illegible] the cost of excavating and constructing the main chan- [illegible] to the upper basin at Joliet, waiving the right of [illegible] of relatively small importance.

[illegible] the cost of excavating, but in order to be comparable [illegible] the cost of drainage and of the transportation of about two- [illegible] material must be added. The determination of this addi- [illegible] and any conclusion of your chief engineer relative thereto, [illegible] universal assent.

oposition 2" will give the cost of excavating and disposing of a part, and only , of the material required to be excavated to furnish a channel for water to per basin. A tailrace, some 5 miles in length, will have to be located and ex- d. Where shall this race be, and how much will it cost to excavate it? These portant points which your engineer can hardly hope to determine in such a r as to be satisfactory to all.

in, the work, if carried out in accordance with the proposed plan under either sitions 1 or 3, will ultimately develop a water power above Joliet of full horse power, which will be utterly lost under Proposition 2. Will such a power have any value, and if so, how much? And should it be considered at connection with the work of the sanitary district, however small its cost and rer great its value?

carrying out the work under either Proposition 1 or 3, a very large portion banks of the channel will be kept clear of spoil, while absolutely none will t unincumbered under Proposition 2. Does any value attach to this consid- n?

avigable channel under propositions 1 and 3 will extend with deep water 5 farther than under proposition 2. Such a channel, or its equivalent, is a neces- o the navigation of the Desplaines and Illinois rivers, and without it the y being expended by the United States Government on the Hennepin Canal and nprovement of the Illinois River will be utterly thrown away. Should this re- any consideration in carrying out this work?

uld it be shown that such a contribution to the work which the Government hand can be made at a nominal cost—work which would cost the Government, ried out independently, many times what it would cost the sanitary district if in connection with the main excavation—may it not be worthy of an effort to e Government coöperation to the extent of the extra cost? And might not a ugh consideration of all these questions by a properly constituted board of eers be the initiatory step to such coöperation?

se are mere hints as to the good which may come out of such a board if wisely n. But in view of the fact that the sanitary district is engaged in a work which entally is contributing immensely toward the project of a waterway which the rnment is expending money upon, may it not be the proper time to take a step may lead to results greatly to the financial benefit of the sanitary district?

m profoundly impressed with the importance of the questions which must be ed after the bids are received on the 8th of June—questions which it may ap- will affect the interests of the sanitary district to the amount of several millions llars—and I believe that the only safe way to approach them is in the manner sted. Should your honorable board reach the same conclusion, then I think all unsettled questions connected with the work below Willow Springs, coming n the domain of the engineering department, should be referred to such board your chief engineer shall have made a report upon the same.

what, as it seems to me, would be conducive to greater expedition and better ts, the consulting engineers might act with the chief engineer in making a report.

spectfully submitted.

BENEZETTE WILLIAMS,
Chief Engineer.

e honorable the BOARD OF TRUSTEES OF THE SANITARY DISTRICT OF CHICAGO.

RT OF MR. WILLIAMS, CHIEF ENGINEER, TO THE BOARD OF TRUSTEES OF THE SANITARY DISTRICT OF CHICAGO, SUBMITTED JUNE 7, 1892.

CHICAGO, *June 7, 1892.*

NTLEMEN: I beg to report hereby, in compliance with the order of your honor- board passed February 17, which is as follows:

"*ed*, That the chief engineer is hereby directed to make comparative and estimates of three alternative routes (one of which shall be the Illinois igan Canal) between the waters of the Chicago River at Ashland avenue w Springs road, and that the route already located be considered in com- th the said routes; and that the estimate on each line include structures, damages, and all supplemental works necessary to make the re; and that he report upon the whole subject as soon as ng the work below Willow Springs."

d Summit, for the purpose of a uniform comparison, the west line has been each case. The footings of the estimates for the various lines begin as fol-

Description of line.	300,000 cubic feet per minute.	600,000 cubic feet per minute.
tch Line No. 1	$10,265,095	$12,099,763
tch Line No. 2	9,284,944	11,175,070
e	7,865,963	9,746,018
e, with narrow right of way to Summit	5,899,963	7,780,018
rk and Ogden Ditch line	9,455,954	11,330,708
rk and canal line	8,903,678	10,804,919
rk line	9,978,153	12,043,016

amounts include the estimated cost of the main channel, with right of way, changes, bridges, and supplemental works west of Ashland avenue, on the ve routes, but give no idea of the relative difficulties that may be encountered ing right of way, or the relative injury to railroad property, which is not sus- of estimate; nor do they give any information as to which location will best e present and future sanitary needs of the city, nor which one will be cheap- cessary supplemental works east of Ashland avenue be included. They are, ar from furnishing a conclusive determination as to which route should be l.

rive at a just conclusion, the question should be considered more in detail the following heads: (1) Facility and expedition with which the respective an be worked. (2) Right of way and obstacles to procuring same, exclu- railroad properties. (3) Interference with railroad interests. (4) Value of y acquired by the sanitary district upon the various routes. (5) Supplemental ecessary to render the main channel fully effective to the extent contemplated sanitary district law, and the prospective incidental advantages in the way vigable waterway and improved harbor facilities which the various routes ford.

1. FACILITY AND EXPEDITION OF WORK.

stimates take cognizance of the relative difficulty of executing the work, as t is possible to do so, in the matter of quantities and cost per cubic yard; but ow nothing as to the time required to carry out the work on the several They are based upon the theory that to the west line of section 7, near Sum- each route, respectively, the excavated material will be removed by scows or and dumped into the lake, either as filling where needed along the shore or ut in deep water as to be no obstruction. This method of disposing of the l is recommended because it is believed to be but little if any more expensive e process of spoiling the waste, unless the spoiling can be done over a large y by means of hydraulic dredges, and because land that may cost the district ,000 to $10,000 per acre will have too great a value after a navigable channel ve been cut through it to be used as dump grounds.

r of the Ogden Ditch routes, the canal route, and the South Fork and canal n be worked in this manner with about equal facility as to time and ex- of transportation, the necessity of constructing and using a lock at the e to the canal about offsetting what will be, at first, the less commodious l of the Ogden Ditch. On either of these routes with the right of way secured sonable time, and an adequate plant, the work can be prosecuted with suf- rapidity to insure its completion by the time the rock cut below Willow is done.

ther side of the two remaining routes having their initial point in the South articularly the southern one, much slower progress must be made because more material to be removed for an equal distance, and no channel exists to e access to the work. Again, to provide temporary crossings for railroads hways will be more difficult on these lines than in the case of the first four

aterial to be excavated on the Ogden Ditch routes, barring the rock at avenue on route No. 2, can be more easily handled than on any other. It aid, however, that the weight which is attached to the variation in the the material, and the difference of the manner in which the work will done on the several lines, finds expression in the rates used in the esti- onclusion is that the work can be executed in less time after the right of way [illegible] secured on the lines following the Ogden Ditch and the canal [illegible] on any of [illegible] routes.

2.—RIGHT OF WAY.

In estimating upon the right of a way a strip 800 feet wide has been included, with some exceptions. A much wider strip for a part of the way between Ashland avenue and Kedzie avenue has been taken for Ogden Ditch, line No. 1, as it is deemed necessary in changing [illegible] the bed of the river to control completely the riparian rights, so far as they exist, [illegible] the West Fork.

On Ogden D[illegible] line No. 2, for a part of the way, only one side of the West Fork has been include[illegible]

In order that the canal line may be at no disadvantage with other lines, a strip has been included on both sides of the canal reserve as far as summit, giving a clear width of 1,000 feet, for the most part, between the railroad rights of way as now established. By the omission of the strip on the south of the canal reserve there will be [illegible] feet remaining for most of the way from Ashland avenue to a point one-quarter of a mile west of the center of section 8, and the estimated cost of the right of way will be reduced [illegible]00.

On the South Fork a[illegible] the South Fork and canal line the strip east of the [illegible] ally but 600 feet wide. There are, of course, other minor [illegible] be noted here. There is not, apparently, any reason wh[illegible] ticularly preferred over another, so far as the condemnation [illegible] concerned, except that with the canal line there will be a less[illegible] ners to deal with.

Should the sanita[illegible] s line with the consent of the canal commissioners there [illegible] within the limits of the canal reserve until the condemna[illegible] tional right of way shall have been closed, thus giving thi[illegible] e in time of beginning over any other. An increase of time al[illegible] e cost of the work, so that, notwithstanding more tenacio[illegible] consider that the cost of the work will be no greater per c[illegible] Ogden Ditch lines.

3.—[illegible]TERESTS.

The constructive cost of railroad changes, the building of bridges, interlocking, etc., is given in detail in the estimates. These amount in the aggregate for each route, respectively, to the following sums:

Ogden Ditch, route No. 1	$830,000
Ogden Ditch, route No. 2	830,000
Canal route	923,000
South Fork and Ogden Ditch route	1,095,300
South Fork and canal route	1,047,000
South Fork route	998,000

As it is impossible to infer from the above figures all the advantages and disadvantages which one route may possess over another, from a railroad standpoint, the following comparison is instituted for each railroad or group of railroads, separately:

Union Stock Yards and Transit Company; Chicago and Northern Pacific; Pittsburg, Cincinnati and St. Louis.—The main tracks of these roads, lying in adjacent and parallel lines, are crossed by all the routes in about the same manner, requiring for each a six-track swing bridge or its equivalent. The Ogden Ditch lines alone cross them where there are now swing bridges, hence the consequential damages and entailed expenses to the operating companies will be less along Ogden Ditch than any other route. It should be said, however, that as yet there are but few vessels passing the Western avenue bridges, and that should the main drainage channel take some other route than Ogden Ditch the conditions are not likely to change materially.

All the routes starting from the South Fork strike the Union Stock Yards and Transit Company's Yards in such a manner as to render rearrangement necessary. With the plan as projected for this rearrangement it is believed that no permanent injury would be done to these yards.

Chicago, Madison and Northern; Chicago, Santa Fe and California.—The main line of these roads would be crossed between Kedzie avenue and Summit by the Ogden Ditch line, and as now located by the canal line, half way between Ashland avenue and Western avenue. The canal line also crosses the branch road of the Chicago, Santa Fe and California Railway Company at the throat of the Corwith yards in such a manner as to be extremely damaging.

Ditch line also crosses the Santa Fe branch tracks north of Corwith, manner as to be particularly objectionable.

these obstacles in the way of the canal line it is proposed to change the these two roads from their present point of crossing eastward, keeping of the canal and crossing the South Fork north of the proposed entrance drainage channel, the new bridge crossing the South Fork thus becom- itute for the one now in use, and saving one bridge to these roads. To he crossing at the throat of the Santa Fe yards it is proposed to remove o the north of the main line, extending from Corwith to the Western In- and to dispense with the present yards.

th Fork and Ogden Ditch line crosses the Santa Fe at the throat of the cuts through property beyond in such a manner as to prevent a removal e as proposed for the canal line. It also crosses the main line in two places ching Summit.

th Fork and canal line and the South Fork line cross these yards in such a to damage them so seriously that it is considered necessary to provide for oval in the same way as proposed for the canal line. It may be said that various changes made as proposed, the Ogden Ditch route is the only one ill affect the Chicago, Madison a[illegible] Railway. In this case, how- injury done would be serious, o[illegible] radical change in the alignment, ting curves for a straight track, a[illegible]ell as introducing a swing bridge.

gden Ditch routes and the South [illegible]rk and Ogden Ditch route are the only ich really damage the Santa Fe R[illegible]road, except in crossing the old Grand ranch, the latter route being so ruinous in its effects as to practically be- ohibitory.

proposed change the Santa Fe system as a whole will be materially bene- the adoption of the canal route.

o, Alton and St. Louis.—This road [illegible] crossed only by the three South Fork In these cases the crossing is suc[illegible] to seriously interfere with the align- ad is very objectionable. The shi[illegible]f the tracks in the manner projected canal line would do this road no i[illegible] but, on the other hand, would ulti- greatly benefit it in a business wa[illegible]

go and Western Indiana Belt.—All t[illegible] routes cross this road in substantially e manner, leaving nothing to mar[illegible] preference for one route over another, hat the Ogden Ditch line comes a[illegible] bad point in the grade of the road.

go and Calumet Terminal.—The road is crossed in the same manner and at the ace by all the lines.

mary of the railroad bridges between Ashland avenue and Willow Springs arious routes after the proposed changes have been made is given in the fol- table:

railroad.	Name of route.				
	Ogden Ditch, 1 and 2.	Canal.	South Fork and Ogden Ditch.	South Fork and Canal.	South Fork.
,Cincinnati Louis.	Double track		Double track	Double track	Double track.
ock Yards nsit Com-	Four track	Six track	Four track	Four track	Four track.
and North- cific.					
Madison rthern.	Double track				
Santa Fe lifornia ine.)	...do		Two double track.		
Santa Fe ifornia, old l Trunk	Single track	Single track	Double track	Single track	Single track.
Alton and is.			...do	Double track	Double track.
and West- iana Belt.	Double track	Double track	...do	...do	...do
Terminal	...do	...do	...do	...do	...do

lusion of the railroad problem it may be said that the indirect damages al route" are at a minimum, while on the "South Fork and Ogden Ditch re at a m[illegible]um and next to prohibitory, so far as the Chicago, Santa ornia R[illegible] is concerned.

4.—VALUE OF ACQUIRED PROPERTY.

The number of feet of available water front which, on the lines and rights of way as proposed, will belong to the sanitary district between Ashland avenue and the west line of section 7, this side of Summit, and to which point it is proposed to keep the banks free of spoil, not including platted streets, railroad crossings, etc., are as follows:

	Linear feet.
Ogden Ditch, line No. 1	71,800
Ogden Ditch, line No. 2	67,200
Canal line	70,800
South Fork and Ogden Ditch line	73,700
South Fork and Canal line	71,800
South Fork line	69,900

From this it is seen that there will be but little difference in the value of the acquired property if the wide right of way be taken on the canal line; but should it be narrowed to 460 feet its value on this line would probably be reduced as much as 75 per cent.

5.—SUPPLEMENTAL WORK.

A comparison of the various elements coming under the first four heads affecting the choice of a route renders it apparent that, if nothing else were to be taken into consideration, the choice would inevitably fall upon the canal. Under this head, however, other considerations may affect the problem, but before entering upon them it should be premised that, so far as supplemental works east of Ashland avenue are concerned, there are practically but two routes, the group consisting of the two Ogden Ditch routes and the canal route constituting one and the three South Fork routes another; and, since all but the canal route from the first group and all but the South Fork and canal route from the latter have been eliminated, our further inquiries are concerned wholly with these two routes as affected by the works necessary to render the main channel fully effective.

It is essential to inquire into the sanitary condition and capacity of the Chicago River and its branches and to reach an understanding of the provisions which will be necessary to meet local sanitary needs when the city shall have grown to such magnitude as to tax the full-size channel as required by the sanitary district law.

SANITARY REQUIREMENTS.

Whichever route may be adopted for the main channel, the main river and the south branch will feel the direct effect of the current created thereby, though only the route leading from the South Fork will have a direct effect upon this filthiest of all stagnant pools. The canal route would produce no natural current through it unless supplemented with an inlet channel from the lake connecting with the South Fork through which a flow of water can be established. In lieu of this, resort must be had to intercepting sewers and a flushing conduit with pumping works.

To do the work thoroughly a circular conduit 12 feet in diameter would be required, the conduit and intercepting sewers being located as shown on the accompanying map. The intercepting sewers would collect all the sewage south of Thirty-ninth street, including everything from the stock yards and slaughterhouses, discharging directly into the conduit. In addition to the sewage the capacity of the conduit would be such as to provide for a change of water in the South Fork once every twenty-four hours.

In the Appendix is an estimate of the cost of such works with the cost of operation capitalized, which, including the latter, amounts to $646,280.

To meet the local sanitary requirements of the North Branch, the method now in use of flushing it by mechanical means will doubtless have to be continued, but in the near future this must be done on a much larger scale by means of an open channel or its equivalent, located farther north than Fullerton avenue.

The volume of water which must be passed through the South Branch, for the proper dilution of the sewage in the Branch itself, is an important element in this inquiry. To determine this some idea must be had of the population whose sewage is and will be, directly or indirectly, tributary to it.

The population whose sewage was, in 1890, tributary to the various branches of the river and that which is estimated will be tributary to it in about twenty years city shall have reached a population of 3,000,000 and the sewage draining ıke shall have been turned to the river, are as follows:

	1890.	Population, 3,000,000.
ch	345,000	1,000,000
	87,000	700,000
ɜh to Bridgeport	277,000	
	152,500	500,000
	145,000	700,000
gan	151,000	....
l	46,500	100,000
	1,204,000	3,000,000

course impossible to predict with assurance at what points in the river the :ontamination will occur from sources other than that of population, om present indications it is safe to assume that the stock yards and packtries will remain where they are, so far as they may not be transferred to and this, as is well known, is the one great source of river pollution. ɪe facts it appears that 300,000 cubic feet per minute, or thereabouts, will for dilution in the South Branch of the river, with even a less relative han that specified in the sanitary district law.

CAPACITY OF THE CHICAGO RIVER.

t guide to the amount of water which it is possible to draw through the River and its branches, either in its present condition or with modifications, l by gauging of the river made during the late flood from May 6 to May ıd similar ones made by the Drainage and Water Supply Commission of n February, 1887. From these measurements it was found that the maxiharge through the South Branch was, at 5 p. m. May 6, 1892, 420,000 cubic ıinute, and on February 10, 1887, 422,000 cubic feet per minute, the former near Eighteenth street and the latter at Kedzie avenue.

ɛimum discharge through the North Branch occurred May 5, 1892, and from . m., and probably amounted to 200,000 cubic feet per minute. The dis- the time measurement was made, 11:30 a. m. of the 6th, was 184,000 per minute. For the 1887 flood the maximum was 125,000 cubic feet per ı Feburary 10, the former measured at Clybourn place and the latter at 'ille.

ximum discharge from the main river was, approximately, as follows (some being made for water that reached the river below the point of measuren May 6, 1892, 584,000 cubic feet per minute and on Feburary 10, 1887, bic feet per minute.

300,000 cubic feet per minute through the South Branch with the conditing on May 6, 1892, required a fall for different reaches as follows:

Reach.	Distance.	Total fall.	Slope per 1,000 feet.
	Feet.	*Feet.*	*Feet.*
to Sixteenth street	9,200	1.04	0.113
treet to Harrison street	5,600	0.53	0.095
reet to Lake street	4,200	0.98	0.233
to Lake street	19,000	2.55	0.134

ocities which obtained at various places on the South Branch on May 6, at flood, when 420,000 cubic feet of water per minute was flowing, ranged feet per second in the wider sections of the river to 5.18 feet per second the cofferdam of the West Division Street Railway Company near to Van eet; and for 300,000 cubic feet discharge per minute the velocities at the es were 1.96 and 3.91 feet per second respectively.

ximum discharge through the main river was, as above given, approxi-4,000 cubic feet per minute, and occurred on May 6 from 11:30 a. m. to 5 p. which time the average total fall from Lake street to the mouth, a dis-,200 feet, was 1.02 feet, or 0.141 per 1,000.

observations and other information, I conclude that to preserve safe and easy navigation of the Chicago River the velocity should not exceed 1½ miles per hour, or 2.2 feet per second.

To get 300,000 cubic feet per minute through the South Branch of the river with this limit of velocity will require material changes. North of Sixteenth street, except at bridges, it can be accomplished by deepening the river to 17 feet in the narrowest places and to a less depth in the wider places. At all bridges, except at Adams, Jackson, and Polk streets, and at the Wisconsin Central Railroad bridge, it can be accomplished by deepening to 18 feet. At Adams and Jackson streets it can be done by opening new passages for water west of the center piers. At Polk Street and the Wisconsin Central Railroad new bridges will be required, or some radical modifications giving an increase in the water passages. South of Sixteenth street it will be necessary to resort to a more general widening, deepening, and redocking of the river on one side and the building of new bridges.

In the event of the adoption of the South Fork and Canal route this general widening must be carried to Thirty-fifth street and the deepening made clear through to the entrance to the main channel.

To pass 600,000 cubic feet per minute through the river all the bridges would have to be rebuilt or additional passages provided around their abutments, the main river deepened and perhaps widened in places, and the South Branch throughout radically widened and deepened. Such an undertaking would be formidable and can only be justified as a last resort or on the grounds of a necessary harbor improvement after every other available means of securing such an improvement shall have been shown to be impracticable and unattainable.

ADDITIONAL SUPPLY OF WATER.

The question of securing an inlet for an additional 300,000 cubic feet of water per minute may be considered wholly with reference to sanitary requirements, all collateral benefits and advantages in this way of improved navigation, enlarged harbor facilities, and the possible relief from the downtown bridge nuisance being ignored; or all of these things may be taken into account and that solution of the problem predicted which will most inure to the general good, not only of Chicago in its dual corporate capacities as city and sanitary district, but to the people of the State and the United States.

While it may not be the province of the sanitary district, strictly speaking, to make any provisions for navigation other than that rendered obligatory by law, or to provide harbor facilities for the city of Chicago, it does seem not only within its province, but at least morally binding upon it, so long as these problems are pressing for a solution and all matters pretaining thereto are in a formative stage, to shape the work in hand as to render coöperation between it and other governmental agencies possible in carrying out supplemental works, as only by such coöperation is it possible to secure the best sanitary, financial, and constructive results. Working upon this theory I shall discuss the questions of supplemental channels and inlets in their relation to the two routes under consideration for the main channel, from two standpoints: (*a*) Strictly from the narrowest sanitary point of view, confined to the sanitary district as such. (*b*) With reference to the broadest sanitary, commercial, and political interest of this community and of the country at large.

(*a*) But for the southern boundary of the sanitary district being Eighty-seventh street, thus placing limitations upon the sanitary problem of the city, it would be obligatory to consider a supplemental channel entering the South Fork from the mouth of the Calumet River, which would intercept the sewage that finds its way into the lake from that source, such channel being made to furnish the additional supply of water and to provide main drainage for that part of the city comprising the old town of Lake and the southern part of Hyde Park. But omitting this because of the omission of the southern part of the city from the sanitary district, we have to consider under this head only the cheapest possible way of obtaining 600,000 cubic feet of water per minute from the lake and the best location of the main channel west of Ashland avenue to adapt it to the lake inlet.

As has already been pointed out, provisions for obtaining 300,000 cubic feet per minute through the South Branch north of Sixteenth street can be made at a comparatively small expense. Another 300,000 cubic feet per minute can be obtained by gravity through a covered conduit laid from the lake to the river along Sixteenth street. Such a conduit, including intake, would be about 4,000 feet long and would need a cross section of about 1,250 square feet. It could probably best be constructed as a twin conduit. To permit of its construction it would be necessary to condemn a strip of property 50 feet wide along the south line of Sixteenth street, which property, after the construction of the conduit, would be as valuable for building sites as now.

The South Branch, south of Sixteenth street, would have to be improved to

The three principal considerations justifying this are as follows:
city of Chicago is confronted with the commercial situation of having at low
a harbor that will barely admit vessels drawing 14 feet of water. The pres-
:bor is too narrow, too shallow, and too tortuous to admit the class of vessels
are fast taking to themselves the carrying trade of the lakes. Vessels nearly
t long and that now carry from 2,000 to 3,000 tons, with present harbor facil-
id depths of channels at the St. Clair River Canal and the Lime Kilns, would
led to 18 to 20 feet draft and carry from 3,000 to 5,000 tons if sufficient depth
ailable. The shallow places throughout the lakes and the Sault Ste Marie
are being improved and deepened by the United States Government to 21 feet.
this work is completed, which will be done in a few years, Chicago's commer-
terests will be seriously threatened if a more adequate harbor is not provided.
y cheaper lake freight rates prevail between Duluth and Buffalo on both grain
al than between Chicago and Buffalo, notwithstanding 111 miles greater dis-
o Duluth and the necessity of passing the Sault Lock.
n, the United States Government is committed to improved navigation of the
River, by reason of the money already expended thereon, and that which is
being expended upon the Hennepin Canal. The sanitary district channel will,
bly, be the most important link in this chain of waterways, and Government
ts will demand a suitable lake connection.
third consideration is found in the urgent need of relieving street traffic in
itral part of the city from the incubus of movable bridges. The injury that
ridges are to business interests is beyond computation and too evident to need
han a mention here.
ving, as I do, that these considerations will, by the time the main channel is
ted from Ashland avenue to Joliet, force the recognition of the necessity of
rbor entrances, it is impossible to consider as final any plan for a new inlet
e lake to the river except one that will answer the three-fold purpose of sani-
a harbor entrance, and an outlet for what I believe will become a great in-
aterway. Hence we have to inquire which of the two routes under consid-
is best calculated to fit any possible location for such a channel. If the
l from the lake should connect with the South Branch north of Bridgeport, or
the river itself be deepened and widened throughout so as to give ample
ty for all purposes, then the "canal route" will obviously be the best that can
sen.
he other hand, should the new channel enter the South Fork at its southern
ity, then the "canal route" would not connect so directly with the lake as
South Fork and canal route," but it would cost no more to pass the water
rard than southward through the South Fork to the main channel, and in
case the intercepting system and flushing conduit would be dispensed with.
ould be said that, on the theory herein advanced, the Chicago Harbor will be-
he terminus of lake commerce on the one hand, and of river and inland com-
on the other, and not a mere short cut for vessels passing from the lakes to

My conclusion then is that there is but little choice between the two route the main drainage channel west of Ashland avenue, as far as any possible connec with Lake Michigan is concerned, and as every other consideration points to "canal route" as the preferable one, I believe there can be no doubt about advisability of adopting it.

The reasons for this conclusion may be briefly recapitulated as follows:

(1) On a like basis as to right of way it is shown to be $1,058,901 cheaper than next cheapest route, and by sacrificing certain prospective advantages in the wa dockage it may be made $1,963,901 cheaper than the next cheapest possible route

(2) Work can be begun on it immediately, quite likely saving a full year in t

(3) With the changes proposed it is open to less objection from a railroad st point than any other route.

(4) Should supplemental works to supply water to the main channel be car out in accordance with the narrowest requirements, it is located in the best posi to command the situation. On the other hand, should they be projected on broadest lines, it still meets the situation as fully as any other location.

FLOOD WATERS.

In order that the estimates for the main channel between Ashland avenue Willow Springs may cover all collateral works, it is necessary to deal with flood-water question and its relation to the main channel. This involves a consi ation of (1) the sanitary question of Chicago as affected by floods; (2) the disposi of the Des Plaines and Chicago rivers flood waters.

(1) The protection of Chicago's water supply from sewage pollution is by far most important phase of the sanitary question. The greater or less dilution of sewage, so long as it is confined to the Chicago River or to the main drainage ca is to the people of this city of little moment compared to the importance of kee sewage, even in small quantities out of the lake. The reasons for this are too pable, too well known and acknowledged to need stating here. Hence, from inception of the project for the sanitation of the city via the Des Plaines and Illi rivers until now, every fair mind that has intelligently approached the subject recognized that the prevention of all flood-water discharge from the Chicago R into the lake is a *sine qua non* of the plan.

(2) Owing to the relations which the upper Des Plaines River, when in flood, tains to the Chicago River, and the occupancy of the lower Des Plaines River Va with the main drainage canal, the plans of the Chicago Drainage and Water Su Commission provided that the flood water from 440 square miles of the Des Pla Valley and from 120 square miles of the North Branch of the Chicago River wa be turned to Lake Michigan through cut-off channels uncontaminated with sew thereby reducing the flood volume from the combined catchment basins of the rivers, of which 400 square miles would remain, to such proportions that a chann the capacity proposed, viz, 600,000 cubic feet per minute, would prevent an out from the Chicago River into the lake. By such an arrangement the Des Pla River could be taken into the main drainage channel at Summit with impunity.

This method was then, in the absence of much knowledge which has since l gained of the Des Plaines and Illinois rivers, apparently the best and safest for acc plishing the end in view.

The further study which has been given to the subject in connection with the tail location of the main drainage channel has convinced me that a cheaper and haps equally safe method is to call into service the combined capacity of the Plaines River and the main drainage channel beyond Summit to carry off the fl of the Des Plaines and Chicago rivers.

During the late flood of May 6 there was a maximum of 606,000 cubic feet minute passed through the Des Plaines River below Riverside, and on February 1887, a maximum of 620,000 cubic feet per minute. On April 21, 1881, the wate the place where these measurements were made reached 1.4 feet greater height, w indicated a discharge of 810,000 cubic feet per minute. Of this amount at least third, and perhaps a greater proportion, passed down the Des Plaines River be Summit. By the removal of a few obstructions, and a little forcing by raising height of floods slightly at Summit, there seems no reason to doubt that the Plaines River itself can be made to carry 400,000 cubic feet per minute from Sur down, leaving about the same quantity to be taken into the main drainage cha at Summit. If this can be done without setting the water toward the lake at point in the Chicago River, then the flood waters will have been provided for s as furnishing a channel for them across the divide is concerned.

The watershed of the North Branch of the Chicago River comprises 172 sq miles, and other portions of the river, including the South Fork, the West I et, the surplus flood waters of the Des Plaines River. The combined of the Des Plaines River and the main drainage channel when in flood, lake at mean height, will be upwards of 1,200,000 cubic feet per minute. ot prepared to say, finally, that it will be permissible to turn such an amount into the Des Plaines River below Joliet, a more extended investigation and a study of the problem being first necessary. The following facts and cons, however, seem to indicate the practicability of such a thing.

g the May flood, which was unusually heavy along the river above Joliet, ssed through Joliet approximately 625,000 cubic feet per minute; this excurred, however, more than twenty-four hours before the Upper Des Plaines its maximum. At Morris the maximum discharge of the Illinois River, as ied by gaugings made by the Engineering Department on May 6, was 4,416,- c feet per minute, and it occurred the same day that the Upper Des Plaines nit was at its highest, showing that at this place the maximun was due to urces of supply than the Upper Des Plaines. From Lasalle to the mouth, r at flood times spreads out to such wide proportions that the maximum dis- t Grafton was not attained until about May 23, seventeen days later than at

Owing to the equalizing tendency which these facts exhibit as the regimen llinois River, it seems evident that the floods from the Des Plaines River ummit are not likely to affect extreme floods in the Illinois River other than nging them; the additional amount of water which may be added by the ainage channel and the upper Des Plaines in the manner described having e if any effect. Hence, I believe it may safely be said that whatever damme in the Illinois Valley by water discharged from the sanitary district chan- occur at intermediate stages with nothing more than the normal flow of nage channel combined with medium floods in the Illinois River. But even treme floods of the Illinois River should be slightly increased, it should be ered that, after land has been overflowed, to add a few inches more or less to rincumbent water would do no harm; it is the first flood that does the damage. consideration is that the modifications of the river that will be necessary to the normal flow of the drainage channel will be sufficient to prevent any of extreme flood heights, even with the floods of the Upper Des Plaines added. in providing for mean and frequently recurring conditions the maximum equently recurring conditions will be amply met.

h it is still an open question, I think the probabilities are all in favor of the posed being equally safe and cheaper than any northern diversion as a means enting a flow of the Chicago River to the lake, the money which such a di- would cost being better applied in down-river improvements and modifica- It can also be much more expeditiously put into operation. By the time of pletion of the main drainage channel conditions may have been created, in ner proposed, that will effectually put a stop to the contamination of Lake n through the Chicago River.

hatever subsequent investigations may show relative to this matter, there is

Appendix.—Estimates Ogden Ditch, Line No. 1.

Capacity, [illegible] cubic feet per minute:		
[illegible] cubic yards earth, at 18 cents	$2,884,320	
[illegible] cubic yards glacial drift, at 27 cents	2,057,400	
[illegible] cubic yards rock, at $1.25	250,000	
		$5,1[illegible]
Bridges and railroad changes:		
[illegible] South Branch, Union Stock Yards and [illegible] Company, Chicago, and Northern Pacific, Pittsburg, Chicago and St. Louis Railway	177,000	
[illegible] South Branch, Union Stock Yards and [illegible] Company, Chicago and Northern Pacific, Pittsburg, Chicago and St. Louis Railway	109,000	
[illegible] Southern Branch, Chicago, Santa Fe and [illegible] Railway	66,000	
[illegible] Southern Branch, Chicago, Milwaukee and Northern Railway	146,000	
[illegible] Southern Branch, Chicago and Western [illegible]	122,000	
[illegible] Southern Branch, Chicago, Santa Fe and [illegible] Railway	105,000	
[illegible] Southern Branch, Chicago and Cali[illegible] Railway	105,000	
		83[illegible]
[illegible] highway swing bridges		18[illegible]
[illegible]		4[illegible]
[illegible] per cent on construction		15[illegible]
[illegible] of right of way		5,70[illegible]
Total		12,09[illegible]
Capacity, [illegible] cubic feet per minute:		
[illegible] cubic yards earth, at 18 cents	1,841,760	
[illegible] cubic yards glacial drift at 27 cents	1,310,040	
[illegible] cubic yards rock, at $1.25	250,000	
		3,40[illegible]

JJ 5.

[illegible] LA GRANGE LOCK AND DAM, ILLINOIS RI[illegible] ILLINOIS.

[illegible] appropriation for "operating and care of ca[illegible] [illegible] as provided by section 4 of the r[illegible] [illegible] the La Grange Lock has been oper[illegible] [illegible] the past fiscal year.

[illegible] navigated or propelled by steam have b[illegible] [illegible] Consequently the lockages for the past y[illegible] [illegible] a large decrease.

[illegible] passing the lock was tripled du[illegible] [illegible] increase in size of vessels.

[illegible] were made to lock gates and mac[illegible] [illegible] constructed above the lock; 212 lin[illegible] [illegible] were constructed along the land ab[illegible] the entrance to the lock, and all buildings and wood and iron w[illegible] about the lock kept well painted.

The lock force, when not engaged in operating the lock, were kep[illegible] work in constructing the revetments, grading and improving [illegible] grounds, and repairing, painting, etc., the appointments of the loc[illegible] mount expended during the year was $8,004.06, a detailed state- which, in accordance with the act of July 5, 1884, is herewith. port by Assistant Engineer C. V. Brainard, hereto attached, gives ed account of all work done at this lock during the year ending , 1892.

during the fiscal year ending June 30, 1892, from the indefinite appropriation erating and care of canals and other works of navigation," in operating and keep- epair the La Grange Lock on the Illinois River.

of lock-tenders and watchmen		$3,929.93
of crews of dredge and tender		567.17
dredge and tender		267.75
nce—		
or		239.72
es		35.20
supplies for lighting lock		25.84
to pump dredge		270.34
neous repairs to plant—		
or		13.50
erials		36.61
		92.48
gal pump		755.00
outfit for dredge		14.90
int, etc., for repairs to lock gates		201.62
s for lock pumps		23.90
g pile revetments above and below lock:		
or	$429.14	
erials	118.59	
		547.73
, rubblestone, piles, and drift bolts for building ice crib		736.76
ing ice, labor		135.35
telephone		31.25
ng expenses		64.68
and express charges		14.33
otal		8,004.06

Money statement.

1891, balance unexpended (reported outstanding June 30, 1891) ..	$834.47
, 1891, allotment	10,000.00
	10,834.47
, 1892, amount expended during fiscal year	8,004.06
1892, balance unexpened	2,830.41
1892, outstanding liabilities	238.00
1892, balance available	2,592.41

REPORT OF MR. C. V. BRAINARD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Kampsville, Ill., June 30, 1892.

AIN: I have the honor to submit report for the operating and care of La- Lock, Illinois River, for the year ending June 30, 1892.

g the year 218 lockages were made, exclusive of boats on this work and skiffs. the high water the past spring 81 steamboats passed over the dam, which, o the number of lockages, makes 299. This shows a decrease of 91 as com- rith the same class of boats last year. This is due to the extreme low water ember, October, and November, during which time the mean stage of water 5 feet as against 1.50 feet above low water in 1890 during the same months. iver was closed by ice during the month of January. During the months of er, January, and February, except for a few days in January, the lock force was reduced to the overseer and two watchmen. About 300 tons of ice was put by the lock force.

A scoop shovel was rigged with a long handle and mounted on a pair of shears [illegible] removing the deposit from the gate recesses. About 9 cubic yards were removed [illegible] this way.

Thirty-five piles, to be driven as guide piles below the land wall, were cut and floated to the lock by the lock force during the high water in May. When not engaged in operating the lock the force has worked on the revetments above the lock, the ice-protection crib, and keeping the dam cleared of drift.

Repairs.—A new nosing was put on the upper gate. The decking on the lower gates was renewed and calked. Fifteen long anchor rods were put in the revetment below the lock. The valves of the upper gates not working properly, they were examined by a diver, and by removing some shims below the pinions, the pinions and segmental gear were made to mesh properly.

A revetment 212 feet long was built above the land wall of the lock, containing [illegible] piles, of which 23 are anchor piles, 204 Wakefield sheet piles, 26 tie rods, 440 lineal feet of 6 by 12 inch oak wales, and 220 lineal feet of 10 by 10 inch pine wales. The angle where the revetment joins the return wall of the lock was filled with [illegible] stone.

An ice-protection crib was built above the river wall, the top being 14 feet above low-water surface above the dam and on a level with the top of the lock walls; [illegible] piles, 300 linear feet of 4 by 8 inches oak wales, 6,000 feet B. M. 3 by 12 inches pine lumber for sheet piles, 5,840 feet B. M. 10 by 10 inches pine lumber, 6,800 feet B. M. [illegible] inches pine lumber, 40 ½ by 18 inch drift bolts, 400 ½ by 16 inches drift bolts and 120 cubic yards of rock filling were used.

Dredging.—The last of August, Dredge No. 1, steamer *Enterprise*, and three dump scows were taken to La Grange Lock to dredge the entrances to the lock. The depth dredged in the lower entrance was 5.4 feet and in the upper entrance 6.3 feet. Five days was spent in casting back of the revetment below the lock and three days casting back of the revetment above the lock.

Two thousand two hundred and eighteen cubic yards of material were removed from the entrances, 190 cubic yards of it being from above the lock and the remainder from below the lock. Seven hundred and fifty-seven cubic yards of this material was handled a second time in putting it back of the revetment above the lock. The remainder was dumped on the east side of the river below the dam. October [illegible] dredging was discontinued and the fleet laid up. Steamer *Enterprise* started for [illegible] but grounding at Meredosia, lay there in charge of a watchman [illegible] was sufficiently to float her, when she was taken back to La Grange [illegible] and three dump-scows were taken to Kampsville Lock.

[illegible] remains to be done: Build permanent quarters for lock-keepers [illegible] of filling around the superintendent's house; 2,500 cubic [illegible] below the dam, and drive a row of guide-piles below the [illegible]

[illegible] respectfully, your obedient servant,

C. V. BRAINARD,
Assistant Engineer.

[illegible] made at La Grange Lock, 1891–'92.

[illegible]	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May.	June.	Total.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......	3	30	24	2	1	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......	......	25	40	5	......	[illegible]
[illegible]					1	......	......	......	......	......	......	[illegible]
[illegible]						[illegible]	5	3	......	......	......	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7	1	[illegible]

[illegible] boats passed over the dam during high water.

[illegible]	Steamboats.	Barges.	Total.
[illegible]	[illegible]	9	[illegible]
[illegible]	30	24	[illegible]
[illegible]	44	20	[illegible]
[illegible]	81	53	[illegible]

nnage passing La Grange Lock during the year ending June 30, 1892.

ass.	Passed through the lock.				Passed over the dam.		
	Registered tonnage.	Freight.	Passengers.	Stock.	Registered tonnage.	Freight.	Passengers.
		Tons.		*Head.*		*Tons.*	
....	37,585.91	2,144	973	219	23,973.29	14	355
....	47,430.00	33,455	....	....	29,681.00	6,900	....
....	85,015.91	35,599	973	219	53,654.29	6,914	355

List of steam vessels passing La Grange Lock 1891-'92.

.	Registered tonnage.	Name.	Registered tonnage.	Name.	Registered tonnage.
....	466.75	H. W. Longfellow ..	40.00	Polar Wave	150.00
....	5.00	Rackett	57.80	D. M. Schmoldt.....	13.00
....	77.16	New Idea	176.00	Joliet	75.00
n	10.00	Dick Clyde.........	76.00	Josie..............	237.51
....	20.00	Verona.............	10.00	Grey Eagle.........	
....	300.00	Borealis Rex	116.13	City of Peoria......	128.00
wa	10.00	Magnet	42.30	White Eagle	312.75
som.....	35.00	City of Brunswick .	77.01	Rescue.............	139.30
ence.....	358.00	Ida Morse..........	10.29		

J J 6.

ILLINOIS AND MISSISSIPPI CANAL.

bject of this improvement is to furnish a navigable waterway ke Michigan to the Mississippi River at the mouth of Rock connection with the upper Illinois River, and the proposed l waterway along the present line of the Illinois and Michigan

ver and harbor act of September 19, 1890, contained the first iation for beginning the construction of this canal.

reference to this work it is to be said that various surveys of routes from the great bend of the Illinois River to the Missis- ver at or above the mouth of Rock River have been made: In P. Low (Report Chief of Engineers, 1871, page 303); in 1882, Benyaurd (Report Chief of Engineers, 1883, page 1757), and in ajor Handbury (Report Chief of Engineers, 1886, page 1707).

was also a report upon this canal by a Board of Engineers in der the provisions of the river and harbor act of August, 1886 Chief of Engineers, 1887, page 2125). All of the local engi- nd the Board of Engineers of 1887, for engineering reasons, eferred and recommeded the Marais d'Osier route, but for com- reasons the Chiefs of Engineers, Generals Newton and Duane, Secretaries of War preferred the Rock Island route, and that s been finally adopted.

led plans and estimates based entirely upon preliminary sur- nder the act of August 11, 1888, were prepared and submitted gress June 21, 1890, the report of which location, plans, and s (without maps and drawings) were submitted June 21, 1890, blished as House Ex. Doc. No. 316, Fifty-first Congress, first

report was the basis evidently of subsequent appropriations.

r the requirements of the act of September 19, 1890, it was ended by this office and approved by the Chief of Engineers, reasons given in the report of the Chief of Engineers, 1891, page at work upon this improvement should begin at the mouth of and that the appropriation be expended at that point.

Repairs.
gates was
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The angle
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dredge
Very resp

on the enumeration, among works of navigation required for by the act of September 19, 1890, of "bridges" to be con- it was inferred by the United States.
on the provisions of the river and harbor act of July 5, 1884, , making an indefinite appropriation for the "operation and nals and other works of navigation."
protracted investigation the Secretary of War decided that he laws of the United States he was not authorized to enter h an agreement, and directed that the lands of this railroad be condemned for the purposes of the canal.
ards on application by the district attorney for the northern of Illinois that the basis of condemnation be specified, *i. e.*, character of bridge to be constructed by the railroad company, fixed or swing, as well as other description, be indicated, it ered by the Secretary of War in effect that the general laws to bridges in the river and harbor act of September 19, 1890, ner acts, applied in this case and that he was not authorized to indicate what bridge would be permitted to be constructed ntained over the canal by the railroad company.
atter again came up before the United States district court at g term, 1892, but as no basis of condemnation of a right of oss the public highway, except an unconditional crossing by a 0 feet wide at the water surface, and 7 feet deep, or 14 feet be- level of the tracks of the railroad, could be presented under the of the Secretary of War by the United States, the court con- he case, and intimated that until the United States officers ecify a basis of joint user over the joint crossing that the case e indefinitely continued, or that the jury would be instructed s the award for the land and damages at the full value of the land and Peoria Railroad, less the proved value of their lands perty for other purposes than as a public carrier between Rock nd Peoria. The case thus stood at the close of the fiscal year. ver and harbor bill pending at the close of the fiscal year end- 30, 1892, contains a provision that specifically defines the greement or condemnation in all such cases, and if passed will he otherwise insurmountable obstacle to the construction of l indicated by the ruling of the Secretary of War and the atti- he United States district court for the northern district of Illi- re which court all condemnation suits will be tried.

PROPOSED APPLICATION OF FUNDS ON HAND.

ds now on hand will be applied to the payment of expenses with the legal proceedings in acquiring right of way around rapids of Rock River, near its mouth, and to purchasing the plant, and constructing the works of navigation in the vicin- l rapids.

APPLICATION OF FUNDS REQUIRED FOR THE FISCAL YEAR ENDING JUNE 30, 1894.

plied, if appropriated, to the definite location ed route, to the fixing of landmarks, and to ons of lands required for rights of way; to and towards the construction of the canal ion along the line as far as may be deter-

LOCK PIT AND FOUNDATION LOCK 37.

Name and address of bidder.	Earthwork.	Material.	Totals.
n Killeen, New Liberty, Iowa	$49,392.00	$11,738.00	$61,130.00
Irew J. Whitney, Rock Island, Ill.*	8,643.60	8,975.00	17,618.60
coxon, Quigley & Moore, St. Louis, Mo	14,076.72	10,474.50	24,551.22
Heidenreich Co., Chicago, Ill	22,226.40	14,143.00	36,369.40

* Lowest bidder.

LOCK PIT AND FOUNDATION, LOCK 36.

Name and address of bidder.	Earthwork.	Material.	Totals,
n Killeen, New Liberty, Iowa	$4,083.30	$10,845.00	$14,928.30
nroe & Richardson, Portsmouth, Ohio*	2,631.46	9,825.40	12,456.86
lcoxon, Quigley & Moore, St. Louis, Mo	3,992.56	9,390.10	13,382.66
Heidenreich Co. Chicago, Ill	4,537.00	12,114.90	16,651.90

* Lowest bid.

LOCK PIT AND FOUNDATION, GUARD LOCK.

Name and address of bidder.	Earthwork.	Rock.	Totals.
chael H. King, Des Moines, Iowa*	$3,107.52	$5,215.00	$8,322.52
vid Sears, Rock Island, Ill	1,434.24	7,748.00	9,182.24
in Killeen, New Liberty, Iowa	4,183.20	11,920.00	16,103.20
nroe & Richardson, Portsmouth, Ohio	2,988.00	5,960.00	8,948.00
lcoxon, Quigley & Moore, St. Louis, Mo	4,661.28	13,410.00	18,071.28
e Heidenreich Co., Chicago, Ill	2,988.00	6,705.00	9,693.00

* Lowest bidder.

REPORT OF MR. L. L. WHEELER, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Milan, Ill., June 30, 1892.

TAIN: I have the honor to submit the following report upon the work on the is and Mississippi Canal, under my own immediate supervision, for the fiscal nding June 30, 1892:

he beginning of the year the force was mainly occupied in preparing plats re- to right of way and in continuing survey of Rock River. Plats of proposed ng of Rock Island and Peoria Railway were drawn, and general information in l to ownership of lands compiled for use of United States district attorney. of witnesses were prepared and evidence given in suit for condemnation of

survey of Rock River was carried up to the mouth of Green River, but above e Bridge no topographical work was done on either bank. The notes of the y between Carrs Island and Moline Bridge were platted, the map completed raced.

econnoissance of the Feeder line was made and an alternative route surveyed e main line in the vicinity of Wyanet.

surements of seven bridges over Rock River were taken and estimates made of f raising four of them to give greater clearance at high water.

eries of measurements of the discharge of the several channels of Rock River r water were made in September, 1891. The method of measurement was by and rod floats, the water being too shallow to permit the use of a current companying this report is a table giving the results for the stream as meas- Carrs Island, where all of the water flows in one channel.

aphical survey of the Mississippi River in the vicinity of the mouth of as made in September, and a map made showing depths at low water.

erence with a committee representing the Business Men's of Rock Island.

rnoon the Board met at Milan, Ill., in accordance with the of the order, and also examined on the ground the so-called oute" for the canal. Milan proved to be an inconvenient e meetings of the Board; consequently, authority was office of the Chief of Engineers to hold the subsequent Rock Island, which was duly granted.

on of Tuesday, September 8, was devoted to the examinas relating to the duties assigned the Board, and to further committee of the Rock Island Business Men's Association, noon to an inspection of the depression east of the ridge ettifers Slough, where it has been proposed to locate a harbor and accomodation of boats while laid up or while ransferring cargoes. It is also claimed that a basin at this ecessary adjunct to the transfer of freight from land to ortation.

vritten invitations were extended to the Business Men's of the cities of Rock Island, of Davenport, and of Moline, W. H. Gest, J. T. Robinson, esq., and to the Sears Brothers, lication in newspapers, to the public generally, to meet the rooms of the first-named organization, on Wednesday the purpose of publicly discussing the questions involved.

day of Wednesday was occupied in such discussion; e freely invited and everyone present was not only perxpress his views but encouraged to do so. Rock Island ort were represented at this public meeting, but, so far as ned, Moline took no notice of the invitation.

lay, September 10, the Board proceeded to Milan, Ill., and e entire extent of the so-called "Southern route," from its ntrance into the Mississippi River at the principal mouth er.

time until the date of adjournment, September 12, 1891, as engaged in considering the matters committed to them, on Friday some time was allotted to an interview with the ners of property situated along the line of the Northern ade oral offers as to the prices they would be willing to ght of way.

DESCRIPTION OF THE LOWER REACH OF ROCK RIVER.

about 3 miles from the Mississippi, and just above the ower Rapids, Rock River divides into two channels, which ssissippi through separate mouths. The lesser channel, is outh Slough, and joins the Mississippi about 2 miles betion of the principal streams. The low-water discharge of as measured for the Board on September 4, 1891, is about at of Rock River.

outh Slough and the larger branch of Rock River lies Big ral square miles in extent, parts of which are overflowed at rom a few inches to 10 feet or more in depth. The centhis island, however, embrace a very considerable area d ground above high water, and the greater part of the ricultural purposes.

Island, the foot of which marks the downstream tion which causes the lower rapids, the main stream of the river is much obstructed by sand bars. Turkey Island, doubtless one of these bars originally, subdivides this channel into unequal chutes, the lower junction of which lies some 4,000 feet above the confluence of this branch with the Mississippi.

Lying within the angle between the principal branch of Rock River and the main channel of the Mississippi, on the right bank of the former and east or left bank of the latter, lies Pettifer Island, a triangular formation having sides one-half mile or more in length, and a surface which is overflowed at high water. It is separated from the mainland by a narrow channel, 100 feet in width, more or less, through which the direction of flow is variable, depending upon the relative stages of water in the two rivers; flowing in toward the Mississippi whenever Rock River is the higher and in the contrary direction whenever the conditions are reversed.

MOUTH OF ROCK RIVER.

From the foregoing general description it may be said that Rock River enters the Mississippi through three mouths, two of which, however, are insignificant at low stages. These channels form a delta some 3 miles, more or less, in extent, measured along the bank of the Mississippi. It would therefore seem that any proper location of the western terminus of the Illinois and Mississippi Canal, on the Mississippi front of the delta described, would comply with the requirements of the act of September 19, 1890, which directs that the western terminus be "at the mouth of Rock River."

Considering the law in the light of the plans and estimates submitted to Congress under date of June 27, 1890 (House Ex. Doc. No. 429, Fifty-first Congress, first session), and upon which this item in the act of September 19, 1890, was probably based, the Board is of the opinion that only the principal mouth of Rock River was contemplated by the act referred to. In this the Board is sustained by the opinion of Mr. Gest, as expressed at the public hearing. Moreover, the Board is of the opinion that, whether the principal mouth of Rock River was especially contemplated by the act or not, it is the best for the purpose, because it is easier of approach by Mississippi River boats than any other, has as good depth of water as any other, and, at sufficient stages of water, affords a secure harbor (under the lee of Pettifer Island), and that it should therefore be accepted as the mouth prescribed by the law, unless it should appear that commercial conditions require the establishment of the terminus at another point, or should no controlling reason to divert it therefrom become apparent.

INCEPTION OF THE SOUTHERN ROUTE.

The "location, plans, and estimates," prepared under the direction of the Secretary of War, in accordance with the act of August 11, 1888, provided for attaining the terminus by passing around the lower rapids of Rock River by canal and slackwater navigation along the northern shore.

The dams pertaining to this route were indicated at the lower end of Vandruff Island and extended across all arms of Rock River. The canal portion of this route terminated near the foot of Turkey Island; thence to the mouth of Rock River it was proposed to improve the open river by wing dams and resulting scour.

The memoir, or report, accompanying these plans (House Ex. Doc.

, Fifty-first Congress, first session, page 4) states with reference to —

Early in the progress of the present investigation it was seen that the previous surveys * * * were not in sufficient detail to allow definite and final plans. * *

When the work is definitely undertaken the vicinity of this line must be further examined, to better, if possible, the location shown upon the maps. * * *

After the passage of the act further examinations were made, as suggested in the report, and the fact was then revealed that the plan, referred to above, for passing the lower rapids of Rock River required modification to the extent that the dams across the south arm of Rock River must be placed at the head of the rapids instead of at the foot, as indicated, and still later it became doubtful if the proposed improvement of the last reach of Rock River would prove successful on account of the apparent small discharge.

Then, still further examination discloses a practicable route upon the south side of Rock River that was thought to possess marked advantages over the improvement as planned along the north bank. This route was therefore recommended by Capt. Marshall, under date of March 19, 1891, and it was formally approved by the Secretary of War March 25, 1891.

As far as known to the Board, the location, plans, and estimates accompanying the executive document above referred to (No. 429) were never formally approved by the Secretary of War, and if that be the case, it may be said that the only part of the Rock Island route for the Illinois and Mississippi Canal (which was designated by him as the one to be followed in preparing plans and estimates under the act of August 11, 1888) that has been definitely located with the formal approval of the Secretary of War is the so-called "Southern route" around the lower rapids of Rock River, terminating "at the mouth of Rock River," as prescribed and directed by the act of September 19, 1890.

With reference to the improvement of the lower rapids of Rock River, it appears that as early as 1867 a canal terminating at the Mississippi River south of South Slough, near the lower end of Rock River Delta, was suggested by Gen. J. H. Wilson in his report on the survey of Rock River. Again, in 1885, when surveys of this locality for the Hennepin Canal were in progress, under the direction of Maj. W. H. H. Benyaurd, Corps of Engineers, under the provisions of the river and harbor act of August 2, 1882, Assistant Engineer G. A. M. Liljencrantz, in a letter dated October 28, 1885, mentioned the fact that the south bank of Rock River was more favorable than the north bank for the construction of the canal in the following language:

What is the objection to running the canal into Mississippi River south of the mouth of Rock River? * * *

The ground south appears, from indications on the printed maps, to be lower and more favorable than north of Rock River, to which letter Maj. Benyaurd replied under date of October 30, 1885, as follows:

The survey made under direction of Gen. J. H. Wilson, in 1867, demonstrates the feasibility of running a canal to the Mississippi below the mouth of Rock River, but as the law authorizing the present survey requires the canal to terminate on the Mississippi at or above Rock Island, it is not deemed advisable or necessary to consider anything below Rock River.

The suitability of the south shore for the location of this part of the canal, therefore, was recognized before 1890, but the terms of the laws under which the surveys were made, upon which were based the detailed locations, plans, and estimates submitted to Congress, June 27, 1890

esigns) is the same as submitted to Congress by the Secre-
'ar June 27, 1890 (H. R. Ex. Doc. 429), and the second is the
roved by the Secretary of War March 25, 1891.

of Congress of September 19, 1890, appropriating money for
ing the construction of the Illinois and Mississippi Canal,
for * * * "a canal to connect the Illinois River, near the
Iennepin, with the Mississippi River at the mouth of Rock

t requires in the canal a depth of 7 feet, and provides for the
ion of * * * "guard gates, waste weirs, locks, lock
asins, bridges, and all other erections, and fixtures that may
ary for safe and convenient navigation of said canal."

ears from the wording of the law and from previous discus-
he subject that the primary object to be attained is the unit-
practicable water route the navigable waters of the Illinois
issippi rivers (as part of a through route of transportation
Great Lakes to the Mississippi River), furnished with all ad-
d structures that may be necessary for the proper manage-
erating and control of the work itself, and for handling the
that may be subserved by the improvement.

jections urged against the route as approved by the Secretary
larch 25, 1891, and statements in favor of a line along the north
Rock River, in the vicinity of its mouth, by the Hon. W. H.
the document referred to the Board, and by the committee of
Island Business Men's Association, are:

The line has been located by Congress along the north bank
River, and can not be changed by the Secretary of War.

. That the terminus on the south side is not accessible to rail-
ams, and Mississippi boats, but that a terminus on the north
uld be easily accessible to the citizens of Rock
venport, and would permit the construction of a
ter level adjacent to the canal, which basin, with
ffer facilities for elevators and other appliances
between land and water transportations, easily

as upon some line in connection with the basin just named (to structed upon the low depression in the mainland north of Turland), and with an entrance into the Mississippi north of Pettiland or by way of a canal constructed through the island.

already stated by the Board, the low-water discharge of Rock exclusive of South Slough (1,500 to 1,650 cubic feet per second), fficient to maintain a practicable channel for such navigation as templated from the foot of Turkey Island to the mouth of Rock through moving sands, by the aid of wing dams. If the north f Rock River be followed, therefore, the canal must be carried to ississippi River. This must be done either by continuing the secf canal below Sear's Canal at the same level as now contemplated, rged at high water (in which case the basin desired by Rock l would be of variable level), or by carrying the level of the upper which is practically the same as extreme high water in the Mispi River, from Sear's Canal to that river.

e former plan would add to the cost of the northern line by the s of cost of the excavation of the canal and basin over that of ring dams below the foot of Turkey Island.

e second plan would require an embankment above high water, in ed of Rock River and on Turkey Island, from Sear's Canal to the ession before mentioned or a canal cut in the plateau from Sear's l to the low ground named; an embankment around the proposed n; the construction of a short section of canal from the basin to the sissippi River, with a lock of 17-foot lift to enter the Mississippi r instead of a lock of 8.5-foot lift as now designed. The lock at 's Canal would still be required as a guard lock and to enable s to use Rock River at high stages of water in that stream, all of ch modifications would add still more to the cost of the northern e than would the first mentioned.

COST OF THE TWO ROUTES.

he Board has considered the estimates, made by Assistant Engineer eeler in his report to Capt. Marshall on routes, dated March 7, 1891, both routes.

xclusive of cost of rights of way, which must always be an uncer- element when voluntary purchases are impracticable, these esties are:

he northern route	$459,055
he southern route	393,530
In favor of south line	65,525

n forwarding these estimates Capt. Marshall gave it as his opinion t, while they indicated approximately the relative cost of the two tes, yet they are too low by fully 20 per cent.

he estimates as thus indicated by Capt. Marshall (exclusive of rights way and legal expenses connected with acquiring the necessary ds, etc.) for the construction of the canal are:

he northern line	$550,865
rn line	472,236
f southern line	78,629

estimates it is to be understood that all costs of rights ndemnation, and damages to property must be a canal along the southern route would be easier of access to teams reaching from the south side of Rock River than if the canal were located along the northern route; that the only railroad now actually crossing Rock River below the head of the Lower Rapids crosses the line of each route, and may therefore be supposed to have equal facilities of access to either; that railroads of the future can not pass Rock River below the head of the Lower Rapids without crossing any canal that may be located along this reach of the river; that any railroad crossing the Mississippi within a comparatively short distance above the mouth of Rock River would have more ready access to a canal established along the northern route, but such a road could reach a canal south of Rock River either by the tracks of the present railroad or by the construction of an independent bridge and an additional length of track not exceeding 2 miles.

That the city of Rock Island exists and it remains to discuss the question whether the benefits which it would derive from a location of the western terminus of the canal on the northern side of Rock River are of such a character as would justify on the part of the United States generally the sacrifice of the advantages of the southern route at the expense of the appropriations made for this public improvement.

The benefits referred to may be summed up as follows: (1) The city would have more easy access to the canal and its terminus both for teams and railroads. (2) Any traffic arising from the transfer of freights from canal boats to Mississippi River craft, or vice versa, and from the storage of boats in the basin would fall to the citizens of Rock Island.

It seems to the Board that the advantages in the first case, so far as teams are concerned, can only be secured at the disadvantage of teams which would desire to reach the canal from the southward of Rock River; and the latter are, in proportion to their number, entitled to equal consideration with the former. In regard to railroads, it is believed that if the freight to be carried shall warrant the construction of more than the one now crossing all lines which have been proposed for the canal, the controlling corporations will not delay in building them.

In case transfers to any considerable extent become necessary at or near the western terminus of the canal there would be some local profit to the business men of Rock Island, acting as the intermediaries. But an argument frequently used by the advocates of the construction of the canal by the General Government was that freight could be carried through it to and from all upper Mississippi River points without transfer, with great resulting benefit to the people of the country westward and northward of Rock Island; that is to say, that the canal is to be simply a part of an extended combined canal and river navigation adapted to Mississippi barges and boats, the termini of which system of navigation are not upon the line of the canal.

Undoubtedly, if a basin at the western terminus of the canal section of this system were to become a storage place for a large number of boats, with their crews, a considerable profit would be derived from the supplies required for subsistence of crews, repair of boats, etc. No estimate of this profit is practicable, but it is very doubtful if it would ever approximate the expectations of the advocates of the northern route.

The citizens of Rock Island have devoted much time and money in advocating the construction of the canal and they naturally seek some return for both. In this the Board is in entire sympathy with them, and if any sufficient reason could be found for recommending the location

APPENDIX K K.

ENT OF RIVERS AND HARBORS ON EASTERN SHORE OF LAKE MICHIGAN.

F MAJOR WILLIAM LUDLOW, CORPS OF ENGINEERS, BVT. OL., U. S. A., OFFICER IN CHARGE, FOR THE FISCAL YEAR END- E 30, 1892, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

Harbor, Michigan.
ix Harbor and entrance to ake, Michigan.
t Harbor, Michigan.
of refuge at Portage Lake, an.
Harbor, Michigan.
n Harbor, Michigan.
r Harbor, Michigan.
ver Harbor, Michigan.
9. Muskegon Harbor, Michigan.
10. Grand Haven Harbor, Michigan.
11. Holland (Black Lake) Harbor, Michigan.
12. Saugatuck Harbor, Michigan.
13. South Haven Harbor, Michigan.
14. St. Joseph Harbor, Michigan.
15. St. Joseph River, Michigan.
16. Michigan City Harbor, Indiana.

EXAMINATION AND SURVEY.

17. Grand River, Michigan, below Grand Rapids.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., July 11, 1892.

AL: I have the honor to submit herewith the annual reports the works of river and harbor improvement in my charge cal year ending June 30, 1892.

pectfully,

WILLIAM LUDLOW,
Major, Corps of Engineers,
Bvt. Lieut. Col., U. S. A.

THOMAS L. CASEY,
Ch f of Engineers, U. S. A.

Money statement.

propriated by act approved September 19, 1890	$15,000.00
2, balance unexpended	15,000.00
propriated by act approved July 13, 1892 (landing pier project)	20,000.00
ailable for fiscal year ending June 30, 1893	35,000.00
(estimated) required for completion of landing pier project	35,000.00
that can be profitably expended in fiscal year ending June 30, 1894	35,000.00

ed in compliance with requirements of sections 2 of river and acts of 1866 and 1867.

K K 2.

MENT OF CHARLEVOIX HARBOR AND ENTRANCE TO PINE LAKE, MICHIGAN.

provements at this harbor include the lower channel leading e Michigan into Round Lake and the upper channel leading und Lake into Pine Lake.

esent project, adopted in 1868 and revised in 1876 and 1884, 12-foot navigation, 100 to 150 feet wide in the lower channel eet wide in the upper channel.

wer channel is protected on the north side by 302 linear feet work built by the United States, 469 linear feet of crib work the local authorities previous to 1873, and 945 linear feet of am revetment built by the United States, with a timber frame feet long covering the gap between the crib work and the t, overlapping the latter about 30 feet. The total length of revetment is 1,724 linear feet, and the projection of the pier the present shore is about 740 feet.

ojection on the south side consists of 491 linear feet of crib d, with the 50-foot wing at the Round Lake end, of 1,538 linear ose piling and plank-beam revetment. The total length of this 2,029 linear feet, and its projection beyond the present shore 0 feet.

pper channel is protected on the north side by a pile revet- -feet long and on the south side by a similar revetment 366 . Both revetments are filled with brush and stone ballast.

edging done in May and June, 1891, was instrumental in main- a navigable depth of water until the end of the season, but s made March 30, 1892, showed a depth of but 10 feet near of the outer pier and through the upper channel.

ecrease in depth is partly owing to the extraordinary low lake t principally to the insufficient projection of the piers and the y nature of the older parts of the piers and revetments. A ade on March 30, 1892, showed a depth of but 10 feet in Lake 170 feet in advance of the South Pier, the shoal extending s the entrance, and, although the present project provides of 100 linear feet to the South Pier (the North Pier al- ojected length), it is evident that a further extension d, if even a 12-foot navigation is to be maintained. ove, 470 linear feet of the North Pier was built to 1873, when the Government took charge of the improvement. This work is a crib structure, rudely built placed on the natural bottom, and, as a result, extends only to a feet below the water surface. It has been repaired and refilled stone from time to time, but is now fast disintegrating. It has n been possible to dredge close up to it, because it would have b undermined thereby and consequently wrecked.

Large quantities of sand find their way through it into the char at every blow, and it is impossible to prevent this so long as the pre work remains.

The original project contemplated its removal and the substitut of a more serviceable and durable structure, and the time for this cha is close at hand.

The revetments of the lower channel are of a temporary nat The channel is narrow, with high sand banks on each side, and it necessary to resort to rapid construction in order to hold the ba while the channel was making.

The portion above water is rapidly decaying, and particularly south revetment, owing to its exposed position with respect to collis vessels, is in great need of strengthening and repairing. Both re ments should be rebuilt above the water surface and provided wi double row of sheet piling and anchor piles in rear.

Owing to the fact that the north revetment has never been f completed, stopping at the lake side of the highway bridge that sp the entrance, and the bank above the bridge has been built out slabs as wharfage for the sawmill, the north draw of the bridg not navigable and passage is confined to the south draw. This ma has not received special attention since the south draw seems, so adequate to the commerce of the port, and no complaints of obstruct have been received. It may be well, however, to note these condit for future reference.

The revetments of the upper channel are also in need of extensio reach into Pine Lake.

The operations during the fiscal year consisted in generally o hauling and repairing the revetments of the lower channel. The br caps and guard timbers were renewed, additional piles were drive strengthen the works, and the gap between north pier and revet at shore line was filled with brush fascines, loaded with large s picked up on the beach.

A permanent benchmark was established on top of the water t at northeast corner of the opera-house block and connected by d cate levels with the United States gauge, and a careful series of w gauge readings was commenced June 1, 1892, to continue throug months of June, July, and August for the purpose of obtaining for adjusting the zero of the gauge to a uniform level with the ga at the other harbors.

The bridge of the Chicago and North Michigan Railroad across lower end of Pine Lake has been completed and is found to be lo and built in accordance with the plans approved by the Secreta War under date of September 4, 1891.

The Government dredge *Saginaw* is now on the way to the harb deepen the entrance and both channels.

The present working balance is $2,300, about half of which wi required to pay for dredging and the remainder will be held for r repairs.

For 1894 the estimate is, for two cribs in the south pier, to com ording to the present project, $9,500; rebuilding 500 feet of inner f north pier, $15,000; sheet piling 2,450 linear feet of plank-beam ment, $12,500; and extending the revetments of the upper channel linear feet, $7,200. The total cost of these items, with $3,000 for ging during two seasons and 10 per cent for contingencies, is 00.

harbor is included in the Michigan collection district, Michigan. The nearest f entry is Grand Haven, Mich.

light-house establishment maintains a fifth-order light on the north pier.

Appropriations for improving harbor at Charlevoix, Mich.

st 14, 1876	$10,000	August 5, 1886	$10,000
18, 1878	12,000	August 11, 1888	12,500
3, 1879	9,000	September 19, 1890	9,000
14, 1880	10,000		
3, 1881	10,000	Total	102,500
st 2, 1882	10,000		
5, 1884	10,000		

nal estimated cost of work, 1868, as amended in 1876 and 1884	$186,000.00
amount appropriated from 1868 to and including act of September 19, 1890	102,500.00
amount expended to June 30, 1892	99,944.24

Money atement.

1, 1891, balance unexpended	$6,230.20
30, 1892, amount expended during fiscal year	3,674.44
1, 1892, balance unexpended	2,555.76
1, 1892, outstanding liabilities	247.12
1, 1892, balance available	2,308.64
nt appropriated by act approved July 13, 1892	10,000.00
nt available for fiscal year ending June 30, 1893	12,308.64
ount (estimated) required for completion of existing project	73,500.00
ount that can be profitably expended in fiscal year ending June 30, 1894	52,000.00

bmitted in compliance with requirements of sections 2 of river and arbor acts of 1866 and 1867.

COMMERCIAL STATISTICS, CHARLEVOIX HARBOR, MICHIGAN.

Entrances and clearances.

Years.	Number.	Revenue collected.	Tonnage.
year:			
[illegible]	772	$355.46	
[illegible]	599	779.53	
[illegible]	674	390.46	
[illegible]	753		151,360
year:			
	526		92,306
	473		
	532		75,224
	534		79,613

*Receipts and shipments by vessel, 1891.**

Articles received.	Quantity.	Tons.	Articles shipped.	Quantity.
Beer .... barrels..	75	8	Bark .... cords..	7,764
Coal .... tons..	....	2,936	Fish .... tons..	....
Feed .... bushels..	200	5	Hay .... do...	....
Flour .... barrels..	320	32	Hoops .... bundles..	6,300
Grain .... bushels..	990	1,237	Lath .... M..	617
Hay .... tons..	....	508	Lime .... tons..	....
Machinery .... do...	....	15	Lumber .... M. feet, B. M..	14,899
Merchandise .... do...	....	447	Merchandise .... tons..	....
Salt .... barrels..	185	26	Pig iron	....
Steel rails .... tons..	....	1,642	Posts, cedar, No. 3... number..	115,470
Shingles .... M..	1,113	139	Potatoes, bushels	4,300
Stone .... tons..	....	1,676	Shingles .... M..	70
			Ties .... number..	931,470
			Wood .... cords..	5,565
Total	....	8,671	Total	....

* Compiled from statements furnish r of customs and by the mayor of Charle

IMPROVEMENT OF FI RT HARBOR, MICHIGAN.

The project for this harbor in 1866 and amended in 1868 1879, provides for a channel ide and 12 feet deep, prote by piers and revetments.

The original facilities for navigation previous to the commence of the improvement by the Government in 1866 consisted in a cha 70 or 80 feet wide, with a depth of 3 to 4 feet. These conditions been greatly improved and at the present time, with the help of sional dredging, a depth of 10 to 12 feet is maintained.

The survey made March, 1892, shows that the 10-foot contour in lake is about 250 feet in advance of the end of the north pier, an consequence of this insufficient development, frequent dredging i quired to maintain the needed depth at the entrance. The depth a the outlying bar was found this spring to be 11 feet, but the 15 contour is immediately beyond, about 420 feet outside of the pre end of the south pier, and thence outwards the lake deepens rap the offshore contour swinging boldly in towards the land.

It is evident that the piers should be built out to at least the 15 curve, but the pier development provided for by the present pro viz, 300 feet on the north pier and 100 feet on the south pier, fall feet short of this on the north and 400 feet on the south pier.

At the beginning of the fiscal year the available depth at th trance was 10 feet and on the 21st of July the Government dredge *inaw* arrived to prepare better water. The channel was dre throughout, 70 feet wide, from Lake Michigan to about shore line, 40 feet wide from there to Lake Aux Bees Scies, and 14 feet deep, quantity of sand removed was 22,770 cubic yards. The dredging completed August 20, 1891.

During the remainder of 1891 no further difficulty was encount by the vessels frequenting the harbor, but at the opening of na tion this spring a depth of only 11 feet was found on the bar in of the entrance, and the shoal overlapping the end of the north encroached considerably on the channel between the piers. rds the end of the fiscal year, however, there was a navigable of 13 feet, in great part due to the rise in the lake level.

e required material for making some minor repairs to the piers revetments, and for sheet piling the latter to make them sand tight, been purchased, and this work will be done as soon as the land er can be spared for use at this harbor.

permanent bench mark was established at the northwest corner e water-works building, on top of the water table and connected uplicate levels with the U. S. gauge, and a careful series of water- e readings was commenced June 1, 1892, to be continued through months of June, July, and August, for the purpose of obtaining for adjusting the zero of the gauge to a uniform level with the es at the other harbors.

e present working balance is about $4,400, with which it is pro- d to sheet-pile the revetments, make some minor repairs to the ting works, and to pay for the necessary dredging restore the en- nce channel to the required width and depth.

The Toledo, Ann Arbor, and North Michigan Railway proposes mak- Frankfort a terminus for the establishment of a new trans-lake e by means of a system of steam ferries for transportation of cars hout breaking bulk. The experiment is one of great importance its success would be a notable event in the development of lake iness.

r 1894 the following estimate is submitted:

o complete the present project by adding 300 linear feet of crib work he north pier, $28,500; and 100 linear feet of crib work to the south , $12,000; for additional repairs, $2,000; and for two seasons ging, $5,000, which, with 10 per cent for contingencies, makes ,000.

e light-house establishment maintains a sixth-order light near the end of the h pier, and the Life-Saving Service a station at the inner end.

his harbor is included in the Michigan collection district, Michigan. The nearest t of entry is Grand Haven.

Appropriations for improving harbor at Frankfort, Mich.

x Becs Scies:		Frankfort, Mich.:	
June 23, 1866	$88,541.00	June 18, 1878	$8,800.00
March 2, 1867	10,000.00	March 3, 1879	4,000.00
July 25, 1868	10,000.00	June 14, 1880	5,000.00
April 10, 1869	29,318.85	March 3, 1881	10,000.00
July 11, 1870	10,000.00	August 2, 1882	15,000.00
March 3, 1871	10,000.00	July 5, 1884	5,000.00
nkfort, Mich.:		August 5, 1886	7,000.00
June 10, 1872	10,000.00	August 11, 1888	8,000.00
March 3, 1873	10,000.00	September 19, 1890	10,000.00
June 23, 1874	10,000.00		
March 3, 1875	10,000.00	Total	273,659.85
August 14, 1876	3,000.00		

ginal estimated cost of work in 1866, as amended in 1868, 1879, and 1892	$329,655.85
hole amount appropriated from 1866 to and including act of September 19, 1890	273,659.85
mount covered into the Treasury (Report 1871, page 133)	5,721.50
hole amount expended to June 30, 1892	263,511.86

Money statement.

July 1, 1891, balan unexpended ....
June 30, 1892, amount expended during fiscal year ....

July 1, 1892, balance unexpended ....
July 1, 1892, outstanding liabilities ....

July 1, 1892, balance available ....
Amount appropriated by act approved July 13, 1892 ....

Amount available for fiscal year ending June 30, 1893 ....

Amount (estimated) required for completion of existing project........
Amount that can be profitably expended in fiscal year ending June 30, 1894
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATI FORT HARBOR, MICHIGAN.

En learances.

Years.	Number.	Revenue collected.
Fiscal year:		
1884	488	$404.70
1885	261	75.66
1886, 1887, 1888	(*)	(*)
Calendar year:		
1888	1,342	
1889	(*)	(*)
1890	443	
1891	1,541	

* Not stated.

*Receipts and shipments by vessel, 1891.**

Articles received.	Quantity.	Tons.	Articles shipped.	Quantity
Beer........barrels..	80	8	Bark........cords..	7,416
Coal........tons..		125	Fish........tons..	
Flour........barrels..	500	50	Fruit........do...	
Feed........tons..		192	Lumber........M feet B. M..	17,571
Grain........bushels..	10,460	288	Potatoes........bushels..	3,000
Hay........tons..		500	Posts........	8,000
Iron........do...		50	Shingles........M..	3,660
Lath........M..	50	15	Slabs........cords..	2,425
Live stock........head..	125	22	Ties........	5,100
Machinery........tons..		6	Wood........cords..	4,370
Lime and cement........do...		100		
Merchandise........do...		1,050	Total........	
Stone........do...		100		
Total........		2,506		

* Compiled from statement furnished by the collector of customs and by the mayor of Fr

K K 4.

IMPROVEMENT OF HARBOR OF REFUGE AT PORTAGE LAKE, MIC

The official project adopted in 1879 and modified in 1880–'8 make this a harbor of refuge with a channel 370 feet wide and deep, protected by piers and revetments.

The north pier consists of 1,240 linear feet of pile work fill edgings, and 151 feet of crib work, and projects 550 feet beyo present shore line.

›uth pier is a pile and edging structure 1,380 feet long, and pro-) feet beyond the present shore line.

ated in the previous Annual Report, the revetments are in a condition. On the north side the superstructure timbers have otally disappeared, or are made unserviceable by the failure of s-ties; the filling has washed out for a length of some 400 linear ring the sea a clean sweep through the work and filling the chan- 1 sand from the beach and banks, and the piles of the side walls a considerable stretch pushed out of position to such an extent ey are useless. The outer half of the south pier is almost as d, in short, almost the whole pile work should be removed and l by more substantial structures.

e the present pile piers and revetments, if they were in service- dition, would be of some benefit, they would not of themselves a navigable depth of water in the channel. At present the 10- ve in the lake passes nearly 250 feet outside of the end of the ier.

dings made in May, 1892, showed a narrow and crooked chan- 1 less than 7 feet water between the piers, and the Government *Saginaw* was sent to improve the navigation. The dredge ar- 1 June 3, and to June 29 completed a cut 40 feet wide and 13 p from lake to lake, removing 20,284 cubic yards.

tempt has been made to expend any part of the available bal- the credit of the harbor on repairs to the revetments, for it iave been so much money wasted, inasmuch as nothing but rad- itment will make them useful.

manent bench mark was established and connected by duplicate rith the United States gauge, and a series of accurate water- eadings was commenced June 1, 1892, to be continued through iths of June, July, and August for the purpose of obtaining data isting the zero of the gauge to a uniform level with the gauges other harbors.

›resent working balance of $4,100 will be used in keeping the e partially accessible by dredging, and to do such repairing as icable.

ithstanding this exhibit it still remains, as stated in the reports last two years, that the natural conditions at Portage Lake, its expanse, ample depth, and central position in the dangerous f 50 miles between Point Betsey and Little Point Sable, justify pose of the original project, and warrant renewed recommen- that this project be carried out.

rbor of refuge is needed in this locality, as there is no safe shel- anchorage in westerly gales between Ludington and South u.

894 the recommendations of the previous Annual Report are 1, viz, for 4 cribs, 200 feet, on north pier, $20,000; for 7 cribs, ;, on south pier, $33,000 (these constructions being in each case f of the projected crib piers); for rebuilding 1,240 linear feet of th pier, $38,000; sheet piling and filling, $6,000, and for dredg- 000. The total of these, with allowance for contingencies, etc., ,000.

ght-House Establishment has recently constructed a fourth-order light-house end of the north pier, upon the only portion of the harbor works capable of ig it.

arbor is included in the Michigan collection district, Michigan. The nearest is Grand Haven, Mich.

Appropriations for harbor of refuge at Portage Lake, Michigan.

March 3, 1879	$10,000	August 5, 1886	$15,000
June 14, 1880	10,000	August 11, 1888	10,000
March 3, 1881	10,000	September 19, 1890	8,000
August 2, 1882	25,000		
July 5, 1884	12,500	Total	100,500

Original estimated cost of work, 1879, as amended in 1890	$267,500.00
Whole amount appropriated from 1889 to and including act of September 19, 1890	100,500.00
Whole amount expended to June 30, 1892	95,055.2

It has been impracticable to obtain commercial statistics for Portage Lake Harbor.

Money statement.

July 1, 1891, balance unexpended	$7,458.15
June 30, 1892, amount expended during fiscal year	2,014.07
July 1, 1892, balance unexpended	5,444.08
July 1, 1892, outstanding liabilities	1,337.47
July 1, 1892, balance available	4,106.61
Amount (estimated) required for completion of existing project	167,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	125,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

K K 5.

IMPROVEMENT OF MANISTEE HARBOR, MICHIGAN.

The project of 1866, modified in 1870, 1874, and 1890, provides for a channel of navigable width and 15 feet deep, extending from Lake Michigan to Manistee Lake, and protected at the entrance by piers and revetments. With the cribs placed during the season of 1891 the piers and revetments have the following development:

North pier, 1,251 linear feet crib work and 1,304 feet of pile revetment. It projects 850 feet beyond present shore line.

South pier, 1,199 linear feet crib work and 490 feet pile revetment. It projects 650 feet beyond present shore line.

At the beginning of the fiscal year a contract was in force with C. H. Starke to complete the dredging of the river to Manistee Lake, and this work was completed August 28. Before leaving the dredge went again over the work of the previous season so that at the end of August there was a through channel 50 feet wide and 15 feet deep from lake to lake, the width being increased to 75 feet at the bend opposite Canfield & Wheeler's sawmill and to 100 feet at the entrance. The material removed during the fiscal year measured 40,784 cubic yards. An examination made in May, 1892, showed that the depth in the river was diminished to 13 feet, with 15 feet at the entrance, which, however, may be looked upon as very good when the long reaches of unprotected bank along the river and the great number of vessels of all sizes using the navigation are taken into consideration.

[T]he depth at the entrance will continue to be unreliable until the [pie]rs shall have been built out to their projected length, which requires [an] addition of 350 feet to each pier.

[T]he contract with George W. Crouter for the construction of four [cr]ibs on the north pier, which was under way at the commencement of [th]e fiscal year, was completed in September, 1891. The cribs were [ea]ch 50 feet long, 24 feet wide, and with the superstructure 22 feet 8 [in]ches high. They rest on a pile foundation at a depth of 16 feet 3 inches [b]elow the zero of the gauge, the piles penetrating from 15 to 17 feet [in]to the bottom. The top of the superstructure is at the same level as [t]hat of the adjacent old work, viz, 6 feet 5 inches above zero of gauge. [A]t the outer end the new work is protected by a structure of guard [p]iles and horizontal waling timbers, filling the space between the end [f]orms, and a mooring post is built into each crib. The cribs were filled [w]ith stone and decked over. The actual addition to the length of the [p]ier by the four cribs is 202 linear feet.

Before final acceptance of the work it was examined by a diver and [fo]und to be satisfactory.

The north revetment being in a tumble-down condition, the part from [S]tation 3+24 to the life-saving station, a distance of 764 linear feet, [w]as cut down to the water surface and rebuilt with four courses of [su]perstructure. The old filling was taken out and the suitable portion [re]placed in a substantial manner in the work, reaching as high as the [lo]wer cross-ties and ballasted with old stone. The sink and water holes [a]long the rear of the work due to seepage and subsidence were filled [u]p with the old filling.

A passage 8 feet wide for the light-keeper's boat was prepared through [th]e new work at Station 7+61 to 7+69.

The upper part of the north pier, Station 14+90 to 15+50, a distance [o]f 60 feet, where the side walls were crumbling away and the filling [ex]posed to the danger of sliding into the channel, was repaired, the [p]rojecting part of the square crib in the south pier (Station 6+16 to [6]+46) was repaired and decked, and a plank walk was laid on south [p]ier from the inner end to the fog-horn house, a distance of 800 feet.

All the above repairs were made by day labor and purchased mate[r]ial, commencing the work in September, 1891, and completing it in [J]une, 1892, operations having been suspended during the winter [m]onths.

A permanent bench mark was established and connected by dupli[c]ate levels with the United States gauge, and a series of accurate water-gauge readings was commenced June 1, 1892, to be continued through the months of June, July, and August for the purpose of obtaining data for adjusting the zero of the gauge to a uniform level with the gauges at the other harbors.

At the present time the existing works are in the following condition:

North pier.—The revetment from the inner end to Station 3+24, a dis[t]ance of 390 feet, is in urgent need of new superstructure. The north [r]evetment is exceptionally exposed to wear and tear, the sailing ves[s]els frequenting the harbor being in the habit of tying up here during [...]w weather on the lake or while waiting for a cargo. The part [from S]tation 3+24 to the life-saving station, a distance of 764 feet, has [be]en rebuilt, and the rest should be repaired likewise as soon [as pos]sible to prevent it from being totally wrecked.

[The p]art from the life saving station to 12+38, a length of 130 feet, [should] be treated in the same manner. Oak snubbing posts should be secured to the rear wall at distances of 50 feet along this whole work to keep vessels from making fast to the cross-ties, which is one of the main causes of the early ruin of the structure.

The north pier from Station 12+38 to 18+83, a distance of 645 feet, is now more than 20 years old, and the part above water, although patched and repaired from time to time, is in urgent need of rebuilding. It is continually giving away in places, and it is getting more and more difficult to repair it, as the old timber is too rotten to hold a bolt. Most of the cross-ties are rotten and broken.

The part from Station 18+83 to the outer end, a distance of 606 feet, is in good condition, but needs some additional filling in the new cribs and some stone riprap along the foot of the lake wall to prevent its being undermined. This should be done before another winter.

South pier.—The inner end consists of some 490 linear feet of pile revetment, built in 1874 and 1875. This work is occupied by the Canfield and Wheeler Lumber Company as a lumber wharf, and in consequence of age and hard usage is completely wrecked. It seems no longer capable of carrying the load placed on it and threatens to cave into the channel. If continued as a part of the lumber yard the company may properly be called upon to rebuild it.

The south pier from Station 0 to 6 + 46, 646 linear feet, is crib work, built previous to 1872. At its inner end it is breaking down, but the remainder is still in tolerably fair condition, and will stand some years yet. From 6 + 46 to the outer end, 451 linear feet, the pier is in good condition.

With the present working balance of $4,800 it is proposed to purchase about 150 cords of stone for refilling the end of north pier and riprapping the foot of the lake wall, to make minor repairs, and to reserve the rest for dredging the entrance when necessary.

The recommendation for 1894 is as follows: For seven cribs, 350 feet, on the north pier; and seven cribs, 350 feet, on the south pier, to complete the present project, $84,000; for repairing 645 linear feet of north pier, $6,450; for repairing 500 linear feet of north revetment, $3,500, and for two seasons' dredging in the harbor, $4,000; which, with contingencies, make $110,000.

The Light-House Establishment maintains a sixth-order light and steam fog signal on the south pier, and the Life-Saving Service has a station near the inner end of the north pier.

This harbor is included in the Michigan collection district, Michigan. The nearest port of entry is Grand Haven, Mich.

Appropriations for improving harbor at Manistee, Mich.

March 2, 1867	$60,000	June 4, 1880	$10,000
July 11, 1870	20,000	March 3, 1881	10,000
March 3, 1871	9,000	August 2, 1882	15,000
June 10, 1872	10,000	July 5, 1884	10,000
March 3, 1873	10,000	August 5, 1886	10,000
June 23, 1874	10,000	August 11, 1888	10,000
March 3, 1875	25,000	September 19, 1890	50,000
August 14, 1876	14,000		
June 18, 1878	15,000	Total	298,000
March 3, 1879	10,000		

Original estimated cost of works, 1866, as amended in 1871, 1873, and 1875, 1890, and 1892	$408,000.00
Whole amount appropriated from 1866 to and including act of September 19, 1890	298,000.00
Whole amount expended to June 30, 1892	292,669.31

Money statement.

July 1, 1891, balance unexpended	$35, 090. 94
June 30, 1892, amount expended during fiscal year	29, 760. 25
July 1, 1892, balance unexpended	5, 330. 69
July 1, 1892, outstanding liabilities	510. 52
July 1, 1892, balance available	4, 820. 17
Amount appropriated by act approved July 13, 1892	50, 000. 00
Amount available for fiscal year ending June 30, 1893	54, 820. 17
Amount (estimated) required for completion of existing project	25, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1894	60, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS, MANISTEE HARBOR, MICHIGAN.

Entrances and clearances.

Years.	Number.	Revenue collected.	Tonnage.
Fiscal year:			
1884	3, 609	$3, 181. 19	....
1885	3, 560	1, 145. 29	....
1886	3, 352	634. 26	....
1887	3, 412	....	991, 872
1888	3, 459	....	889, 879
Calendar year:			
1888	3, 595	....	966, 221
1889	3, 524	....	945, 329
1890	3, 691	....	975, 049
1891	3, 617	....	1, 079, 818

*Receipts and shipments by vessel, 1891.**

Articles received.	Quantity.	Tons.	Articles shipped.	Quantity.	Tons.
Beer ... barrels	610	61	Bark ... cords	7, 528	7, 528
Brick ... M	528	1, 325	Coal ... tons	....	1, 700
Coal ... tons	....	6, 699	Fish ... do	....	487
Eggs ... dozen	27, 658	17	Fruit ... do	....	300
Flour ... barrels	13, 221	1, 322	Furniture ... do	....	75
Feed ... tons	....	1, 181	Lime and cement ... barrels	250	33
Gravel ... do	....	6, 500	Lumber ... M feet	283, 320	495, 810
Grain ... bushels	129, 800	3, 570	Lath ... M	27, 452	8, 236
Hay ... tons	....	757	Machinery ... tons	....	50
Iron ... do	....	200	Merchandise ... do	....	1, 869
Live stock ... head	198	35	Posts ... number	113, 140	2, 263
Lime and cement ... barrels	1, 000	130	Potatoes ... bushels	86, 000	2, 580
Machinery ... tons	....	250	Salt ... barrels	1, 077, 162	150, 851
Merchandise ... do	....	14, 590	Slabs ... cords	2, 849	7, 658
Oil ... barrels	20	4	Shingles ... M	154, 041	19, 255
Pork ... do	2, 300	230	Stone ... tons	....	625
Sugar ... do	273	68	Wood ... cords	665	998
Vinegar ... do	123	12			
[illegible] ... tons	....	6, 250	Total	....	700, 318
Total	....	43, 201			

*Compiled from statements furnished by the collector of customs and by the mayor of Manistee.

K K 8.

IMPROVEMENT OF LUDINGTON HARBOR, MICHIGAN.

The project adopted in 1867 and modified in 1885 and [illegible] for a channel 200 to 250 feet wide and 18 feet deep, protected [illegible] and revetments.

The development of the protection works is as follows:

North pier consists of 1,482 linear feet of crib work, built [illegible] 1868 and 1890, and projects 900 feet beyond the present shore [illegible] its inner end it connects with an old slab revetment, built at [illegible] expense, and now in a tumble-down condition.

South pier consists of 567 linear feet of pile work, built [illegible] and of 1,814 linear feet of crib work, built between 1868 and [illegible] extends along the entire channel from Pere Marquette Lake [illegible] Michigan and projects into the latter 1,500 feet.

Considerable portions of the present works are very old and [illegible] newal above the water line, particularly the part of north pi[illegible] Station 5+88 to 12+36, a distance of 648 feet, the pile structure [illegible] south side 567 feet long, and the south crib work from Station [illegible] 14+23, 856 linear feet.

The mentioned parts of the north pier especially are in need [illegible] pairs in consequence of serious abrasions by colliding vessels [illegible] undermining action of steamers.

The remaining structures are in good condition and only need [illegible] additional stone ballast and riprap around the outer ends of [illegible] piers.

The dredging by Government plant, which was under way at [illegible] ginning of the fiscal year, was continued till July 20, by which [illegible] channel 18 feet deep and 40 feet wide, extending from lake to lake [illegible] been excavated.

The Government dredge returned to the harbor early in Nove[illegible] but the season was too far advanced to allow of much work. How[illegible] the worst portion of the channel was again deepened, and no tr[illegible] was experienced by the vessels frequenting the harbor during [illegible] winter on account of insufficient water.

The quantity of sand removed during the year was 19,397 [illegible] yards. The available depth when surveyed in April, 1892, was f[illegible] to be nowhere less than 14.5 feet, the lake level being 1½ feet below [illegible] zero plane.

In order to remove any doubts regarding the stability of the [illegible] placed in extension of the two piers during 1889 and 1890, the fo[illegible] tions were again examined by a diver in September, 1891, and no f[illegible] changes discovered. During the winter the dredge *Saginaw* rec[illegible] such repairs to machinery, etc., as were needed to place her in con[illegible] for the coming season's work.

A permanent bench mark was established and connected by dup[illegible] [illegible] with the United States gauge. The bench mark is on ston[illegible] [illegible] face of pump-house of water works. [illegible] the gauge. A series of accurate water- [illegible] to be continued during June, [illegible] data for adjusting the [illegible] [illegible] gauges at the other harbors [illegible] July 1, $3,100 for [illegible] [illegible] and stone filling and [illegible] [illegible] Rebuilding above [illegible]

[illegible]

Total [illegible]

[illegible]

IMPROVEMENT OF [illegible]

The [illegible] project, adopted in [illegible] and amended [illegible] provides for a [illegible]-foot navigation between [illegible]

The work [illegible] consists of [illegible] linear feet of [illegible] linear feet of pile work [illegible]

[illegible]

ted length, the intended depth of 12 feet can not be maintained ut repeated dredging, and this is caused partly by the inefficiency inshore revetments to exclude the sand, and partly by the ad- of the shore line since the project was made.

10-foot curve of Lake Michigan is about even with the present the south pier, and the 15-foot curve is 400 feet farther out. It dent that the piers are in need of additional length if the pro- depth of 12 feet is to be maintained between them.

siderable portions of the piers and revetments, from age and ac- , have become inoperative in excluding the sand coming from each and banks, and are in urgent need of repairs.

north pier crib work from Station 1+51 to 3+50 and the pile from 3+50 to 6+72, a total length of 521 feet, and the south pier ork from Station 0 to 6+19, a length of 619 feet, are now more 20 years old and should be rebuilt above the water line. The side revetment has been been rebuilt during recent years, as y as the funds permitted, 725 linear feet, Station 6+19 to 13+44 g received new superstructure, but the inner end from Station 4 to 17+61, a length of 417 feet, still remains to be treated in the manner. In addition most of this pile work needs sheet piling the rear to make it sand tight.

250 feet of railroad bulkhead at the inner end of the south revet- is in a tumble-down condition; the piles are decayed; it is quite d of filling, and large quantities of sand are sucked through it he channel by the action of passing vessels.

inner end of the north revetment has been wrecked by collisions eeds rebuilding.

the beginning of the fiscal year the available depth of water in hannel was 10 feet, and August 18 the Government dredge *Far-* commenced improving the waterway, completing this work Octo-

During this time a 50-foot channel 14 feet deep was dredged Pentwater Lake to Lake Michigan, removing therefrom material amount of 15,395 cubic yards.

further trouble was experienced during the year, but soundings April 11, 1892, showed that the channel had again filled up, a h of about 600 feet near the shore line having barely 10 feet of . It is intended to send a dredge to this harbor as soon as prac- e.

repairs of the south revetment, which were under way on July re completed November 30, the work having been suspended dur- wo and a half months of this time, to utilize the services of the over- n the improvement of the St. Joseph River. The repaired por- xtends from Station 8+88 to 13+44, a distance of 456 feet. The were sawed off, and a new superstructure four courses high in front wo courses high in rear with cross-ties 8 feet apart, built on top; d filling was overhauled to below the water line and new edgings tone placed in the work.

plank walk was laid over the south revetment for a length of feet to connect with the elevated walk to the pier light.

ermanent bench mark was established on top of a large bowlder ting from the foundation of the Sands & Maxwell furniture factory, uthwest corner, and connected by duplicate levels with the tates gauge, and a series of accurate water-gauge readings enced June 1, to be continued through June, July, and the purpose of obtaining data for adjusting the zero of the rm level with the gauges at the other harbors.

It is proposed to use the balance available July 1 ($2,400) for redre
ing the entrance and for minor repairs.

The needs of the harbor have been outlined above. To meet th
requirements, the following estimate is submitted: For 4 cribs for sou
pier (to complete the present project), $24,000; for rebuilding ab
water and refilling 521 feet of north pier, 619 feet of south pier and
feet of south revetment, 1,557 feet in all, $15,570; for sheet piling 1,
feet of north pier and revetment and 780 feet of south revetmen
total of 1,830 feet, $5,490; and for dredging, $3,000; which, with
estimate for contingencies, makes $53,000.

The light-house establishment maintains a sixth-order light, and the Life-Sa
Service a station on the north pier.

This harbor is included in the Michigan collection district, Michigan. The nea
port of entry is Grand Haven.

Appropriations for improving harbor at Pentwater, Mich.

March 2, 1867	$55,000	June 14, 1880	$4
April 10, 1869	17,820	March 3, 1881	10
July 11, 1870	10,000	August 2, 1882	10
March 3, 1871	10,000	July 5, 1884	15
June 10, 1872	30,000	August 5, 1886	10
March 3, 1873	20,000	August 11, 1888	8
August 14, 1876	10,000	September 19, 1890	8
June 18, 1878	10,000		
March 3, 1879	6,000	Total	233

Original estimated cost of the work, 1866, amended in 1873, 1884, and 1892	$286,82
Whole amount appropriated from 1866 to and including act of September 19, 1890	233,82
Whole amount expended to June 30, 1892	231,39

Money statement.

July 1, 1891, balance unexpended	$7,81
June 30, 1892, amount expended during fiscal year	5,39
July 1, 1892, balance unexpended	2,42
July 1, 1892, outstanding liabilities	1
July 1, 1892, balance available	2,41
Amount appropriated by act approved July 13, 1892	5,00
Amount available for fiscal year ending June 30, 1893	7,41
Amount (estimated) required for completion of existing project	24,00
Amount that can be profitably expended in fiscal year ending June 30, 1894	48,00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS, PENTWATER HARBOR, MICHIGAN.

Entrances and clearances.

Year.	Number.	Revenue collected.	Ton
Fiscal year:			
1884	461	$400.99	....
1885	187	69.17	....
1886	(*)	(*)	....
1887	(*)	(*)	....
Calendar year:			
1888	300	....	
1889	(*)	(*)	....
1890	27	....	
1891	1,140	....	

* Not stated.

*Receipts and shipments by vessel, 1891.**

Articles received.	Quantity.	Tons.	Articles shipped.	Quantity.	Tons.
tons		100	Brick, number	600,000	1,200
do		115	Carriages	30	10
...iture, do		18	Fruit and vegetables, tons		550
...vel, do		300	Fish, do		15
...in, bushels	14,851	342	Flour, barrels	721	72
...y and feed, tons		342	Furniture, tons		535
...e, do		60	Lath	905,000	272
...mber, M feet, B. M	1,000	2,000	Live stock, head	6	3
...e stock, head	34	17	Lumber, feet, B. M	5,887	11,774
...e and cement, barrels	500	50	Merchandise, tons		41
...chinery, tons		45	Posts, number	45,217	1,130
...rchandise, do		566	Shingles	11,252	1,687
...t, barrels	965	144	Ties, number	12,500	1,125
...ne, cords	90	570	Wood, cords	250	500
Total		4,669	Total		18,914

* Compiled from statement furnished by D. C. Wickham, of Pentwater, Mich.

K K 8.

IMPROVEMENT OF WHITE RIVER (LAKE) HARBOR, MICHIGAN.

The present project is for a 12-foot navigation 200 feet wide, and pro-...ted by piers and revetments, between Lake Michigan and White ...ke.

The north pier is a pile structure filled with edgings and stone, ...15 feet long, and projecting about 350 feet beyond the present shore ...e.

The south pier consists of 356 feet of crib work at its outer end, and 1,498 feet of pile pier and revetment. It projects about 630 feet be-...nd the present shore line.

Although the project contemplates a channel with a navigable depth ...12 feet, it has not been possible to attain this object, except for short ...riods of time by means of repeated dredging, for the reason that the ...ers are not sufficiently extended and the inshore revetments are not ...nd tight.

With reference to the existing project, the north pier still needs 250 ...et and the south pier 200 feet of crib work to complete them.

The north pier at present reaches only to the 8-foot curve in the lake, ...d even after its completion will fall some 300 feet short of the 15-foot ...rve, while the south pier after the addition of the proposed 200 feet ...ll probably be long enough for a considerable time to come. It is ...ident that large quantities of sand find their way into the channel ...om the North Beach around the end of north pier, and the latter ...hould be extended as soon as possible. Although on general prin-...iples the extension of the north pier requires the first attention, the ...d of the south pier is in a somewhat unstable condition. The end ...ib is slowly but steadily sinking into the bottom, and at least one ...hould be added to the pier at the first opportunity to hold the ...t work.

...siderable portions of both piers and revetments have been re-...bove water during the last few years, but there still remains 316 ...t of ...th revetment (Station 7+40 to 10+56) and 367 linear ...e work (Station 3+56 to 7+23) which are now

22 years old, and require new superstructure and filling. The m tioned portion of north pier particularly is in urgent need of attenti as the superstructure timbers are nearly gone and the filling bei washed out permits the sand from the rear to wash into the chann Part of the south-side crib work also needs repairs very badly, es cially the cribs (Station 2+55 to 3+05 and 0+50 to 1+00) which h lost part of their lake wall.

In order to make the pile structures as nearly sand tight as pra cable, they must be sheet-piled along the rear, and material for this p pose is now on hand at the harbor. A special land driver was b last year for this kind of work, but as it was first needed at other l bors it could not be made available for this harbor until now.

Operations have now been begun and the work will be pushed rapidly as circumstances will permit.

Soundings made March 21 showed an available depth of only 9 10 feet at the entrance over a distance of some 400 feet and it is tended to send one of the Government dredges to this harbor at first opportunity.

A permanent bench mark was established on the doorsill, south of the light-house, and connected by duplicate levels with the Un States gauge. Its elevation is 20.83 feet above the zero. A serie accurate water-gauge readings was commenced June 1, to be contin through June, July, and August, for the purpose of obtaining data adjusting the zero of the gauge to a uniform level with the gauge the other harbors.

The balance of $11,400, available July 1, will pay for the work, under way, of sheet-piling part of the north and south pile structu for building new superstructure on north revetment from Station 7- to 10+56 (316 linear feet), for repairing the south-side crib work, for the dredging required this season.

The amount that can be profitably expended during the next y is: For building five new cribs on north pier, $23,750, and four cribs on south pier (to complete the project), $24,000; for 367 lin feet new superstructure and filling on south pier, $3,670; for sh piling 1,000 additional feet of north and south revetments, $3,000; for dredging, $3,000, which, with 10 per cent for contingencies, ma $63,000.

The Light-House Establishment maintains a fourth-order flashing coast ligh the shore and a sixth-order harbor light on the south pier. The Life-Saving Ser has a station on the north pier.

This harbor is included in the Michigan collection district, Michigan. The n est port of entry is Grand Haven, Mich.

Appropriations for improving harbor at White River, Mich.

March 2, 1867	$57,000	March 3, 1879	$
April 10, 1869	44,550	June 14, 1880	
July 10, 1870	20,000	March 3, 1881	
March 3, 1871	20,000	August 2, 1882	1
June 10, 1872	10,000	July 5, 1884	1
March 3, 1873	7,000	August 5, 1886	1
June 23, 1874	10,000	August 11, 1888	1
March 3, 1875	10,000	September 19, 1890	1
August 14, 1876	5,000		
June 18, 1878	12,000	Total	27

Original estimated cost of work, 1866, amended in 1873, 1881, and 1892	$337,5
Whole amount appropriated, 1866, to and including act of September 19, 1890	274,5
Whole amount expended to June 30, 1892	262,9

Money statement.

891, balance unexpended	$18,117.94
1892, amount expended during fiscal year	6,482.12
892, balance unexpended	11,635.82
1892, outstanding liabilities	195.92
1892, balance available	11,439.90
appropriated by act approved July 13, 1892	5,000.00
available for fiscal year ending June 30, 1893	16,439.90
nt (estimated) required for completion of existing project	43,225.00
nt that can be profitably expended in fiscal year ending June 30, 1894	58,000.00

itted in compliance with requirements of sections 2 of river and bor acts of 1866 and 1867.

COMMERCIAL STATISTICS, WHITE RIVER HARBOR, MICHIGAN.

Entrances and clearances.

Year.	Number.	Revenue collected.	Tonnage.
ear:			
	304	$1,347.23	....
	1,416	476.16	....
	1,623	313.65	....
	1,885	....	262,440
	1,742	....	184,247
r year:			
	1,408	....	147,142
	732	....	....
	579	....	62,276
	405	....	47,135

*Receipts and shipments by vessels, 1891.**

rticles received.	Quantity.	Tons.	Articles shipped.	Quantity.	Tons.
tons	....	82	Hay .... tons	....	20
do	....	127	Lumber .... feet, B. M.	20,395	35,691
bushels	21,346	587	Lath	350,000	105
tons	....	5	Slabs .... cords	7,119	19,136
barrels	116	13	Ties .... number	17,000	1,530
dise .... tons	....	148	Wood and bark .... cords	735	919
barrels	10	2			
d bark .... cords	205	256			
barrels	20	2			
	....	1,222		....	57,401

*Compiled from statement furnished by the collector of customs.

K K 9.

IMPROVEMENT OF MUSKEGON HARBOR, MICHIGAN.

official project adopted in 1866 and amended in 1880 and 1889, gain revised in 1892, provides for a navigation 15 feet deep, en piers 300 feet apart at the entrance and about 180 feet at the line.

ry 25, 1892, a special report was submitted to the Chief of En-

gineers, setting forth the condition and needs of the harbor, and sh
ing with detailed estimates measures required for the construction
maintenance of a reliable 15-foot navigation. The report estimates
an extension of both piers 800 feet to reach the 20 foot contour in
lake; for dredging from lake to lake, with channel width of 75 feet
depth of 18 feet, and for revetting both banks from the inner end of
pier to Muskegon Lake. The total estimate for this work is $260,
and recommendation was made for appropriation of $150,000 to c
two seasons' work. A copy of this report is herewith for incorporat

The north pier, as now existing, consists of 800 linear feet of
work, parallel with and distant from south pier 300 feet; of 329.6 li
feet of crib work built in 1891–'92, connecting the outer portion of
pier at an angle with the interior portion, in order to close the
existing gap in the north pier; of 322 linear feet of old crib
and 392 linear feet of pile work parallel with the south pier, at a
tance of 180 feet. It projects about 900 feet beyond the present
line. The former end crib, which had been undermined and torn
from the rest of the work in 1889, has been removed and is now
contract to be replaced, together with one additional crib, which
been considered necessary to add in order to insure the stability
restored old crib.

The south pier consists of 800 linear feet of crib work and 380 l
feet of pile work, and projects about 920 feet beyond the present
line.

Both piers are in good condition, with the exception of the inn
feet of the north-side crib work, which is now from 22 to 24 year
and needs rebuilding above the water line, and the north-side
work, which is somewhat unstable, in consequence of undermining
needs an additional row of piles along the channel wall and other
repairs. Besides, there is some additional stone needed to refi
crib work and to riprap the end of the south pier.

From the inner end of the Government works to Muskegon Lak
channel banks are partly revetted with slabs. This work was do
former years by the occupants of the shore, but since the lumber
have been removed they have received no care and are now fast b
ing down. The project includes the substitution of new sheet pi
vetments for the old slab docks, and the material for 1,000 linear f
this work for the north side is now on hand.

Contractor E. G. Crosby completed the removal of 316 linear f
the inner north pier and the construction of the new crib work to
the gap between the remaining portion of the old pier and the
detached pier in October, 1891. The removal of the old pie
effected by blasting it out with dynamite and dredging up the d
All the old stone filling was saved and afterwards used again in th
crib work. The latter consists of seven cribs, 20 feet wide, th
cribs being framed to form close joints with the adjacent struc
which they connect. The cribs rest on a pile foundation, and wit
superstructure are 20½ feet high.

The total length of the new work is 329.6 feet on the channel
2 feet of which overlap the horns of the former detached piers
both ends it is securely connected with the old structures. It is
with stone to the top and decked over.

Gaylord & Wing, the contractors for the raising and restorat
the outer sunken crib of the north pier, having commenced
operations June 29, continued their work under considerable di
ties. They removed the stone filling by means of divers, and

eptember had so far completed that portion of the undertaking justified in attempting to raise the crib with chains and jack-igged up on a specially constructed platform of piles and tim-e long exposure of the crib to the effects of the frequent and orms of the season had weakened it, however, to such degree ailed to withstand the strain and tore apart just above the bottom. The two parts were then raised separately, towed to ichorage in Muskegon Lake, and left for the winter.

tone removed from the crib by the contractors measured 153 cords of which were placed in the old work as filling, which is eded, the remaining 81 cords being stored on top of the pier e use in filling the restored crib. The 72 cords placed in the will be replaced by the contractors at their own cost. They mitted to deposit it in the pier at their request, as it hindered their operations, and were in consequence willing to replace per cord, which is a much lower price than that at which erial can be bought here under ordinary circumstances. As s no possibility of their completing the work within the time by the contract, the contractors requested an extension to 1, 1892, and this was granted by the Chief of Engineers.

iprobability of the contractors completing the work on the old ore August 1, 1892, and the impracticability of having other ors carry on operations at the end of the pier at the same time, ently led to a recommendation to the Chief of Engineers to the Gaylord & Wing contract for restoration, by adding to it the construction of the additional crib to be placed outside of red old one, and also to modify the first contract in so far as to the stone foundation, later developments showing that it entirely practicable to replace the old crib on a pile founda-l insure more uniform work. This recommendation received oval of the Chief of Engineers, and a supplementary contract ng these provisions was concluded with Gaylord & Wing 5, 1892, the work to be completed September 1, 1892.

ontractors resumed operations under the modified contract May upper part of the old crib was cut up, saving only the unin-oss-ties and the iron for use in the reconstructed crib. A new ill was placed under the recovered lower portion, which was e restored by new timber blocking and bolting to a sound and ory condition, and the crib entirely rebuilt from the third course the suitable old and otherwise with new material. At the the fiscal year the structure had been completed to the twelfth

onstruction of the new crib has progressed to include the twen-urse, which makes the crib ready for sinking in its place when foundation shall have been prepared.

beginning of the fiscal year the navigable depth in the har-from 15 to 16 feet at the entrance and between the piers. Soon closing of the gap in the north pier this commenced to show on the entrance channel. The former gap had acted as a sort way, the large body of water pouring through under the influ-northerly gales assisting by its scouring effect in maintaining n navigable depth in the outer portion of the fairway. The of the closing structure, namely, the removal of the dangerous rrents at the entrance, had been fully attained, but the channel perceptibly. At the end of September the 15-foot depth had d to 70 feet next to the south pier, and the remainder of the space between the piers was occupied by a shoal with only 11 feet wa over it.

In order, if practicable, to restore the needed depth of water, and the earnest solicitation of the harbor interests, the Government dre Farquhar commenced work October 9, but the season was so rough th to November 30 but sixteen days were partially fit for dredging, and four of these at the end of the pier. The benefit of this dredging to harbor was consequently very slight, and the cost per yard very hea viz, 32 cents. Four thousand nine hundred and ten cubic yards the quantity removed during the seven and a half weeks that the dre was kept in commission.

This endeavor to relieve navigation near the end of the pier and late in the season was undertaken and continued with two objects view: First. The attainment, if by chance it were possible, of the sired result, as to which, however, no favorable expectations whate were entertained. Second. To prove conclusively the practical culties and outlay involved in such an attempt, and thereby meet facts, in lieu of arguments, the insistance on the part of those in ested, both at Muskegon and at several other points, that the Gov ment dredge be kept under pay for the work in question. The dem stration was convincing and worth what it cost to make it.

At the opening of navigation in 1892 great difficulty was imm ately experienced by entering and departing vessels; a number of sels grounded in the shoal water and were with difficulty relea There was a depth of scant 12½ feet close to the south pier.

The Government dredge *Saginaw* began work April 21, dug a c nel 100 feet wide and 18 feet deep at the entrance, and removed the s places in the inside navigation to Muskegon Lake to a depth of 16 completing this work May 31. The quantity of material removed 30,914 cubic yards.

On May 5 the *Saginaw*, while at work at the harbor entrance the spuds down, was run into by the *City of Racine*, breaking two sp The dredge was delayed four days making repairs.

A permanent bench mark was established on top of the stone si the most southerly window on the east side of the light-house. Its vation is 9.43 feet above zero of gauge. A series of accurate wa gauge readings was commenced June 1, to be continued through J July, and August, for the purpose of procuring data for the adjustm of the zero of the gauge to a uniform level with the gauges at the o harbors.

Upon completion of the work now under contract both piers lack 800 feet of their full extension according to the revision of J ary, 1892.

The recommendations for the fiscal year 1894 are: For 322 linear new superstructure, north pier, Stations 3 + 16 to 6 + 38, $3,220; fo pairing north pile pier and revetment, $700; for refilling both piers riprapping end of south pier, $1,500; for building 1,000 linear feet sh pile revetment, north side (timber and piles on hand), $2,000; for 2 additional feet sheet-pile revetment (1,000 on each side), $12,000 ten new cribs on the north pier and ten on the south pier, $120,000 for dredging, $4,000, which, with 9 per cent for contingencies, m $156,000.

The Light-House Establishment maintains a fourth-order coast light on the shore and a sixth-order harbor light on the south pier. The Life-Saving Servic a station on the north pier

This harbor is included in the Michigan collection district, Michigan. The ne port of entry is Grand Haven, Mich.

Appropriations for improving harbor at Muskegon, Mich.

2, 1867	$59,000	March 3, 1881	$20,000
, 1870	10,000	August 2, 1882	25,000
3, 1871	15,000	July 5, 1884	20,000
), 1872	10,000	August 5, 1886	12,500
, 1874	10,000	August 11, 1888	45,000
3, 1875	25,000	September 19, 1890	50,000
14, 1876	15,000		
3, 1879	5,000	Total	329,000
, 1880	7,500		

l estimated cost of the work, 1866, amended in 1869, 1873, 1881, 1890, and 1892		$589,000.00
amount appropriated from 1866 to and including act of September 9, 1890		329,000.00
amount expended to June 30, 1892		317,796.53

Money statement.

1891, balance unexpended		$44,727.79
0, 1892, amount expended during fiscal year		33,524.32
1892, balance unexpended		11,203.47
1892, outstanding liabilities	$311.23	
1892, amount covered by uncompleted contracts	9,640.39	
		9,951.62
1892, balance available		1,251.85
t appropriated by act approved July 13, 1892		75,000.00
t available for fiscal year ending June 30, 1893		76,251.85
unt that can be profitably be expended in fiscal year ending June 1894		156,000.00

nitted in compliance with requirements of sections 2 of river and rbor acts of 1866 and 1867.

COMMERCIAL STATISTICS, MUSKEGON HARBOR, MICHIGAN.

Entrances and clearances.

Years.	Number.	Revenue collected.	Tonnage.
ear:			
	7,160	$4,987.06	
	6,112	1,621.34	
	5,543	1,025.17	
	1,745		232,007
r year:			
	2,685		
	4,626		884,869
	3,786		649,540
	2,886		704,046

Receipts and shipments by vessel, 1891. *

Articles received.	Quantity.	Tons.	Articles shipped.	Quantity.	Tons.
[illegible]	[illegible]	[illegible]	Crackers .... barrels..	300	[illegible]
[illegible]	[illegible]	[illegible]	Fish .... do....	340	[illegible]
[illegible]	[illegible]	[illegible]	Flour .... do....	1,170	[illegible]
[illegible]	[illegible]	[illegible]	Fruit and vegetables..tons..	....	[illegible]
[illegible]	[illegible]	[illegible]	Furniture .... packages..	34,221	[illegible]
[illegible]	[illegible]	[illegible]	Iron .... tons..	....	[illegible]
[illegible]	[illegible]	[illegible]	Lath .... M..	13,747	[illegible]
[illegible]	[illegible]	[illegible]	Lumber ...... M feet, B. M..	274,986	[illegible]
[illegible]	[illegible]	[illegible]	Merchandise .... tons..	....	[illegible]
[illegible]	[illegible]	[illegible]	Paper .... do....	....	[illegible]
[illegible]	[illegible]	[illegible]	Plaster .... barrels..	5,739	[illegible]
[illegible]	[illegible]	[illegible]	Staves .... packages..	11,100	[illegible]
[illegible]	[illegible]	[illegible]	Sundries .... do....	34,641	[illegible]
[illegible]	[illegible]	[illegible]	Sugar .... barrels..	21	[illegible]
[illegible]	[illegible]	[illegible]	Sawdust .... tons..	....	[illegible]
[illegible]	[illegible]	[illegible]	Shingles .... M..	9,463	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] .... cords..	152,000	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] .... do....	596	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] ...... number..	580	[illegible]
[illegible]	[illegible]	[illegible]	Total	....	1,121,[illegible]
Total					

* Compiled from statement of [illegible] Board of Trade of Muskegon.

REPORT OF MAJOR WILLIAM [illegible]OW, CORPS OF ENGINEERS.

UNITED [illegible]TES ENGINEER OFFICE,
[illegible], Mich., *January 25, 1892.*

GENERAL: Pursuant to telegraphic instructions of January 22, I beg to report as follows relative to the present condition of Muskegon Harbor, Michigan, and to what is required for its improvement. The accompanying blue prints show the condition of the harbor at the respective times of examination, viz, September, 1890, and November, 1891. From the depths as shown on the tracing are to be deducted the variation of the lake surface below the harbor zero, constituting the corrections or reduction, which vary 6 inches to 2 feet on the 1890 map and 1.7 on the 1891 map. As appears to be the case almost invariably, at this harbor a 13-foot bar exists outside the piers, and this depth is reduced at times by an abnormal wave action during heavy gales in fall and spring. The navigation depth is thus diminished at times to 11 feet, and the entrance becomes unsafe or impracticable for laden vessels of the ordinary lake drafts. The official project for Muskegon Harbor provides for an actual navigation of 13 feet, but it is evident that to secure this reliably three points must be covered.

1. The piers should have such extension into the lake as to cover the entrance to such depth beyond the actual navigable depth as to protect the channel when made, and to allow for the rise and fall of the sea and the send of a heavy vessel. This would indicate that the pier should reach at least the 20-foot contour in order to be sure of having 15 feet clear between them.

2. The fairway between the piers, and thence upward, should [illegible] dredged to a depth sufficient to allow for reduction of lake level be[illegible] the zero plane, and for the inevitable filling in of the dredged cha[illegible] which follows disturbance of the bottom and ensues from the brea[illegible] down of the channel walls and the readjustment of the bottom mater[illegible]

indicates dredging to, say, 18 feet in order to be sure of securing r 16 feet.

) In order to prevent as far as may be the access of loose material the banks, these must be revetted throughout the length of the lged channel of entrance, as the action of currents, of waves, of d, and of passing vessels tends constantly to the erosion of the nnel banks, the seepage of sand into the channel, and its delivery he fairway.

complete statement of what is required for the thorough improve-it of Muskegon Harbor, in order that its navigation may be fully properly adapted to the commercial requirements, must include ee items:

1) Pier extension in such measure as is needful to create and protect lear 15-foot navigation. This, for the present, is assumed at about feet, although it is by no means certain that ultimately the 25-foot ntour in the lake should not be reached.

(2) The dredging of the channel or fairway from lake to lake to a pth, say, of 18 feet, with a width of 75 feet.

(3) The revetment of both banks, whenever unprotected, with as onomical a structure as will be substantial. For this purpose the llowing estimates are made:

(1) Pier extension. To enable both piers to reach the 20-foot contour the lake an extension of 800 feet is required for both. Estimating e cost of this work from the most recent and reliable data for similar nditions, the cost per linear foot will average $120.

(2) To dredge a channel 75 feet wide and 18 feet deep from lake to ke requires the handling of 54,000 cubic yards, which under contract ll cost say 15 cents per cubic yard.

(3) The revetting of the naked banks involves covering some 5,600 ear feet on the two banks, and the structure proposed for this will st $6 per linear foot. The total estimate therefore is as follows:

00 linear feet pier, at $120	$192,000
00 cubic yards dredging, at 15 cents	8,100
00 linear feet revetment, at $6	33,600
Total	233,700
ntingencies, 11 per cent	26,300
Aggregate	260,000

The funds in hand will suffice to build a single crib on the north pier tside of the damaged crib, which is under contract of restoration, d the total pier extension above noted of 800 feet on each pier is com-ted from what would be the outer ends of the two piers, supposing e work now under way and immediately in prospect to have been mpleted. There are at this time the materials for about 1,000 linear t of revetment on the north pier under contract, and we have funds ough to build it. The present revetment estimate, therefore, omits is from consideration. The dredging estimate is computed on the sis of the most recent survey.

The estimate of $50,000 given in the annual report 1891, as the basis r appropriations for the fiscal year 1892, was intended to cover 300 tension of pier, half on each side; 2,000 linear feet of revetment, each side, with an allowance for dredging and contingencies.

r the system of biennial appropriations for rivers and harbors as prevailed of late years, the appropriations to be made at this Congress must do duty for two years. In the case of Mus-gon's work would be about as follows: Say 10 cribs for [illegible] on each side, 2,800 feet of revetment, and all dredging, the cost of which in all would be, with contingencies, [illegible]

During the following season, the remaining half of the revet[ment] would be built, and say, [illegible] more cribs, which, with some allowan[ce for] dredging and contingencies, would cost say $96,000, leaving the re[main]ing ten cribs to be added later. If, therefore, the improvement o[f this] harbor were to be planned and prosecuted as an engineering me[asure] without reference to the system of scaling annual appropriations, [and] to prolong the work and maintain it in an unfinished conditi[on, the most] favorable method of appropriating would be the allotment of the [amount] required for the season of [illegible] and [illegible], namely $176,000.

It is not to be expected that an appropriation of this amount c[an be] had at one time, but it is evident from the data furnished that a[n ap]propriation of [illegible] could be advantageously expended i[n the] ensuing two years.

In explanation of the commercial conditions expending upo[n] access to the harbor of Muskegon, I can hardly do better than [refer] to my annual reports of 1880 and 1881, copies of which are herew[ith].

Respectfully,

WILLIAM LUDLOW,
Major, Corps of Engineers,

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

K K [illegible]

IMPROVEMENT OF GRAND HAVEN HARBOR, MICHIGAN.

The existing project, adopted in [illegible], and amended in 1880 and [illegible], is to secure an entrance channel 18 feet deep between piers and [revet]ments 400 feet apart.

The present constructions are as follows:

On the north side 1,059 linear feet of crib work and 2,128 linea[r feet] of pile pier and revetment, or a total of 3,187 linear feet, proje[cting] 1,200 feet beyond the present shore line.

On the south side 1,205 linear feet of crib work and 4,272 linea[r feet] of pile pier and revetment, a total of 5,477 linear feet, projecting [illegible] feet beyond the present shore line.

No difficulty was experienced during the past year by enterin[g or] departing vessels, the available depth never having been less tha[n] [illegible] feet between the piers, and 17 to 18 feet on the crossing of the [outer] bar, and the steamers of the Detroit, Grand Haven, and Milw[aukee] Railway made regular trips throughout the winter.

The construction of 6 new cribs, 3 on each pier, commenced d[uring] the previous fiscal year, under contract with E. G. Crosby, was [com]pleted in October, 1891. The cribs are each 50 feet long and [illegible] wide, and with the superstructure about 27 feet high in the nort[h pier] and about 29 feet high in the south pier. Each crib rests on a fo[unda]tion of 39 piles, the piles penetrating from 13 to 15 feet in the gr[ound]. The work was filled with stone to the top and decked over. A m[ooring] post was built into each crib. The foundation piling of the new xamined by a diver and found to be satisfactory, with a few slight tions, which were remedied by driving three additional piles and ing them under the cribs, to assist the same number of original , which had been found to project with part of their diameter out-

e lake bottom, which at the crib site had been 22 to 23 feet below ero of gauge previous to placing the cribs, scoured out afterwards lepth of 27 to 28 feet at the outer end of the south pier, but no hensions were entertained, as this was the greatest depth of h there was any record, and the foundation piles, which are twelve in number under each crib than those under any crib placed here- e, still had a penetration of about 10 feet. However, the great of December 4 and 5 threatened destruction to the new work. rt of this under date of February 18, 1892, is herewith. This gale h blew continously from thesouthwest with a maximum velocity of iles on the 4th and 49 miles on the 5th created a head of water in ngle between the south pier and the beach, causing a powerful off- e current along the lake wall of the south pier and around its outer and scouring out the bottom to the unprecedented depth of 38 feet w zero of gauge, undermining the foundation piles and letting cribs sink down. Measurements made after the cessation of the n showed that the amount of subsidence at the outer end was 11 while a lateral displacement had taken place at the same time, rds the south, to the extent of 11 feet at the lake end.

e superstructure timbers had been torn apart, there being gaps of t in the second crib from the end, and smaller ones at other places. e stone filling does not appear to have moved much at first. On ember 6 a noticeable settling was apparent only in one pocket of of the two outer cribs, both on the lake side, although a subsequent r's examination disclosed large holes under the cribs. On Decem- 14, one pocket of the outer crib had lost all its stone, two pockets e second crib were half empty, and nearly the whole lake side half e three new cribs had experienced a perceptible settlement of its g, while the filling along the channel side underwent almost no ge.

e piles under the end crib, where the diver found the bottom acces- e, had disappeared.

eps were immediately taken to strengthen the work temporarily, s to hold it till spring, when permanent repairs were to be made, the pier secured by the addition of new crib work. Extra timbers screw-bolted over the gaps in the superstructure, long drift bolts hing down into the cribs proper were driven through the super- cture timbers, and a large quantity of stone was cast around the outer cribs. About 40 cords of stone were borrowed from St. ph Harbor, where it was in store without immediate call for its use, the rest, about 80 cords, was taken from the inshore revetments. empty pocket of crib 3 and the corner pockets of crib 2 were refilled part of this stone. Since the beginning of January no further ge in elevation or alignment has been noticed.

circumstances attending the accident to the crib work indi- several defects in the general design of the cribs heretofore built, modified design was prepared for future use. The new plan s for a closed central compartment, of nearly half the total of the crib, to hold the permanent load, and a narrower com- t on each side, next to the side walls, with open bottoms to

[illegible]

[illegible] with stone.

[illegible] the location of the proposed [illegible] line [illegible] of the extension of the [illegible] [illegible] to be done [illegible] after the [illegible]

[illegible] Williams and [illegible] the several work.

[illegible] mark was established on [illegible] the [illegible] House, and connected [illegible] water gauge. The elevation is [illegible]

[illegible] of the present works and their [illegible]

[illegible] —This work is in good condition [illegible] the [illegible] railing of about 1,000 lineal [illegible] the [illegible] station [illegible] the [illegible] of the three [illegible] and [illegible]

[illegible] the completion of the repairs [illegible] of the [illegible] this work will be in good condition [illegible] linear feet of [illegible] and 2,835 feet of [illegible] The first-mentioned part was built [illegible] and has [illegible] repairs since that time, except [illegible] work. The second part was constructed in 1882 and [illegible] in the [illegible] blows from [illegible] it is built [illegible] parts should be rebuilt [illegible]

500 linear feet and the south pier of 300 linear feet beyond that ıder contract. The changes made necessary in the general plan ıs and foundation, to prevent a recurrence of the dangers like f last winter, inevitably enhance the cost of the work, and the ribs in view of their location far out in the lake can not be built sum considered sufficient heretofore.

estimate for the fiscal year 1894 is therefore as follows: 800 feet crib work to extend both piers and complete the project, 00; 2,500 linear feet of shore revetment, $15,000; sand fencing, planting, etc., $7,000; 2,300 linear feet repairs of south revet- $18,400; general repairs of existing works, $5,000; dredging , which, with contingencies, makes $180,000.

Light-House Establishment maintains a fourth-order flashing coast light f the entrance and a sixth-order light on the south pier, with duplicate fog

Life-Saving Service has a station on the north pier, inside the shore line. harbor is included in the Michigan collection district, Michigan. Grand is a port of entry.

Appropriations for improving harbor at Grand Haven, Mich.

30, 1852 (mouth of d River)	$2,000.00	August 14, 1876	$15,000.00
2, 1867 (mouth of d River)	40,000.00	June 18, 1878	15,000.00
, 1866	65,000.00	March 3, 1879	9,000.00
0, 1869	1,866.15	June 14, 1880	50,000.00
, 1870	10,000.00	March 3, 1881	50,000.00
1870 (allotment)	500.00	August 2, 1882	40,000.00
3, 1871	6,000.00	July 5, 1884	50,000.00
), 1872	15,000.00	August 5, 1886	30,000.00
3, 1873	75,000.00	August 11, 1888	25,000.00
, 1874	50,000.00	September 19, 1890	75,000.00
		Total	624,366.15

ıl estimated cost of the work, 1866, amended in 1880, 1890, and	$804,366.15
amount appropriated and allotted from 1852 to and including act ptember 19, 1890	624,366.15
amount expended to June 30, 1892	604,240.82

Money statement.

1891, balance unexpended		$58,422.18
), 1892, amount expended during fiscal year		38,296.85
1892, balance unexpended		20,125.33
1892, outstanding liabilities	$628.59	
1892, amount covered by uncompleted contracts	14,058.14	
		14,686.73
1892, balance available		5,438.60
t appropriated by act approved July 13, 1892		90,000.00
t available for fiscal year ending June 30, 1893		95,438.60
ınt (estimated) required for completion of existing project		35,000.00
ınt that can be profitably expended in fiscal year ending June 30, 1894		90,000.00

ıitted in compliance with requirements of sections 2 of river and rbor acts of 1866 and 1867.

t of proposals for extension and repair of South Pier, etc.—Continued.

	For repairs.				
	White pine (16,992 feet, B. M.).		Stone in work (250 cords.)		
s and address of bidder.	Per M feet B. M.	Amount.	Per cord.	Amount.	Total.
l, Manistee, Mich	$20.00	$339.84	$8.00	$2,000.00	$2,339.84
rosby, Muskegon, Mich	26.00	441.79	6.75	1,687.50	2,129.29
en, Racine, Wis	30.00	500.76	7.25	1,812.50	2,322.26
s. & Co., Grand Rapids	18.00	305.86	7.40	1,850.00	2,155.86
l & Co., Ludington, Mich	19.00	322.85	9.00	2,250.00	2,572.85
auvais, Charlevoix, Mich	52.00	543.74	17.00	4,250.00	4,793.74
th, Ludington, Mich	24.00	407.81	7.00	1,750.00	2,157.81
oper, Manitowoc, Wis	17.50	297.36	7.00	1,750.00	2,047.36
rns, Charlevoix, Mich	20.00	339.84	7.00	1,750.00	2,089.84

awarded to Messrs. Truman & Cooper, and executed under date of April

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COMMERCIAL STATISTICS, GRAND HAVEN HARBOR, MICHIGAN.*

Entrances and clearances.

Year.	Number.	Revenue collected.	Tonnage.
	2,331	$5,221.81	
	1,634	1,985.43	
	1,384	1,548.32	
	1,297		632,159
	1,888		1,036,620
:			
	1,508		1,405,600
	1,110		649,370
	1,172		834,089
	819		616,422

*Receipts and shipments by vessel, 1891.**

s received.	Quantity.	Tons.	Articles shipped.	Quantity.	Tons.
barrels	3,926	393	Beer, barrels	54	5
tons		17,315	Cement, do	100	15
do		5,657	Cheese, boxes	200	4
do		134	Coal, tons		1,658
barrels	725,355	72,535	Fruit, do		960
bushels	15,888	437	Fish, barrels	330	36
tons		33,773	Gravel, tons		3,250
tierces	5,951	982	Iron, do		1,058
bundles	38,072	1,904	Lumber, M feet, B. M	3,761	6,582
barrels	280	31	Leather, bundles	18,739	937
et, B. M	360	630	Lime and cement, tons		49
tons		7,223	Merchandise, do		21,556
sacks	17,131	685	Paper stock, bales	1,291	65
kegs	772	39	Rags, do	31	7
barrels	60	12	Seeds, bushels	2,282	114
do	2,146	215	Staves, car loads	43	753
bales	1,734	390	Slabs, cords	1,643	4,416
p, do	5,625	3,655			
cords	5,026	31,412	Total		40,865
sacks	2,282	114			
cases	831	8			
bales	3,319	290			
tons		200			
barrels	4,752	475			
		178,499			

ed from statements furnished by the collector of customs and by Col. R. C. Duryea.

REPORT OF MAJOR WILLIAM LUDLOW, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., February 13,

GENERAL: I have the honor to forward herewith plans and specifications and form of advertisement for the continuation of work at Grand Haven Harbor, Michigan, with request for consideration and approval.

The steps in this direction would have been taken earlier had it not been for the damage to the outer three cribs of the south pier, to which reference was made in the monthly report for December. It has been necessary to keep these cribs under observation for a certain period in order to feel sure that the limit of movement had been reached before making arrangements for additional work. The storm of December 4 on Lake Michigan was of exceptional severity, and occasioned notable changes at nearly all the harbors on the east coast, the wind blowing heavily and continuously from the southwest, producing a very heavy sea at the entrance and setting in motion immense quantities of sand in the lake bed.

At Grand Haven, owing to the great projection of the pier into the lake, a formidable scouring action was developed, due to the piling up of the water in the angle between the south pier and the shore line, whence it escaped in a powerful current offshore along the pier and across its outer end northward.

The erosion adjacent to the pier amounted to from 5 feet at about 1[illegible] feet from the end to 10 feet at its extremity, in consequence of which the current cut under the three outer cribs, leaving the foundation piles exposed and letting the cribs down by the inability of the piles to support them.

It was at first feared that these three cribs, which were built last season and as well as any on the lake, were practically destroyed, but within two or three weeks after the storm the cribs seemed to reach their ultimate movement, the excess of depth adjacent to them was partly refilled, and observation by transit and level indicate that a permanent position has been reached.

Two results ensue:

1. It had been proposed with the balance to the credit of the appropriation to continue construction by building four new cribs, two on each pier, but this balance must be drawn upon to rebuild the superstructure of the three damaged cribs, to restore the level and integrity of the work. It is estimated that these repairs will cost between $3,000 and $4,000, nearly the cost of one 50-foot crib.

The possibilities of construction at this time are therefore reduced to three cribs, two on one pier and one on the other. The construction of a single crib at the outer end of piers so exposed as at Grand Haven is inexpedient for the reason that the precautionary additions to an end crib to secure its safety until further extension can be made, cost about [illegible] in excess of that of an interior crib, and this expense is wasted as soon as additions to the pier are made. As it may be expected that further appropriations will presently be made for Grand Haven, it is therefore deemed advisable to defer the single outer crib for the north pier and limit the construction at this time to the addition of two cribs to the south pier.

2. [illegible] it does appear advisable to build three new cribs on the south pier [illegible] the history of the harbor indicates that the mean action [illegible] wind and waves at this harbor is nearly normal to the shore line, a[illegible]

at the resultant action is directly shoreward and that the best results navigation have been found when the outer ends of the two piers are pt nearly abreast of each other.

(2) Pile foundations have in general been used for the eastern Lake ichigan harbors with good results but with occasional failure, as rmerly at Muskegon and Michigan City and recently at Grand Haven. n the other hand, the riprap foundation used elsewhere on the lake some cases, as at Chicago, with satisfactory results, when tried two asons ago at Michigan City in connection with the outer breakwater as not satisfactory, the weight of the cribs, etc., forcing the riprap 5 nd 6 feet into the lake bed, and requiring subsequent raising on two casions. Furthermore, after two years of settlement, a hard northerly orm, at Michigan City last fall, was still found to affect the line and vel of the work. The recent experience with the Grand Haven cribs as proved conclusively that at so great a projection into the lake, xposed to powerful currents and seas, a pile foundation alone is not liable, while the Michigan City experience indicates that a riprap undation requires for ultimate rest an undue and uncertain period of me.

It is, therefore, necessary in the Grand Haven case to combine the wo methods, and, for the attainment of a reliable level as well as ecurity of construction, to use a foundation of piles driven to proper epth and to strengthen these and prevent erosion of the lake bed by free use of riprap.

The accompanying plans and specifications provide for these and for nother point in addition. If 100 linear feet of pier are to be built there does not seem to be any sound reason for not building a single crib 100 feet long instead of two cribs of 50 feet each.

The advantage of the single structure in point of strength being continuous at every course from the bottom up instead of being entirely separated below the superstructure would seem obvious, and there should be some economy also perhaps.

It is true that an attempt some years ago at one of the western harbors to sink a 100-foot crib was not entirely fortunate, but this, it is believed, was due to insufficient means of loading the crib promptly, the stone scows being of small dimensions. The stone scows now in use on the lake are of large dimensions, capable of carrying 150 to 200 cords of stone, and the specifications provide that the crib shall be half filled within twelve hours and entirely so within twenty-four. There is no reason to anticipate any difficulty in this direction, and none that will offset the advantages of the single construction, which, it is believed, will in the present case be found entirely advantageous.

It is therefore proposed to contract for a 100-foot crib, and in addition to procure the material, timber, and stone necessary to rebuild and refill the superstructure of the damaged cribs. This work can not well be specified, and, as in similar cases, it is proposed to do the work by hired labor, contracting only for the delivery of the material.

Should the project and specifications be approved, it is requested that the inclosed advertisement and accompanying letter to the chief clerk of the War Department be forwarded, and that authority be given to print 250 copies of the specifications.

Very respectfully,

WILLIAM LUDLOW,
Major, Corps of Engineers, Bvt. Lieut. Col., U. S. A.

g. Gen. THOMAS L. CASEY,
ief of Engineers, U. S. A.

orth beach and 304 feet on the south beach, with some 40 feet of ·al fence on the back wall of the north pier at shore line, to stop ying sand from blowing into the waterway.

ermanent bench mark was established on the stone foundation of ght-keeper's dwelling and connected by duplicate levels with the d States gauge. Its elevation is 6.98 feet above the zero of the e. A series of accurate water-gauge readings was commenced 1, to be continued through June, July, and August, for the pur of procuring data for the adjustment of the zero of the gauge to form level with the gauges at the other harbors.

make the revetments subserve their purpose of excluding sand the channel they should be sheet piled, the north pier from Sta- 5+10 to 12+60, or 750 feet, and the south pier from Station 5+50 +90, or 740 feet. As it may be impossible to drive sheet piles g the rear of the works on account of the brush and driftwood om, it may be necessary to drive them along the face of the chan- wall, and in that case they must be protected by special guard piles waling timbers.

he remainder of the north revetment from Station 16+22 to 18+50, 28 linear feet, should be rebuilt above water, and some minor re- s made to the rest of the works.

e available balance, July 1, is $2,100, and it is proposed to use this redging and incidental repairs.

e estimate for the fiscal year 1894 is: Sheet piling, north and south tments, 1,492 linear feet, $7,460; general repairs of existing works, ding new superstructure of 228 feet of north revetment, $5,000; ging channel, $3,000, which, with contingencies, makes $17,000.

addition, provision should be made for further extension of the , for which purpose the project should be amended to reach the ot contour in the lake.

Light-House Establishment maintains a fifth-order harbor light, and the Life- g Service a station on the south pier.

s harbor is included in the Michigan collection district, Michigan. The near- rt of entry is Grand Haven, Mich.

Appropriations for improving harbor at Black Lake, Michigan.

st 30, 1852	$8,000.00	March 3, 1879	$6,000.00
23, 1866	55,615.31	June 14, 1880	6,000.00
h 2, 1867	51,000.00	March 3, 1881	6,000.00
11, 1870	10,000.00	August 2, 1882	10,000.00
h 3, 1871	10,000.00	July 5, 1884	15,000.00
10, 1872	10,000.00	August 5, 1886	5,000.00
h 3, 1873	12,000.00	August 11, 1888	5,000.00
23, 1874	15,000.00	September 19, 1890	10,000.00
h 3, 1875	15,000.00		
st 14, 1876	15,000.00	Total	274,615.31
18, 1878	10,000.00		

nal estimated cost of the work, 1866, amended in 1873, 1879, 1884, l 1892	$291,615.31
e amount appropriated, 1852, to and including act of September 19, 0	274,615.31
e amount expended to June 30, 1892	272,242.87
nt carried to surplus fund	1.19

Money statement.

July 1, 1891, balance unexpended ....
June 30, 1892, amount expended during fiscal year ....

July 1, 1892, balance unexpended ....
July 1, 1892, outstanding liabilities ....

July 1, 1892, balance available ....
Amount appropriated by act approved July 13, 1892 ....

Amount available for fiscal year ending June 30, 1893 ....

Amount that can be profitably expended in fiscal year ending June 30, 1894
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS, HOLLAND (BLACK LAKE) HARBOR, MICHIGAN.

Entrances and clearances.

Year.	Number.
Calendar year 1891	2,676

*Receipts and shipments by vessel, 1891.**

Articles received.	Quantity.	Tons.	Articles shipped.	Quantity.
Bark .... cords	30,000	10,000	Butter .... tons	
Brick .... M	7,250	2,000	Coal .... do	
Butter .... tons		67	Flour .... barrels	70,000
Coal .... do		22,000	Fish .... tons	
Grain .... bushels	170,000	5,100	Fruit .... do	
Hay and feed .... tons		1,329	Farm products ... packages	16,802
Iron .... do		123	Furniture .... do	420,000
Laths .... M	300	90	Grain .... bushels	30,000
Lumber .... M feet, B. M.	12,000	21,000	Hay and feed .... tons	
Lime and cement .... barrels	3,000	398	Live stock .... head	1,000
Leather and hides .... tons		780	Leather and hides .... tons	
Logs .... do		22,000	Lumber .... M feet, B. M.	1,437
Miscellaneous freight .... do		3,611	Machinery .... tons	
Machinery .... do		1,611	Potatoes .... bushels	30,000
Merchandise .... packages	270,000	1,918	Stone .... cords	3,926
Posts .... number	1,000	200		
Salt .... barrels	6,200	866		
Stone .... tons		300		
Slabs .... cords	2,000	5,278		
Shingles .... M	2,000	250		
Total		100,630	Total	

K K 12.

IMPROVEMENT OF SAUGATUCK HARBOR, MICHIGAN.

The project for this improvement was adopted in 1869 and revised ... It was originally proposed to create a 12-foot navi... ... to be prepared and maintained by dredging at ...

*Compiled from statement furnished by W. C. Walsh, esq., Holland, Mich.

for a permanent work to cut across this neck of land and make the improve- that point, but on account of the improvements already made at the present of the river, which are available, estimates for opening this channel were the expenditures being deemed too great.

y also be stated that an additional reason for adhering to the river channel was the fact that it had already a navigable f about 8 feet, which encouraged the belief that it could be ed effectively to 12 feet.

efforts to improve the present entrance, however, by remodeling tending the existing revetments from the lake along the south f the river to above the bend and revetting the north bank at d and at the entrance proved unavailing. The revetment in d was repeatedly undermined, and the sands from the naked orth of the harbor poured steadily into the channel under the of the northwest gales, and repeated dredging insured an en- depth of but 10 feet, and for short periods only.

82 it was concluded that the depth of 8 feet then existing, and hich the draft of water had varied little for many years, was ly sufficient for "the present and prospective commerce," and e appropriations should be applied merely to maintaining the in their then existing condition.

last appropriation was made for this harbor in August, 1888, hich time the entrance has been kept partially open by the nal service of a dredge.

dredging of May, 1891, was instrumental in maintaining a toler- avigable channel till the fall of the year, but in May, 1892, the depth on the bar, covering the entire width of the harbor, nearly te the light-keeper's dwelling, was found to be only 3 feet; at the the piers the water was 6 feet deep, and on the outlying bar 8

steamers trading to Saugatuck and requiring from 7 to 8 feet of have been in the habit of scouring out a temporary channel with ropeller wheels, but it is evident that a channel obtained by such is but temporary, as the sands are only removed from one place should be made for the extension and completion of the necessary work. The present conditions are as follows:

The piers and revetments are in urgent need of repairs. The south pier from the outer end to Station 25+24, 2,524 linear feet, is a total wreck. It should be rebuilt above the water surface and refilled with brush and stone. New filling is also needed in the remaining 1,339 feet of the south revetment and in the north pier 714 feet, and the upper end of the south revetment should be connected with the shore to keep the river from cutting behind it. A great part of the north revetment in the bend is swallowed up by the sand advancing from the north, and the remaining part has become a danger to navigation, as it has caved over into the channel, a considerable portion of the piling being below the water surface. It should be replaced by a more substantial structure.

The recent soundings show the 5-foot curve of Lake Michigan to be 400 feet in advance of the north pier and about 200 feet from the south pier. With this condition of affairs it can not be expected to maintain a navigation of even 5 feet.

A permanent bench mark was established on top of stone foundation southeast corner of light-keeper's dwelling (the former light-house), and connected by duplicate levels with the United States gauge. It is [illegible] feet above zero of gauge.

A series of accurate water-gauge readings was commenced June 1, to be continued through June, July, and August, for the purpose of obtaining data for adjusting the zero of the gauge to a uniform elevation with the gauges at the other harbors.

To preserve the present structures, pending serious attention to the completion of the improvement, the outer 2,524 feet of the south pier should be rebuilt above the water surface and the remainder of the south revetment and the outer north pier, altogether 2,050 feet, should be refilled with brush and stone. This is estimated to cost $25,000. For dredging the sum of $5,000 is estimated required. The total estimate for 1894 is, therefore, $30,000.

The light-house establishment maintains a fifth-order light on the south pier.

This harbor is included in the Michigan collection district, Michigan. The nearest port of entry is Grand Haven, Mich.

Appropriations for improving harbor at Saugatuck, Mich.

July 25, 1868	[illegible]	March 3, 1879	$5,000
April 10, 1869	[illegible]	June 14, 1880	5,000
July 11, 1870	10,000	March 3, 1881	5,000
March 3, 1871	20,000	August 2, 1882	8,000
June 10, 1872	15,000	July 5, 1884	4,000
March 3, 1873	20,000	August 5, 1886	8,000
June 23, 1874	10,000	August 11, 1888	5,000
March 3, 1875	10,000		
August 14, 1876	3,000	Total	140,439
June 18, 1878	2,500		

Original estimated cost of the work, 1867, modified in 1869, 1870, 1875, [illegible] $175,699.46

Whole amount appropriated from 1868 to and including act of August [illegible] 140,439.00

Whole amount expended to June 30, 1892 .... 139,094.25

Money statement.

y 1, 1891, balance unexpended	$1,458.30
e 30, 1892, amount expended during fiscal year	113.55
y 1, 1892, balance unexpended	1,344.75
y 1, 1892, outstanding liabilities	10.00
y 1, 1892, balance available	1,334.75
ount appropriated by act approved July 13, 1892	5,000.00
ount available for fiscal year ending June 30, 1893	6,334.75
Amount (etimated) required for completion of existing project	30,260.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	30,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS, SAUGATUCK HARBOR, MICHIGAN.

Entrances and clearances.

Years.	Number.	Revenue collected.	Tonnage.
scal year:			
1884	300	$422.84	
1885	265	118.86	
1886	(*)	(*)	
1887	(*)	(*)	
lendar year:			
1888	662		132,400
1889	314		76,300
1890	178		42,000
1891	492		120,000

* Not stated.

*Receipts and shipments by vessel, 1891.**

Articles received.	Quantity.	Tons.	Articles shipped.	Quantity.	Tons.
Brick ... M	15	38	Flour ... barrels	349	35
Coal ... tons		125	Fish ... tons		60
Lime and cement ... barrels	300	39	Flags ... do		4
Lumber ... M feet, B. M	100	175	Fruit and vegetables ... do		17,513
Merchandise ... tons		520	Farm produce ... do		20
Machinery ... do		70	Household goods		9
Salt ... barrels	100	14	Live stock ... heads	16	8
Shingles ... M	50	6	Machinery ... tons		35
Piles ... M	40	640	Merchandise ... do		11
			Meats ... do		93
Total		1,627	Total		17,788

* Compiled from statement furnished by Messrs. Griffin & Henry.

K K 13.

IMPROVEMENT OF SOUTH HAVEN HARBOR, MICHIGAN.

The official project, adopted in 1866 and modified in 1869, 1872, and 1888, provides for a channel 12 feet deep, 180 feet wide, and protected by piers and revetments at the entrance, and extending up Black River to the highway bridge.

The existing works are as follows:

On the north side: 255 feet crib work 32 feet wide, built in 1872 to 1874; 30 feet crib work 30 feet wide, built in 1871; 321 feet crib work 20

feet wide, built in 1868 and 1869; 524 feet pile work built in 1876, a
feet plank beam revetment built 1879. The total length is 1,5
and the pier projects 700 feet beyond the present shore line.

On the south side: 50 feet cribwork 30 feet wide, built 1888; 1
crib work 32 feet wide, built 1871–1874; 352 feet crib work 20 feet
built 1868; 143 feet pile work, built 1878, and 855 feet plank beam
ment, built 1878 to 1882. The total length is 1,553 feet, and th
projects 520 feet beyond the present shore line.

The dredging, which was in progress at the beginning of th
year, was completed August 4, 1891, giving a channel 13 feet de
50 feet wide. Eleven thousand six hundred and seventy cubic
were removed after July 1. At the opening of navigation this y
entrance was found to have again shoaled to 10 feet, and the G
ment dredge reopened the channel to a depth of 14 feet and w
50 feet between May 21 and June 23. A few shoals in the rive
the revetments were also removed, and the quantity dredged m
13,830 cubic yards.

The repairs of the outer crib, north pier, were completed. Cl
were driven around the outer half of the crib and connected by
of caps and screw bolts to the old timber work, and the ne
structure built up on the work thus strengthened. The gaps
side walls were closed with vertical timbers and screw bolts,
repaired work was filled with stone. One hundred linear fee
outer end of the south side pile work, at shore line, where it jo
the crib work, was provided with a double row of sheet piling
place has always permitted large quantities of sand to pass 1
into the channel. Although it was not possible to drive the sh
very deep, owing to the mass of brush and driftwood in the bo
is believed that this part of the work is now practically sand ti

The north pile revetment, 524 feet long, was also double she
along the rear wall and refilled with new brush, ballasted with
stone. The same difficulty was encountered here in driving sh
as on the south side, but the indications are that the seepage
through the revetment has been stopped.

The conversion of the north plank beam into a sheet pile re
has been commenced. The work was cut down to 3 feet ab
water surface, and is to be provided with a new cap over the fro
and a wale streak along the water line, additional piles along t
wall, a double row of sheet piles to penetrate to not less tha
below the water, and anchor piles 10 feet in the rear connect
the front walls by iron tie rods. This part of the revetment is
long, and it is expected to complete the conversion during the m
July. One hundred and ninety-two linear feet of sand fence w
on the north beach, and the vertical fence on the rear wall o
pier was moved out to the shore line, where it will do better
The end wall of south pier was repaired.

During the early spring the Government pile-drivers and
struction scow received needed repairs to fit them for the seasor

A permanent bench mark was established on top of brick fou
at southwest corner of Mr. Hallock's house on the northeast c
Michigan avenue and St. Joseph street, and connected by d
levels with the United States gauge. It is 41.68 feet above z
series of accurate water gauge readings was commenced June
continued through June, July, and August, for the purpose of
ing data for adjusting the zero of the gauge to a uniform level w
gauges at the other harbors.

completion of the repairs now in progress the works will
lowing condition: The north pier, although most of it is
ll not need any repairs, except some occasional patchwork,
wo years to come.

200 feet of south pier is in a fair state of preservation, and
repairs in the immediate future, but the 20-foot crib work
9 + 98 to 13 + 50, 352 linear feet, which is now 24 years old,
need of rebuilding above the water surface, as the timber
rotten and barely hangs together. As the best water in
is habitually close to the south pier, this part is particu-
d to injury from passing vessels, and its repairs should not
any longer.

s are proposed at this time for the south plank beam revet-
he time is not far distant when it will be necessary to
t with anchor piles in the rear, and tie rods, and when that
it may be found desirable to provide it with sheet piling.

rs now being made to the north revetment will help ma-
reserving the needed depth of water in the harbor, but the
l causes of the interfering shoals will still exist unimpaired.
he insufficient development of the piers, and the unpro-
ition of the north bank of Black River above the revet-

nt piers do not project beyond the general 10-foot curve in
d although there is usually a depth of 14 to 16 feet at the
iers, a bar with sometimes not more than 10 feet on its crest
ross the entrance immediately beyond, and even after the
ave attained their full length as intended by the present
h provides for an addition of 150 feet to the north pier and
he south pier, they will fall some 300 feet short of reaching
lepth in the lake.

bank of Black River is in its natural state, although the
s very close to it, and it is subject to erosion from the cur-
river, when in flood, and from the waves and suction of
sels. It would seem to be the duty of the riparian owners
evet the bank, in order to assist in maintaining the desired
igation.

working balance of $900 it is proposed to complete the
e north revetment, now under way.

scal year 1894, the estimate is as follows: For repairs to
and general repairs, $5,000; for completing the existing
lditional cribs, $42,000; for dredging, $3,000, which, with
for contingencies, makes $55,000.

use establishment maintains a fifth-order light on the south pier, and
g Service a station on the north pier.
is included in the Michigan collection district, Michigan. The nearest
s Grand Haven, Mich.

Appropriations for improving harbor at South Haven, Mich.

....	$43,000	June 14, 1880..................	$5,000
....	10,000	March 31, 1881	5,000
....	15,000	August 2, 1882..................	10,000
....	12,000	July 5, 1884	7,500
....	20,000	August 5, 1886..................	5,000
....	10,000	August 11, 1888	10,000
....	10,000	September 19, 1890	15,000
3:..................	10,000		
....	12,000	Total	207,000
....	7,500		

... work, 1866, amended in 1869, 1872, and ... $282,00
... 1866 to and including act of September ... 267,00
... 30, 1892 ... 26,87

Money statement.

... $11.80
... during ... 8.68

... 3,12
... 2,21

... 90
... approved ... 10,00

... year ending June ... 10,90

... required for completion of existing project ... 40,43
... profitably expended in ... ending June 30, 1894 ... 45,00
... with requirements of sections 2 of river and ... and 1867.

... STATISTICS, SOUTH HAVEN HARBOR, MICHIGAN.

Entrances and clearances.

...	Number.	Revenue collected.	Tonn.
	466	$555.72	
	361	204.50	
	283	115.55	
	264		52
	420		29
	1,080		
	2,246		128
	2,904		261

K K 14.

IMPROVEMENT OF ST. JOSEPH HARBOR, MICHIGAN.

ficial project, adopted in 1866 and modified in 1874 and 1875, ure a channel of entrance from Lake Michigan into St. Joseph 270 feet wide and 16 feet deep, protected by piers and revet- Thence to Benton Harbor it is designed, as later authorized to carry 13 feet through the Benton Harbor Canal, widening nnel to 100 feet.

iannel entrance from Lake Michigan into St. Joseph Harbor is d on the north side by a pier consisting of 457 linear feet of k, 30 to 24 feet wide, and built between the years 1875 and 373 linear feet of old crib work built previous to 1886, and of ır feet of pile revetment built in 1886–'87, and on the south side near feet of pile pier built 1867 to 1872, and of 213 linear feet ib work built previous to 1866. The inner end of the north nt is connected with the shore and the new light-house depot l by a pile wing 179 feet long. The north pier projects 600 feet the present shore line and the south pier 540 feet.

73 feet of old crib work in the north pier has been maintained s of repeated patching, sustaining piles, tie rods, etc., for the years, but the time has come when this is no longer practica- the work should be rebuilt above the water line, and as a con- e portion of the channel wall below the water has been lost, ing will have to be driven here to support the new superstruc- o rebuild this work in proper shape is estimated to cost $5,000. lling in the north revetment has settled considerably, and to avoid the loss of the stone ballast and exclude the sand of t behind from the channel it should again be refilled with brush. s estimated will cost $600. Some minor repairs to the other the north pier and to the south pier, which will not cost above will put the existing channel revetments at the entrance into air for some years to come.

resent constructions are not sufficient, however, to maintain ected entrance depth, owing to their insufficient extension. In ual Report for 1891 it is said:

> umulation of sand from the action of the winds and the currents is against pier, and this has now occasioned bars and shoals of 10 feet beyond the north pier and overlapping to the southward across the entrance. In uoy marking the entrance, as established this spring about 1,000 feet a h of west from the end of the north pier, marks the south end of a shoal ch there is but 13 feet of water.

nditions at the entrance went from bad to worse until, in the of 1891, a shoal with only 7 feet of water on it overlapped the orth pier and projected nearly 100 feet in front of it into the Several vessels ran aground on it while trying to enter the but all escaped without serious damage, as the lake happened iet at the time.

quently this shoal was partially scoured out under the combined of southwesterly gales and the river current, but the ma- ere distributed farther out and added to the ridges extending north across the harbor entrance, raising the summit of the about 500 feet beyond the end of north pier to 11 feet below r surface.

December, the company agree[illegible] [illegible]sible on account of the weather. As a matter [illegible] found fit for work between December [illegible] become obvious to the company that further dredging [illegible] futile, the attempt in that direction was discontinued a[illegible] up.

The weather conditions of the past winter were more [illegible] than had been the case for several years. Ice formed [illegible] quantities in the lake and its beneficial action in prote[illegible] [illegible] the weight and action of storms was made [illegible] St. Joseph. With the surface covered, wave action was [illegible] the current of the river had its normal effect in securin[illegible] [illegible] navigable depth nearly in the direct prolongation [illegible] less difficulty was experienced and the winter [illegible] with fair measure of regularity.

The freshets this spring have been of unusual volum[illegible] [illegible] and immense amounts of silt have been brought [illegible] current. Large deposits were made on the bars [illegible] but the material was soft and a vessel could p[illegible] [illegible] without serious hindrance. In time it is [illegible] material will disappear from the channel [illegible] where distributed.

[illegible] does not provide for any further p[illegible] [illegible] report of November [illegible] [illegible] is to be secured.

[illegible] constructions at [illegible] some 1,500 linear feet of plank [illegible] side of the canal with a [illegible] passage of the waters [illegible] Paw [illegible] an extent that throughout the greater part of its length the 5 to 6 feet deep in it. In this condition it naturally is incapable erving the purpose for which its was built, and should in part be above water and refilled. The plank beam revetment is also in n-down condition. There is an agreement with the railroad y whereby the company is to remove this revetment and replace substantial sheet-pile structure about 10 feet farther back, thus g to the canal the projected width of 100 feet. The railway y, if permitted to use the wing dam, should also rebuild it as heir works extend. It is estimated that it will cost $6,000 to nd refill the other part of the wing dam.

emaining part of the north bank of the canal and the winding t Benton Harbor are revetted by the owners, but most of these ents are badly built and permit the soil from behind to wash canal. The south bank has nothing that can be called a re- t, but the city of Benton Harbor has recently passed ordinances ng all riparian owners to properly bulkhead their fronts.

dredging in progress at the commencement of the fiscal year was ed until October 28, 1891, and during this time the winding t Benton Harbor and the canal were dredged throughout to a f 13 feet; the main channel in the harbor below the canal was ed to 15 feet, as well as the shoal area between the railroad and the north revetment, and a channel 50 feet wide and 17 to deep was made across the bar between the ends of the piers. proach to the life-saving station back of north pier was also ed, and the shoal at the mouth of the Paw Paw in the canal hav- ppeared, this was again dredged out before the plant left for an City.

dredge *Farquhar* again arrived at the harbor on December 11, nd, as already stated, was temporarily kept in commission in the t to open a passage across the bar in front of the entrance.

ng the winter the Government plant was repaired, and on the April the dredge resumed operations and again restored the tion in the canal to a depth of 13 feet. The flood in the St. Jo- iver, which set in early in May, made further dredging in the impossible for the time being, and the plant was sent to South The total dredging during the year amounted to 57,520 cubic

e present time much complaint is made regarding the navigation oseph Harbor, the high river having brought down large quan f sand from above, and the available depth above the railroad is only 11 to 12 feet. The service of a dredge will be required soon as further appropriations shall have been made.

epairs of the north revetment, by refilling with brush and stone, mpleted in July, 1891, and the effect became apparent at once, nore sand found its way through this work afterwards. A plank as laid over the revetment from the inner end of the elevated hich was rebuilt.

incomplete portion of the superstructure of the south pier was l. The gap in the end wall of the north pier, under the super- re, was closed with vertical timbers, placed with the help of a nd end the crib filled with stone and decked. The end of the pier bsequently injured by one of the steamers which ran aground of the shoals near it and broke off the end horns. The damage paired with extra timbers and tie rods, and a washout at station north pier was closed with plank aprons and stone ballast.

West Michigan Railway has commenced dredging ... drawbridge, in accordance with the ... Secretary of War. They have been much delayed by the ... the persistent freshets, making dredging ... impracticable, but they are doing what th... and will have it completed in July.

... renewed complaints against the Chica... bridge is an obstruction to the harbor ... report submitted under d...

... was established on top of a bonding iron ... south abutment of the railro... levels with the United St... A series of accurate wa... to be continued through Ju... data for the adjustm... level with the gauges at the ot...

... 1894 the following estimate is submitted: ... $5,000; for re... for repairing ... which, with contin...

... required for extending the p... which would repre... could be done for ... The estimate for the fiscal year 1894 is th...

Money statement.

91, balance unexpended	$11,102.64
892, amount expended during fiscal year	9,821.73
92, balance unexpended	1,280.91
92, outstanding liabilities	632.33
92, balance available	648.58
ppropriated by act approved July 13, 1892*	60,000.00
vailable for fiscal year ending June 30, 1893	60,648.58
that can be profitably expended in fiscal year ending June 30, 1894	85,000.00

ted in compliance with requirements of sections 2 of river and r acts of 1866 and 1867.

COMMERCIAL STATISTICS, ST. JOSEPH HARBOR, MICHIGAN.

Entrances and clearances.

Years.	Number.	Revenue collected.	Tonnage.
	560	$1,096.14	
	467	361.57	
	789	248.53	
	580		144,000
	679		208,797
ar 1889	966		359,925

Years.	Vessels entered.	Tonnage.	Vessels cleared.	Tonnage.
ing Benton Harbor)	948	131,607	946	131,395
ing Benton Harbor)	742	215,334	743	215,591

and shipments by vessel at St. Joseph and Benton Harbor, Michigan, 1891.a

les received.	Quantity.	Tons.	Articles shipped.	Quantity.	Tons.
tons		508	Cement, tons		1,277
do		41	Carriages, do		1,113
packages	282	12	Canned goods, cases	3,515	1,141
vegetables, tons		75	Fruits and vegetables, tons		8,642
bushels	15,700	398	Fish, do		46
barrels	18,525	1,853	Flour, barrels	10,760	1,076
tons		4	Hides, bundles	561	27
packages	390	59	Iron, tons		20
tons		470	Live stock, head	40	8
head	236	42	Lumber, M feet, B. M	359	634
M feet, B. M.	2,867	6,417	Merchandise, tons		36,540
e, tons		12,494	Nails, kegs	3,510	176
bundles	3,964	199	Paper, bundles	52,478	2,654
barrels	100	15	Produce, crates	141	22
	3,000	60	Pipe, sewer, tons		120
cords	75	469	Rags, bales	517	116
barrels	1,155	293	Starch, boxes	719	18
packages	2,960	148	Sugar, barrels	170	43
			Sundries, tons		1,139
			Tobacco, hogsheads	127	30
			Vinegar, cider, barrels	2,820	282
			Wool, sacks	165	17
		23,552	Total		55,141

a Compiled from statement furnished by the collector of customs.

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* Of which $1,000 may be expended on St. Joseph River.

president Board of Trade of St. Jose
1891 of a total of 230,189 tons.

MAJOR WILLIAM LUDLOW, CORP

UNITED STATES ENGI
Detroit, Mich.,

In compliance with Department in
of November 3, from the Hon
Secretary of War, relative to th
St. Joseph, Mich., Harbor, I beg to
of navigation the conditions
been the cause of much soli
observed by means of repeate
several personal insepections.
be found partly in general
all lake navigation, and partly i
referred to and the remedy

from the action of the winds
and this has now occasioned bars
pier and overlapping to the south
the entrance, as established this
the end of the north pier, marks
feet of water. If the official pr
such extension as this to th
to the south pier for future
advisable to extend the south
end of the north pier, and about

is one of the oldest on the l
the improvement as a ha
extended and later include
Benton Harbor.

the appropriations made were
work as the age of the pier

movement and the resulting formation of extensive shoals have reatly expedited by the open winters of the past three years, the northwest gales free sweep on the lake, and at this time are lly aggravated by the abnormal level of the lake, which is about ower even than the extraordinary low water of one year ago. results are shown in the accompanying tracing from the most re- rvey.

ig the earlier part of the season the course entering was nearly t in after getting the outer black spar buoy abreast. ;, a small shoal formed close to the end of the north pier, which se developed into the extensive areas inclosed within the 10-foot r, with depths of 7½ and 8 feet upon them. At present this ies across the prolongation of both piers and has crowded the se to the southward, toward the 10½ and 11 foot shoal lying on le, the heavy gales in October having occasioned the rapid and ccumulations.

obvious remedy is the westward extension of the north pier past ick buoy to about the 15-foot contour, a distance of some 1,200 hich would cost $100 per linear foot.

lieve this extension to be indispensable to the maintenance of the ; and that it should be provided for as early as practicable. As porary measures for the relief of navigation, I regret to say that r of none that I could recommend or suggest at this time. Dur- fall and winter months the lake is kept in a state of almost in- t agitation, such as to make it impracticable to operate dipper s on the bar, and such scanty work as might be done by await- brief opportunity would be undone in an hour or two. The riation balance to the credit of the St. Joseph Harbor is but , and in any case it is manifestly hopeless for a dredge to contend r make any useful impression on such an accumulation as has been l up southward of the line of the north pier. I believe that the t conditions will probably become no worse, as the outflow of er has a certain effect in conserving the channel, and in all prob- the lake will rise from heavy rains and continue to do so, so as e the level 1½ feet above the present stage.

nwhile the channel has a navigable depth of 13 or 14 feet, which aprove, and with judgment in selecting the best water, it may ne to be used in ordinary conditions.

Respectfully,

WILLIAM LUDLOW,
Major, Corps of Engineers,
Bvt. Lieut. Col., U. S. A.

;. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

K K 15.

IMPROVEMENT OF ST. JOSEPH RIVER, MICHIGAN.

project of March, 1889, contemplates securing a depth of 3 to 4 om St. Joseph to Berrien Springs, a distance of 25 miles, by the al of snags and bowlders and the construction of wing dams where l.

rations were resumed July 13, and continued till the end of Sep- r, when the available funds were exhausted. At Twin Springs

current was diverted into the right-hand channel
... of a closing dam between the island and the left ba
... rude ... retaining dike at the foot of the island was repaired,
subsequently an additional wing dam, 100 feet long, was built ab
1 mile below to maintain a navigable channel across the shoal ca
by the scour of the concentrated current above. A second dam
built at the head of Long Reach, 7 miles from St. Joseph. The riv
very wide in this locality, and it is probable that additional dams
be needed to insure a navigable depth.

Farther down the river at Royalton Island, some 3 miles above
Joseph, the navigation is affected by the stage of Lake Michigan, w
during the last few years has been very low, and in the fall of the y
when the river carries a reduced volume of water, the available d
in this locality is usually small. In order to improve matters he
much as the limited means would permit, a number of water-soaked
were arranged as a kind of dam ... the right-hand channel, and
left-hand channel was further cont... at the foot of the island
dam of the same material.

Before closing operations the entire stretch of river from Be
Springs down was cleared of such snags as still remained to obst
the best water. Altogether 318 snags, 15 overhanging trees a
large bowlders were removed, and at the end of September an unin
rupted navigation of at least 3 feet was insured for the rest of the
son.

It is probable that these rude measures of relief will not suffi
keep the river in good condition for any great length of time. The
water channel will need to be restricted in a greater degree and
greater number of points, and snags will be brought down and lod
in the channel at every high water. It is also probable that the ba
will need protection at several places to prevent erosion. Hereto
the constructions have been inexpensive, as the materials, such as b
and stone, cost only the labor of gathering them, and the necessary
ing of the plant was done gratuitously by Mr. Graham, the own
the river steamer. It is probable that in future the cost of similar
will be increased, as the supply of suitable stone is now nearly
hausted, and the required brush may soon have to be paid for.

For further operations it is recommended that an appropriatio
$2,000 be made.

Appropriations for improving St. Joseph River, Michigan.

August 11, 1888	$2,...
September 19, 1890	1,...
Whole amount appropriated, including act of September 19, 1890	3,...
Whole amount expended to June 30, 1892	3,...

Money statement.

July 1, 1891, balance unexpended	$1,...
June 30, 1892, amount expended during fiscal year	...
July 1, 1892, balance unexpended*	
Amount that can be profitably expended in fiscal year ending June 30, 1894	2,...

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

* The river and harbor act approved July 13, 1892, provides that $1,000 ... appropriation for improving St. Joseph Harbor may be expended on St. J... River.

COMMERCIAL STATISTICS, ST. JOSEPH RIVER, 1891.

One steamer, *May Graham*, 95 tons, load draft 30 inches, plying between St. Joseph and Berrien Springs.

S. A. Graham & Co., of St. Joseph, Mich., states that the freight carried on the steamer amounted to about 2,600 tons.

K K 16.

IMPROVEMENT OF MICHIGAN CITY HARBOR, INDIANA.

The works of this harbor consist of the improvement of Trail Creek by entrance piers 100 feet apart and dredging the creek bed to 13 feet (the local authorities and owners attending to the bank revetting), constituting the "Inner Harbor," and of extensive breakwater and pier constructions in the open lake, constituting the "Outer Harbor."

OUTER HARBOR.

This harbor [extract from Annual Report for 1890] consists of several works constructed at different dates and designed for the protection of the general lake commerce in view of the great development of the shipping industries and the exposed situation of the harbor at the head of the lake.

The "Outer Basin," projected in 1870 and completed in 1884, is inclosed on the east by the "east pier" (originally 1,100 feet in length, now reduced by the advance of the shore line to half that), on the north by the "breakwater," 1,400 feet in length, and on the west by the outer 550 feet of the "west pier," prolonged for that purpose. The entrance, 215 feet wide, common to the basin and the creek, is at the northwest angle, fronting about north-northwest down the lake.

It was a part of the project that the inclosed area of this "Outer Harbor" should be dredged to a depth of 14 feet, furnishing some 40 acres of protected anchorage, but this has never been done, and if it were the basin would still be of no commercial value whatever for the reason that the entrance, 215 feet, is too narrow for a harbor of refuge and being directly open to the heaviest storms on the lake, viz., those from the northwest quadrant, admits the sea freely into the basin.

Prior to the completion of these structures it was found that the heavy sea, in connection with the powerful currents sweeping westwardly across the mouth, made the entrance extremely hazardous, for which reason a spur pier, locally termed the "Breakwater Pier," projecting at right angles from the west end of the breakwater 400 feet northward into the lake, was designed in 1880 and completed in 1889. This pier has been found of advantage, but the inherent difficulties of the situation remain. There was, therefore, no "harbor of refuge" for vessels needing shelter from the storms of the lake between Chicago and Grand Haven, nor, in fact, could the "Outer Harbor" at Michigan City furnish it so long as the northward opening in the lake was retained, so that, in 1882, the project for the "outer breakwater" was adopted. In conformity with which work was begun last season by the construction of the first ten cribs. The project provides that the eastern end of the new breakwater shall begin 400 feet west of the north end of the Breakwater Pier, leaving that space open for an entrence; thence extending westerly 1,000 feet to the angle in the work; thence inclining towards the shore at an angle of 135 degrees, and extending another 1,000 feet.

The report points out the disadvantage of the proposed direction of the outer arm of the new breakwater, approaching as it does with its outer end to within 600 feet from the then 18-foot curve, thus making any future extension of the breakwater impracticable, and recommends a modification of the project so as to change the proposed alignment to be nearly parallel with the shore line.

Also, as a necessary condition of the utilization of the large expendi-

[illegible] west pier" and the "old east pier." The [illegible] repaired during recent years and only needs a littl[e] [illegible] good order, but the outer 700 feet of [the] pier, which is now twenty-four years old, is quite gone, the [illegible] having disappeared to several feet below the water surfa[ce] [illegible] unless speedily rebuilt. A portion [illegible] would be removed upon the completion of the project, but a[s it] is required as a revetment for the maintenance of the ent[rance] [illegible] harbor," and as the 10-foot curve in the "outer b[reakwater illegible] with the outer end, it should be rebuilt unless the "ga[p illegible] It is estimated that this will cost $8,000.

The operations during the year have consisted in con[structing] superstructure over the 300 feet of crib work in the outer [breakwater]. These cribs were placed on a heavy stone foundation in 18[illegible] feet above water surface. When work was commenced o[n the] structure in the spring of 1891, they had partly settled [illegible] side to 4 feet below water, indicating a total subsidence i[n the] bottom of 6 to 7 feet. The submerged portion was leveled [illegible] course superstructure built on top, the upper course havi[ng a] [illegible] of about 6.5 feet above the harbor zero. The work wa[s filled with] stone and decked over, the ends of the deck plank being [illegible] secured with binding timbers. During the winter a furt[her settlement] took place to the extent of 2.4 feet in the worst place, as asc[ertained by] levels on June 16, 1892. In order to avoid such excessiv[e settlement of] the crib work in the future, with its attendant extra cost [illegible] ing, it is proposed to place all work of this class on a pile [foundation] and to secure the structure by heavy stone rip rap against b[eing under]mined.

Some repairs are needed to the decking, which has bee[n illegible] many places during the past winter.

With the working balance of $13,300, available July 1, it [illegible] to pay for the repairs of the old breakwater, which are now [illegible] for repairing the decking of the outer breakwater, partly re[illegible] filling in the west pier, dredging for the maintenance of [illegible] [illegible]

Appropriations for improving harbor at Michigan City, Ind.

Date.	Outer harbor.	Inner harbor.	Total.
			$20, 000. 00
			30, 000. 00
			60, 783. 59
4			25, 000. 00
2			20, 000. 00
(claim J. R. Bowes)			470. 33
6			75, 000. 00
8 (allotment)			25, 000. 00
9 (allotment)			31, 185. 00
0	$25, 000. 00		25, 000. 00
	15, 000. 00		15, 000. 00
2	50, 000. 00		50, 000. 00
	50, 000. 00		50, 000. 00
74	50, 000. 00		50, 000. 00
	50, 000. 00		50, 000. 00
76	35, 000. 00		35, 000. 00
78	50, 000. 00	$25, 000. 00	75, 000. 00
ent)	2, 500. 00		2, 500. 00
	40, 000. 00		40, 000. 00
80	40, 000. 00	15, 000. 00	55, 000. 00
	20, 000. 00	25, 000. 00	45, 000. 00
2	60, 000. 00	20, 000. 00	80, 000. 00
	40, 000. 00	10, 000. 00	50, 000. 00
5	54, 375. 00	1, 875. 00	56, 250. 00
88	90, 000. 00	5, 000. 00	95, 000. 00
90	50, 000. 00	7, 500. 00	57, 500. 00
	721, 875. 00	109, 375. 00	1, 118, 638. 92

stimated cost of project for outer harbor, 1870	$324, 421. 40
by cost of repairs and maintenance to 1882	90, 067. 10
r outer breakwater, including dredging of outer basin, 1882	587, 000. 00
al estimates	1, 001, 488. 50
ount appropriated and allotted 1870, to and including act of ber 19, 1890	721, 875. 00
ount expended to June 30, 1892	706, 588. 95

Money statement.

91, balance unexpended	$42, 954. 88
1892, amount expended during fiscal year	27, 668. 83
92, balance unexpended	15, 286. 05
92, outstanding liabilities	1, 905. 71
92, balance available	13, 380. 34
ppropriated by act approved July 13, 1892	30, 000. 00
vailable for fiscal year ending June 30, 1893	43, 380. 34

t (estimated) required for completion of existing project	249, 613. 50
t that can be profitably expended in fiscal year ending June 30, 1894	100, 000. 00

ted in compliance with requirements of sections 2 of river and r acts of 1866 and 1867.

INNER HARBOR.

vailable depth having diminished to 13 feet at the entrance 11 feet in some places in the inner harbor, dredging was com- at the beginning of September, 1891, and by the end of the 0-foot channel 16 feet deep had been excavated from the bend inner end of the Government revetments to the entrance, and wide and 15 feet deep from the bend to the Michigan Central d bridge.

redging plant was thoroughly overhauled and repaired during ter, and operations were resumed April 22, 1892. Between that me 30 the entrance has again been deepened to 18 feet for of 0 feet, the shoal places in the interior navigation removed to a depth of 15 feet, and dredging has begun on extension of the harbor at its inner end towards the railroad cro accordance with the project. The quantity dredged during the was 84,893 cubic yards.

With the working balance of $2,000 at the beginning of the year it is proposed to maintain a 13-foot navigation and to con the extension of the channel at its upper end.

To complete this work will require the removal of 135,000 cubic y at an estimated cost of $15,000, to which should be added for re and maintenance, $5,000. Total estimate with 10 per cent conti cies, $22,000.

Amount appropriated and expended from 1836 to 1869, inclusive	$287,
Original estimated cost of project for inner harbor, 1870, revised in 1892	131,
Whole amount appropriated, 1870, to and including act of September 19, 1890	109,
Whole amount expended to June 30, 1892	105,

Money statement.

July 1, 1891, balance unexpended	$6,
June 30, 1892, amount expended during fiscal year	3,
July 1, 1892, balance unexpended	3,
July 1, 1892, outstanding liabilities	1,
July 1, 1892, balance available	2,
Amount appropriated by act approved July 13, 1892	15,
Amount available for fiscal year ending June 30, 1893	17,
Amount that can be profitably expended in fiscal year ending June 30, 1884 } Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	7,

COMMERCIAL STATISTICS, MICHIGAN CITY HARBOR, INDIANA.

Entrances and clearances.

Years.	Number.	Revenue collected.	T
Fiscal year:			
1885	1,334	$116.35	...
1886	966	90.10	...
1887	1,099	....	
1888	1,167	....	
Calendar year:			
1888	1,153	....	
1889	795	....	
1890	921	....	
1891	837	....	

Receipts by vessels, 1891.

[Compiled from statements by John M. Clark, collector of customs.]

Articles received.		Quantity.	
Coal	tons	....	
Lath	M	14	
Lumber	M. feet, B. M.	78,853	
Posts	number	122,667	
Salt	barrels	106,054	
Slabs	cords	246	
Shingles	M	62,444	
Stone	tons	....	
Total		....	

K K 17.

[Printed in House Ex. Doc. No. 197, Fifty-second Congress, first session.]

MARY EXAMINATION OF GRAND RIVER, MICHIGAN, BELOW GRAND RAPIDS.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., November 12, 1890.

RAL: The preliminary examination of Grand River, Michigan, and Rapids to Grand Haven, called for by circular letter o ber 20, 1890, from the office of the Chief of Engineers, has been ad in pursuance of the requirements of the act of September , I beg to report that in my judgment the river between the ted points is "worthy of improvement" as a commercial r. The main facts upon which this opinion is based are given at at length in my report of March 22, 1890, a copy of which is ed for incorporation herewith.*

mary of the main points of this report and of other papers of nd relating thereto is as follows:

the case of *The Daniel Ball* (quoted in 10 Wallace, 557; also in Sup. Ct. Decisions, 69) the United States Supreme Court de- e national character of the navigation as follows:

nd River, in Michigan, held to be a navigable water of the United States outh, in Lake Michigan, to Grand Rapids, a distance of 40 miles, being a pable of bearing for that distance a steamer of 123 tons burden, laden handise and passengers, and forming by its junction with the lake a con- ghway for commerce, both with other States and with foreign countries.

veys and examinations of Grand River were authorized by the d harbor acts of 1880, 1886, 1888, and 1890, and appropriations ting $50,000 were made for its improvement by the river and cts of 1881, 1882, and 1884. Congress, therefore, has repeatedly ed the status and importance of the stream as a national water

llowing my report of March 22, 1890, and the preparation of a the river from a new survey made by the Board of Trade of Rapids, The Board of Engineers in New York, to which the sub- s referred by the Chief of Engineers, reported, under date of , 1890, that the river is "worthy of improvement" and may ened by dredging so as to give 6 or 8 feet to Grand Rapids; t 10 feet or more can be obtained by the same means, although of a lock and movable dam might be more economical. Addi- formation as to the topography and geology of the river valley eeded for the determination of this and other important ques- copy of this report † and the accompanying letters from the

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*ed; printed in Annual Report Chief of Engineers for 1890, pages 2676–

†ed; printed in Senate Ex. Doc. No. 104, Fifty-first Congress, first session, nnual Report Chief of Engineers for 1890, pages 2681 2682.

Chief of Engineers* and the Acting Secretary of War* is forwar herewith.

4. As is shown by the accompanying statement, dated Novembe 1890, from the Grand Rapids Board of Trade, it is evident that commercial interests concerned in the improvement of the river ar great magnitude and that the value of water communication with ot lake ports and the country generally would amount to a large s annually.

5. From the data furnished by the official surveys and reports a the personal examinations made, it is found that the natural featu of the stream furnish indications favorable to its improvement; have any been so far disclosed as to discourage a reasonable expectat of its conversion into a valuable water way.

The low-water navigation is already one practically of 4 feet. T variations in width are moderate; the banks for the greater portion the upper part are firm and with an elevation of from 4 to 6 feet ab low water; the lower portion of the river, for one-half its length practically at the lake level and the slope of the upper portion va from 3 to 6 inches to the mile. The discharge of the river at low wa while moderate, is sufficient to fill a channel of 8 to 10 feet wit navigable width.

6. The case is evidently one worthy of thorough investigation to co the points needed for a final determination of the extent to which navigation can be improved and the best means and cost of effecting

In my report of March 22, 1890, I estimated the cost of a thoro examination at $8,000, which the survey made by the Grand Ra people would reduce by about $3,000. I am now of opinion that, w $4,000 available for the survey, all the information necessary to final determination of the matter can be procured, including a proj and estimates.

For convenient reference there is forwarded herewith a reducti from the large map of the Grand Rapids survey, showing the main tures of the stream.

Respectfully,

WILLIAM LUDLOW,
Major, Corps of Engineers, Brt. Lieut. Col., U. S. A

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. O. M. Poe, Corps of Engineers, Division Engin Northwest Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Detroit, November 14, 189

Respectfully forwarded.

As a report of preliminary examination these papers seem to m be exhaustive. I have personally examined the river, as well a could be done in one day, and concur in the opinion of Major Lud that it is worthy of improvement.

I therefore recommend that his project and estimate for a survey examination be approved.

O. M. POE,
Col., Corps of Engineers, etc.,
Engineer Northwest Divisi

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* Omitted; printed in Senate Ex. Doc. No. 104, Fifty-first Congress, first ses
† Not printed.

our factories in that branch of industry being the largest in the world.
the enactment of the interstate-commerce law, railroad freight rates to have been largely increased, forcing our manufacturers in sharp and, in stances, ruinous competition with centers situated on our lakes and navi-ers, compelling some to remove their plants to cities where water commu-with Lake Michigan was had, and some to change their line of manufacture. stries, having their attention called to our city through its well-earned rep-the wood-working lines, have passed us by, needing cheap water trans-, at least for their raw material, and have located at lake ports. The hard-ber, of which we at present use 28,000,000 feet annually, becomes each year cult of access by railroad and the fine oak timber lands in Manistee, Ben-m, Charlevoix, and other counties in northern Michigan are rapidly invaded acturers from Chicago, Milwaukee, Kenosha, Racine, Cheboygan, and other uring cities situated on the opposite shore of Lake Michigan, and we, for of water communication, are powerless to claim our share of this wealth so ded for our future prosperity.
jobbing trade with an investment of about $4,000,000 feels the need of low-nsportation to meet the favored competitors of Detroit, Chicago, and Mil-

d more jobbing houses to meet the demand of the rapidly growing towns rn Michigan and of the upper peninsula. Capital for investment in such s is ready, provided it can get their wares from the eastern markets and ign countries by an all-water route.
Rapids is a port of entry and we import direct.
the manufacturing and commercial interest of Grand Rapids is growing, anding our many difficulties, is evidenced in the fact that the combined f our railroads and one small river steamer for 1889 was 1,120,823 tons as 88,000 tons for 1888, and the year's business from data at hand to date will a larger amount.
senger traffic for 1889 over these lines shows 309,226 persons in and out. ures are obtained by us from the official records furnished our board by the ompanies.
future of our city will depend largely on such improvement of our river as it lake vessels to load and discharge freight at our port. Every business e city is alive to that project. The counties of Ottawa and of Kent, through resentatives, have indorsed this scheme by suitable resolutions presented to Rapidly growing northern and western Michigan and the upper peninsula ding on Grand Rapids for a market, and their newspapers have seconded s to that effect. The jobbing interest, with but a small increase of capital, sed its sales from $12,489,500 in 1887 to nearly $16,000,000 in 1889, showing anything else the growth of such sections of our State as look to Grand r their supplies. Hard-wood timber lands being cleared becomes fine farm-and is taken up as fast as it is put on the market. Manufactories of various

With an average saving of only 1 cent per 100 pounds on this traffic it repre the enormous amount of [illegible] per year that would be saved in freight going to and out of Grand Rapids.

If any other information you may require, I shall be glad to furnish it.

Respectfully yours,

H. D. C. VAN ASMUS,
Secreta

Maj. WILLIAM LUDLOW,
Corps of Engineers, U. S. A.

SURVEY OF GRAND RIVER, MICHIGAN, BELOW GRAND RAPIDS.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., April 11, 18

GENERAL: I have the honor to submit a report, with accompany papers, maps, etc., on the surv[illegible] Grand River, Michigan, from Gr Rapids to Grand Haven, as au[illegible]d by the act of September 19, 1 in the following terms:

Grand River below Grand R[illegible] a view of determining the existenc [illegible] of underlying rock [illegible] of the river, and the detailed to raphy of the valley subject to o[illegible].

Grand River, the largest in the [illegible] and the main affluent of L Michigan, drains the heart of [illegible] lower peninsula, with a waters stretching across to within 40 [illegible] of Lake Erie and covering s 5,700 square miles of territory. [illegible] the mouth of Grand River, on east shore of Lake Michigan, is the town of Grand Haven, whose bor has always been an important harbor of refuge by reason of capacity and depth, due to the large discharge of the stream. Fo miles up the river, at the head of navigation, is the city of Grand Rapi an exceptionally thriving center of population and industry, wh products, particularly furniture, reach the markets of the world.

Between Grand Haven and Grand Rapids the river is navigable light-draft vessels, the depths diminishing from 4 fathoms in the har to 4 feet in the upper reaches, with a few bars of less depth at m mum stages, and this navigation it is proposed, if practicable, to dee and maintain in order that the full capacity of the stream for wa transportation may be developed. The question therefore resolves it into (1) the extent to which the physics of the stream and its val will admit of betterments of the existing transportation facilities, the means best adapted to this end, and (3) the cost of securing th

For a better understanding of the general and special aspects of matter, its official history may first be summarized.

The status of the navigation in question was adjudicated by Supreme Court of the United States in the case of *The Daniel Ball* [illegible]

[illegible] Grand River [illegible] Michigan, held to be a navigable water of the United States [illegible] from [illegible] Michigan to Grand Rapids, a distance of 40 miles, being a st [illegible] a steamer of 123 tons burden, laden with [illegible] passengers, and forming by its junction with the lake a conti highway [illegible] with other States and with foreign countries.

The act of June 14, 1880, authorized a survey and examination of navigable section, a report of which was submitted under date of [illegible]ruary 12, 1881.

Transit lines were run on both banks from Grand Rapids to the l end of the Ottawa boom, a distance of 33 miles, and a line of le on the north bank from Grand Rapids to Spoonville, 29 miles, with t of dredging with the facilities for such work then existing , and at 30 cents per cubic yard the estimate for an 8-foot n by dredging and wing dams was about $750,000.

; of March 3, 1881, appropriated $10,000 toward an improve- he river; that of August 2, 1882, $15,000; and that of July 5, ,000; which sums were mostly expended in deepening the ches by dredging; but the contract cost was excessive, rang- $1 to 25 cents and 30 cents per cubic yard, and the net results eby correspondingly reduced.

be noted, as indicating the nature of the river bed and the ies of maintaining a dredged channel, that the materials exca- l deposited near the line of the improvement are still in place. bsequent acts of August 5, 1886, and August 11, 1888, author- ier examinations, that of 1888 for the first time declaring the of navigation called for, viz: "a channel of navigable width num depth of 10 feet."

eference to this, after personal inspection of the river and amination of the records, maps, etc., I made report under arch 22, 1890, from which the following is taken:

data of record a general view of the situation can be had and some ts become evident.

s been on the part of the commercial interests of Grand Rapids a strong stained endeavor to secure, if such a thing be possible, adequate water tion with Lake Michigan, and in the absence of the means of forming a tion of what is practicable, their demands have gone to the fullest limit ty. Grand Rapids has apparently gauged her navigation requirements le measure of her own development and commercial standing, and insisted er should be made to fulfill them, as is indicated in Major Harwood's orig- , where reference is made to the desire for means of making shipments of ids products direct to Europe without breaking bulk. In the course of ect as this there are more obstacles than the inadequate capacity of Grand

mercial statistics for the year 1887 state the number of operatives in the s at 11,110, the capital employed at $15,216,400, and the value of the an- ct at $24,048,800. Such industries as these can not wisely be discouraged, difference in cost between rail and water freights—the latter averaging half the former—be taken into account, the annual value of water commu-

nt lowering of the bed of the channel at the upper limits, due epening, the datum slopes being less than half an inch to the Grandville down, and about two-thirds of an inch to the mile nd Rapids to Grandville.

it prices for material in the estimates are believed to be fairly nd contingencies of 15 per cent are included in the totals. The item, of course, is the dredging, which is estimated at 10 cents. case of a project of this magnitude there should be no diffiloing the work within this figure. The Government dredging rbors on the east coast, with plant of small capacity and movpoint to point, averages less than 10 cents, and in one case a for 60,000 cubic yards was made at Portage Lake for that price. is a question of handling 3 or 4 million yards, the price, if means and a properly equipped plant are available, should d 7 or 8 cents.

neral conclusions derivable from the data now at hand may be follows:

open 10-foot channel of navigable width can be constructed sum the expenditure of which would be warranted by the mag the commercial interests concerned and the economic value nproved navigation.

construction of a dam in the stream in order to diminish the of dredging needed to secure a 10-foot navigation will not re total cost of the project, and the objection thereto, viz, cost tion and maintenance and interference with free movement of nd flow of water, as well as possible claims for land damages, ounterbalanced by any economic advantages.

reduced cost of the 8-foot open channel is not sufficient to restriction in navigation facilities.

probable that at some points permanent works in the bed of m may hereafter be found advisable to regulate the movement ater, and an allowance is made in the estimates for these cons.

vident, however, that such permanent works should not be il the approximate corrected regimen of the river shall have blished, and prolonged observation and experience under the onditions of discharge clearly prove their necessity and indisites and methods to be adopted in building them.

estimated cost of the three comparative projects is as follows:

open 8-foot navigation	$463,450
oot navigation with lock and dam	673,880
open 10-foot navigation	670,500

totals in each case include a sum of $169,000 as a preliminary for wing dams, etc. It is entirely possible that much of this be found unnecessary, but it is considered proper to introduce

nmend the adoption of the last project and that an appropria-100,000 be made for beginning the work.

ticable the total sum required should be placed at the dispothe Engineer Department, to be drawn against in annual sums l be needed, in order that the completion of the work should led for without suspension from lack of funds, and contracts for the full amount of work to be done. By this means costly ould be avoided, and advantage could be taken to procure the of a thoroughly equipped and effective plant, under conditions economic and engineering results.

hree times, the results of which differed somewhat. Before beginning the herefore, an adjusted or most probable value for the elevations of the vas determined, and these most probable elevations used.
tum plane of reference in the surveys of 1884 and 1889 is 100 feet below the water table of Rindge, Bertsch & Co.'s store, corner of Pearl and Campau rand Rapids, the point taken being on the Pearl street side, 1 foot and from the Campau street side." All elevations in the present survey have rred to the same datum. The datum plane of reference for the city of Grand 76.08 feet higher than the above datum.

II.—BORINGS.

ing at the Fulton Street Bridge, in Grand Rapids, borings were made in the for about 32 miles. For the remaining 7 miles, to the mouth at Grand nore than a 10-foot channel already exists, and no borings were necessary art of the river. Ninety-two borings were made in all, decreasing in fre-own river. For the first 6 miles the average number of borings per mile is the next 9 miles the average is three, and for the remaining 17 miles the is two per mile.
rings were made from a flatboat or raft 20 feet long by 10 feet wide and inches deep. The boat was provided with spuds at the corners for g it and keeping it steady while at work. A well hole about 8 inches vas made in the middle of the boat for working the tools through.
ections, from 3 to 5 feet in length, of extra heavy 2-inch (internal diameter) ing with strong couplings were procured. A strong steel annular shoe, larger in external diameter than the pipe and formed with a cutting edge, wed to the lower end of the lower section. On the upper end of the upper was screwed a strong steel driving-head. To make a boring the pipe was ertically through the well-hole in the boat and driven by sledges handled aborers. The blows were transmitted to the steel head through a wooden ound with iron rings and held in place. As the pipe descended under the the blows, it was turned around by a pipe-wrench. When occasion re-e head was unscrewed, another length of pipe introduced, the head screwed p of the new length, and the driving continued. To withdraw the pipe a vas placed on the boat with its top vertically over the well-hole. Power ted through a windlass with ordinary wagon wheels attached for applying wer, and a 3-sheaved block and tackle for further multiplying the hand force. this arrangement no serious difficulty was experienced in withdrawing the ipe. In most cases it was possible to drive the pipe to the desired depth withdrawing it in the process, but in hard material in order to reach the l depth it was sometimes found necessary after driving the pipe to refusal draw it, remove the material collected within the pipe, replace it, drive nd so on. Sometimes the required depth was reached by introducing within ch pipe a smaller pipe with a drill attached, and the hole continued by g the latter. A large number of specimens of material brought up in the ipe were preserved for record.
epths of the borings vary from 13 to 15 feet below water surface at the time re made, which was at a low stage of the river. As those in the upper part ver have a depth of 15 feet, it will be seen that the borings give a knowledge aterial underlying the river bed for about 10 feet below the water level of chigan. At the time of making the borings their locations were determined urements to stakes on the shore or by ranges. A stake was also set with its ot above water surface. Afterwards the location and elevation of these vere determined by the stadia with reference to points of the survey. The of the borings, and the elevation of their bases, or of the different strata of l found, thus become known.
m Shell Bar, 5 miles below Grand Rapids, very hard material was found at elow water surface, and at 12 feet, or at an elevation of 59.6, plaster rock ick. This rock does not extend for more than 1,000 feet in the direction of r, and as it is almost wholly below any contemplated dredging, and is a k, it is hardly worth noting. At no other place was rock found. In the miles gravel and clay predominate and below this sand.
rst boring was made August 26, and the last on September 23. For want of boat, the most of the borings in the upper reach were made near the shore, o place was especial pains taken to make the borings in the deepest water. ieved that this does not detract from the reliability of the information ob-rom them, as it is not likely that the character of the material would change eet or so either side of the channel. These borings have been plotted on of the survey and a sectional representation of them has been prepared, ich full information of the material met with in the bed of the river may ned at a glance.

No.	Material.	Depth.	Thickness.	Elevation of water surface.	Date.		Remarks.
		Feet.	*Feet.*	*Feet.*			
	Boring 0:						
1	Water	2.0	2.0				
2	Small stones, coarse gravel, and fine sand mixed.	14.[illegible]	12.[illegible]	73.[illegible]	Aug. [illegible]		
	Boring 1:						
1	Water	2.9	2.9				
2	Fine gravel and coarse sand	[illegible]	4.5				
3	Fine sand changing to blue clay.	[illegible]	3.3	74.7	Aug. [illegible]		
4	Quicksand	[illegible]					
5	Blue clay	[illegible]					
	Boring 2:						
1	Water	[illegible]	0.5				
2	Fine gravel and sand, changing to blue clay.	[illegible]	0.2				
3	Quicksand	4.0	4.0				
4	Blue clay (hard)	6.2	2.5	74.7	Aug. 28		
	Boring 3:						
1	Water	7.0	0.5				
2	Coarse gravel and sand	12.6	6.6				
3	Small stones and fine sand	1.9	1.9				
4	Blue clay (hard)	7.6	5.7	74.7	Aug. 29	1,[illegible]	
	Boring 4:						
1	Water	9.0	1.4				
2	Mud	14.4	4.6				
3	Blue clay (hard)	3.2	3.2				
	Boring 5:						
1	Water	3.4	0.2				
2	Medium fine sand mixed with blue clay (soft) 4 to 1.	15.0	11.6	74.5	Aug. 29	2,402	
	Boring 6:						
1	Water	3.9	3.9				
2	Coarse gravel and sand	16.5	12.6	74.4	Aug. 31	3,830	
3	Fine sand and blue clay						
	Boring 7:						
1	Water	4.9	4.9				
2	Fine gravel and sand	10.0	5.1				
3	Medium coarse gravel and sand.	15.5	5.5	74.4	Aug. 31	5,470	Near [illegible] above Plaster [illegible]
	Boring 8:						
1	Water	2.5	2.5				
2	Fine gravel and sand	10.0	7.5				
3	Medium coarse gravel and sand	11.6	1.6	74.1	Sept. 1	6,575	Near d[illegible] in river, bowlder.
	Boring 9:						
1	Water	2.5	2.5				
2	Fine gravel and sand	10.0	7.5				
3	Medium coarse gravel and sand	12.6	2.6	74.1	Sept. 1	6,590	Struck bowlder at 12.6 ft.
	Boring 9:						
1	Water	2.5	2.5				
2	Fine gravel and sand	10.0	7.5				
3	Medium coarse gravel and sand	13.0	3.0				
4	Gravel and sand mixed with clay.	16.1	3.1	74.1	Sept. 1	6,477	Located at dredge dump, river.
	Boring 10:						
1	Water	4.0	4.0				
2	Gravel and fine sand	9.0	5.0				
3	Blue clay (soft) mixed with stones and sand.	16.0	7.0	74.2	Sept. 2	7,815	Located near [illegible] dock above Plaster Mill.
	Boring 11:						
1	Water	2.4	2.4				
2	Fine sand, shells, and gravel	5.0	2.6				
3	Fine white sand	7.5	2.5				
4	Same and very coarse gravel	12.0	4.5				
5	[illegible] clay and stone	14.8	2.8	73.7	Sept. 2	9,368	Near right bank.
	Boring 12:						
1	Water	4.0	4.0				
2	[illegible]	7.6	3.6	73.7	Sept. 2	10,328	Near right bank. Struck bowlder at 7.6 ft.
	[illegible]	[illegible]	[illegible]	73.7	Sept. 2	10,338	Located 6 ft. from No. 12.
	[illegible]	[illegible]	[illegible]	73.7	Sept. 3	11,913	Near left bank at mouth of creek.
	[illegible]	[illegible]	[illegible]	73.3	Sept. 4	13,263	Near left bank, below L. S. & M. S. R. R. bridge.

Record of the borings—Continued.

Material.	Depth.	Thickness.	Elevation of water surface.	Date.	Distance from foot of Gaines canal.	Remarks
	Feet.	*Feet.*	*Feet.*		*Feet. Below.*	
Boring 16:						
Water	2.3	2.3	73.4	Sept. 4	15,010	Near right bank.
Fine sand	15.0	12.7				
Boring 17:						
Water	2.4	2.4	73.3	Sept. 5	15,903	Near mouth of creek on right bank.
Yellow clay and sand mixed	10.0	7.6				
Sand and coarse gravel	15.0	5.0				
Boring 18:						
Water	2.5	2.5	72.8	Sept. 5	16,652	Located near right bank.
Sand, shell, and reddish clay	11.5	9.0				
Coarse gravel	13.6	2.1				
Gravel and white sand	14.3	0.7				
Boring 19:						
Water	3.0	3.0	71.9	Sept. 5	18,670	Near left bank at mouth of creek.
Mud	4.0	1.0				
Sand	9.5	5.5				
Very coarse gravel and sand	15.0	5.5				
Boring 20:						
Water	1.7	1.7	71.9	Sept. 8	19,906	Near right bank a spring creek.
Fine sand	5.0	3.3				
Sand, gravel, and shell	6.5	1.5				
Blue clay (hard)	14.8	8.3				
Boring 21:						
Water	3.7	3.7	71.9	Sept. 8	21,664	Near right bank.
Sand	5.0	1.3				
Blue clay (hard)	12.0	7.0				
Blue clay (hard), sand, and gravel.	14.8	2.8				
Boring 22:						
Water	4.0	4.0	72.0	Sept. 8, 9	22,905	Located at mouth of creek, right bank. Too hard to drive farther.
Sand	6.0	2.0				
Yellow clay	8.0	2.0				
Gravel and clay (hard)	12.0	4.0				
Boring 23:						
Water	4.0	4.0	72.0	Sept. 9	22,911	6 feet below boring 22.
Sand	6.0	2.0				
Yellow clay	8.0	2.0				
Clay, sand, and gravel mixed (very hard).	15.0	7.0				
Boring 24:						
Water	3.4	3.4	72.0	Sept. 9	24,696	Near right bank.
Fine sand	9.0	5.6				
Gravel and blue clay (soft)	10.0	1.0				
Blue clay (soft) and stone	15.0	5.0				
Boring 25:						
Water	3.7	3.7	71.5	Sept. 10	26,382	Near left bank at Clam-shell bar; rock at 10 ft.
Sand	8.0	4.3				
Blue clay, sand, and shell mixed (very hard).	10.0	2.0				
Boring 26:						
Water	3.7	3.7	71.5	Sept. 10	26,392	Rock at 10 ft.
Sand	8.0	4.3				
Blue clay, sand, and shell mixed (very hard).	10.0	2.0				
Boring 27:						
Water	2.5	2.5	71.6	Sept. 11	26,774	Located at right bank at Clam-shell bar.
Fine sand	6.0	3.5				
Clay	9.0	3.0				
Clay and stone (hard)	12.0	3.0				
Plaster rock	13.2	1.2				
Boring 28:						
Water	3.8	3.8	71.6	Sept. 11	26,960	Near right bank at Clam-shell bar; rock at 10.8 ft.
Fine sand	6.0	2.2				
Clay	10.8	4.8				
Boring 29:						
Water	4.5	4.5	71.5	Sept. 11	27,090	Near right bank at Clam-shell bar; rock at 10.02 ft.
Sand	6.0	1.5				
Blue clay (stiff)	8.0	2.0				
Blue clay and gravel	10.2	2.2				
Boring 30:						
Water	4.5	4.5	71.3	Sept. 12	29,257	Near left bank.
Sand	14.0	9.5				
Boring 31:						
Water	5.0	5.0	71.3	Sept. 12	31,105	136 ft. from left bank at Grandville.
Sand	7.0	2.0				
Yellow clay (stiff) and stone	14.0	7.0				

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Date.	Distance from foot of Genesee canal.
						Feet. Below.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Fine sand and clay [illegible]	[illegible]	[illegible]	[illegible]	Sept. 18	70.116

Record of the borings—Continued.

Material.	Depth.	Thickness.	Elevation of water surface.	Date.	Distance from foot of Ganoes canal.	Remarks.
	Feet.	*Feet.*	*Feet.*		*Feet.* Below.	
	7.8	7.8	69.3	Sept. 18	71,786	125 ft. from right bank.
	14.4	6.6				
	5.0	5.0	69.3	Sept. 18	72,918	113 ft. from left bank.
d	13.5	8.5				
and	14.5	1.0				
	3.8	3.8	69.3	Sept. 18	74,420	124 ft. from left bank.
and	13.3	8.5				
d	14.3	1.0				
	4.0	4.0	69.2	Sept. 19	75,977	Near midchannel.
and	12.0	8.0				
coarse sand	14.0	2.0				
	4.0	4.0	69.2	Sept. 19	77,538	Near left bank.
and	12.5	8.5				
	14.0	1.5				
	4.0	4.0	69.2	Sept. 19	79,468	Located near left bank.
	14.0	10.0				
	5.0	5.0	69.0	Sept. 19	81,833	Near left bank.
	14.0	9.0				
	7.0	7.0	69.0	Sept. 19	84,018	37 ft. from left bank.
	8.0	1.0				
and	14.0	6.0				
	3.8	3.8	69.0	Sept. 19	86,498	Located 78 ft. from left bank.
and	8.8	5.0				
and (soft)	11.0	5.2				
	3.8	3.8	68.75	Sept. 19	89,687	140 ft. from left bank.
and	6.8	3.0				
and	13.0	6.2				
	14.0	1.0				
	11.3	11.3	68.7	Sept. 21	91,125	Near center bridge pier at Lamont.
and	14.3	3.0				
	6.5	6.5	68.7	Sept. 21	92,610	145 ft. from left bank.
	14.0	7.5				
	5.0	5.0	68.6	Sept. 21	95,360	60 ft. from right bank.
and	14.0	9.0				
	6.2	6.2	68.6	Sept. 21	97,853	Located near mid-channel.
and	7.2	1.0				
d	14.0	6.8				
	4.2	4.2	68.6	Sept. 21	100,218	150 ft. from right bank.
and	14.0	9.8				
	3.0	3.0	68.6	Sept. 21	102,750	140 ft. from left bank.
d	14.0	11.0				
	7.0	7.0	68.5	Sept. 22	104,698	Near right bank.
	13.5	6.5				
	7.5	7.5	68.5	Sept. 22	106,694	Do.
and, fine gravel and	13.5	6.0				
	7.0	7.0	68.5	Sept. 22	108,843	Near lower end of dock at Eastmanville.
and	10.0	3.0				
	13.5	3.5				
	4.0	4.0	68.4	Sept. 22	110,755	Located 96 ft. from right bank.
and	12.0	8.0				
	13.5	1.5				
	5.0	5.0	68.4	Sept. 22	112,325	82 ft. from right bank.
and	12.0	7.0				
l clay mixed	13.0	1.0				

[illegible]

e line of the upper posts. The wire on the upper section was so adjusted the soundings of this section directly upstream from the corresponding lower section.

ity of that portion of the stream lying between any two soundings on section and the corresponding two on the upper section was determined by Before dropping in a float it was so weighted as to pass down through l section with its lower end close to the river bed. The place for drop-floats was determined by stretching the wire across the river about 20 the upper sounded section so as to bring the tags directly above the mid-ons determined by the corresponding down and up stream soundings. The then dropped at these tags from a small boat. The time at which each d the upper and lower sounded sections was taken to the nearest second. se observations the mean area and velocity per second of each 10-foot the river was determined, which multiplied together gave the discharge tion, and the sum of these the total discharge. The total discharge di-e total area gives the mean velocity. From the care taken to have the h near the bottom, and from other considerations, it has been thought y to make any correction or deduction from the discharge as computed served quantities. A temporary gauge for reference during the sounding bservations was set and afterwards referred to a permanent bench.

ct of setting the four posts on the bank was to preserve the exact loca-gauged section in the hope that rises in the river would occur during s of the survey and enable new gaugings to be made at the same place t river stages, for the purpose of comparison and more accurate deter-f relative velocities and discharges due to different depths.

level and tape the form of the sounded sections from the water's edge to t the top of the bank was determined, so that a complete section of the een the tops of banks could be plotted, and the area and wetted perimeter pth could be computed. With this data such a section of the river bed etween the sounded sections has been prepared at each of the places of n.

e of the river remained almost stationary during the survey, and no op-offered for further gauging. The slopes, velocity, and discharges, as e accompanying table for other stages than that of the observation, must e taken as near approximations only. The result of gauging near Grand en in the first line of the table.

comparison of the conditions of Grand River with similar conditions in rs where gaugings have been made, we are led to select for the coefficient ss in Kutter's formula a value of 0.026. Substituting this value, the ob-an velocity and the hydraulic mean radius in that formula, and solving, 0003 as the value of the slope. From the observed low water of 1889, the water surface in the 9,880 feet next above Grandville is 0.33 feet, giving a e of 0.0000334. Considering the fact that the water surface at the time of gauging was about 0.46 feet lower than the observed low water of 1889

The following table gives the results of the observations and compr derived from Kutter's formula, which is more fully elaborated on page 2

Stages on [illegible]	[illegible] stage [illegible] discharge section	Mean [illegible]	Sectional area.	Wetted perimeter	Hydraulic mean radius	Slope.	Mean velocity. Feet per second.
			A	b	$r = \frac{A}{b}$	i	$v = \frac{Q}{A}$
[illegible]	[illegible]	[illegible]	1 2[illegible]5.51	350.0	3.653	.000[illegible]	0.[illegible]
[illegible]	[illegible]	[illegible]	1 765.[illegible]	345.[illegible]	5.100	.000[illegible]	1.21[illegible]
[illegible]	[illegible]	[illegible]	2,961.91	[illegible]7.5	8.059	.000[illegible]	1.[illegible]42
[illegible]	[illegible]	[illegible]	4 [illegible]5.43	[illegible]2.0	11.136	.000[illegible]	2.[illegible]

An examination of the tabulated gauge readings herewith will show the time of year and duration of the stages for which discharges have been co

[illegible] the mean, highest and lowest monthly elevations of river surface obser [illegible] Grand Rapids, Grandville, and Lamont gauges, and of the lake surface at Grand

Months.	Means: Grand Rapids.	Grandville.	Lamont.	Grand Haven.	Highest observed: Grand Rapids.	Grandville.	Lamont.	Grand Haven.	Lowest observed: Grand Rapids.	Grandville.	Lamont.
18[illegible]											
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	75.87	72.76	69.[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	72.96	70.[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

PROFILE.

...e of the river from Grand Rapids to Grand Haven has been prepared show... ...w-water surface of November, 1889, which is nearly as low as that of 1891, ...ce of the water at the time the soundings were taken, the probable water ...r each 1 foot rise on the Grand Rapids gauge from a 75 to an 83 foot stage, ...ion and depth of borings, and a mean profile of the river bed averaged for ...of 100 feet.

...e along which this profile is made is shown on the maps, and, approximating ...resent channel, is the line along which it is thought the proposed improve... ...ould be made. A reduced profile of the entire river has also been made. ...wing the bottom of proposed dredging are also shown on these profiles.

GAUGE READINGS.

...readings were taken at four places on the river from December 22, 1890, to ...13, 1891, namely, at Grand Rapids, Grandville, Lamont, and Grand Haven. ...adings have been plotted on profile paper for convenience of comparison.

*...of maps and profiles of Grand River, below Grand Rapids, submitted herewith.**

1. A map of upper 12 miles of river.
2. A map of middle 12 miles of river.
3. A tracing of lower 15 miles of river.
4. A tracing of reduced map and profile of river.
5. A profile of river.
6. Gauge reading.
7. Sections of borings.

...following table shows the low-water (1889) slopes, total fall, and fall in inches ...le of different portions of the river. It will be seen from it that the fall from ...Rapids to Grandville, a distance of 6 miles, is 2.85 feet, or 5.73 inches per mile; ...m Grandville to Lamont, a distance of 11.5 miles, it is 2.92 feet, or 3.05 inches ...le; and that from Lamont to Grand Haven, a distance of 21.64 miles, the fall ...foot, or 0.24 inch per mile; also that from Grand Haven to the mouth of ...Creek, a distance of 27.26 miles, the fall is only 1.04 feet, or 0.46 inch per ...aving 5.16 feet fall in the upper 12 miles. Any contemplated improvement ...herefore be principally concerned with these upper 12 miles.

Low water (1889) slopes and total fall.

Place.	Distance from canal.	Elevation.	Place.	Distance from canal.	Elevation.	Difference of distance.	Difference of elevation.	Slope.	Fall per mile.
									Ins.
...s Canal	0	74.47	B. M. 2	4,320	74.09	4,320	.38	.0000877	5.56
...2	4,320	74.09	B. M. 3	8,260	73.64	3,940	.45	.0001142	7.24
...3	8,260	73.64	B. M. 4	13,442	72.42	5,182	1.22	.000235	14.89
...4	13,442	72.42	B. M. 5	16,956	72.39	3,514	.03	.0000085	.54
...5	16,956	72.39	B. M. 6	21,624	71.95	4,668	.44	.000094	5.96
...6	21,624	71.95	B. M. 8	31,504	71.62	9,880	.33	.000033	2.09
...8	31,504	71.62	B. M. 9	32,695	71.57	1,191	.05	.000042	2.66
...9	32,695	71.57	B. M. 11	38,453	71.01	5,768	.56	.000097	6.15
11	38,453	71.01	B. M. 12	43,735	70.14	5,282	.87	.0001647	10.44
12	43,735	70.14	B. M. 13	46,805	70.04	3,070	.10	.0000325	2.06
13	46,805	70.04	B. M. 14	50,295	69.95	3,490	.09	.000026	1.65
14	50,295	69.95	B. M. T	55,636	69.70	5,341	.25	.0000468	2.97
T	55,636	69.70	B. M. J	62,570	69.31	6,934	.39	.0000562	3.56
J	62,570	69.31	B. M. 15	77,530	69.18	14,960	.13	.0000087	.55
15	77,530	69.18	B. M. I	84,961	69.00	7,431	.18	.0000242	1.53
I	84,961	69.00	B. M. S	88,165	68.84	3,204	.16	.0000490	3.16
S	88,165	68.84	B. M. 19	92,235	68.70	4,070	.14	.0000344	2.17
19	92,235	68.70	B. M. II	97,386	68.58	5,151	.12	.0000233	1.48
II	97,386	68.58	B. M. III	105,105	68.50	7,719	.08	.00001036	.66
III	105,105	68.50	B. M. IV	110,382	68.44	5,277	.06	.00001137	.72
IV	110,382	68.44	B. M. V	119,297	68.36	8,915	.08	.00000819	.52
V	119,297	68.36	B. M. VI	126,080	68.34	6,783	.02	.00000295	.19
VI	126,080	68.34	B. M. VII	135,305	68.29	9,225	.05	.00000542	.34
...Haven	206,500	68.27	B. M. 19 Lamont (B. M. J.).	92,235	68.70	114,265	.43	.000003763	.24
...	206,500	68.27	Sand Creek	62,570	69.31	143,930	1.04	.000007225	.46
...at B. M. 19	92,235	68.70	...do	62,570	69.31	29,665	.39	.000013147	.83
...	92,235	68.70	B. M. 8, Grandville	31,504	71.62	60,731	2.92	.0000480808	3.05
...Creek B. M. J.	62,570	69.31	...do	31,504	71.62	31,066	2.31	.000074358	4.71
...ville	31,504	71.62	Foot of Ganoes Canal.	0	74.47	31,504	2.85	.0000904647	5.73

*Not printed.

For the purpose of showing the relation between quantity of discharge, [illegible] section of channel, the following table has been prepared by the aid of the [illegible]let and Kutter formula:

$$v = \left(\frac{a + \frac{l}{n} + \frac{m}{i}}{1 + \left(a + \frac{m}{i}\right) \frac{n}{\sqrt{r}}} \right) \sqrt{ri}$$

in which $a = 41.66$, $l = 1.81132$, and $m = 0.0028075$.

v = mean velocity, r = the hydraulic mean radius.

i = sine of slope and n = coefficient of roughness of perimeter.

In the table n is taken [illegible] .026.

The form of a section of the channel is assumed to be trapezoidal.

z = width of base.

θ = angle of inclination of sides to the horizon.

d = depth.

A = area.

b = wetted perimeter.

Hence,

$$A = dz + \frac{d^2}{\tan \theta} = \frac{dz \tan \theta + d^2}{\tan \theta}$$

and

$$b = z + \frac{2d \sec \theta}{\tan \theta} = \frac{\tan \theta\, z + 2d\sqrt{1 + \tan^2 \theta}}{\tan \theta}$$

Table to ascertain dimensions of channel to be [illegible].

z	tan θ	d	A	b	r	n	i	Fall per mile	v
								Inches.	
[illegible]	[illegible]	6	918	179.8[illegible]	5.1[illegible]	.026	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	8	772	115.77[illegible]	6.[illegible]	.026	[illegible]	[illegible]	[illegible]
		8	912	150.6[illegible]	6.[illegible]	.026	[illegible]	[illegible]	[illegible]
[illegible]		8	848	125.777	6.7[illegible]	.026	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	10	[illegible]	93.72[illegible]	7.[illegible]	.026	[illegible]	[illegible]	[illegible]
		1[illegible]	[illegible]	134.72	8.10[illegible]	.026	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	165.245	7.96[illegible]	.026	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	134.72	8.165	.026	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	165.245	7.9[illegible]	.026	[illegible]44	2.7[illegible]84	[illegible]
	[illegible]	[illegible]	[illegible]	146.7	8.7[illegible]	.026	[illegible]	2.97[illegible]	1.[illegible]

[illegible] of discharge, q, taken in the table in all except the last three [illegible] the observed low-water discharge at the 1881 gauging [illegible] [illegible] last three cases q is the discharge at the same place for a [illegible] Rapids, which is 1.53 feet above the low-water stage.

[illegible] Assuming i [illegible] .0000[illegible] = 2.2176 inches per mile, which is th[illegible] nearly 2 miles above Grandville, a 6-foot channel w[illegible] [illegible] have a base of 153 feet; if the depth be increased to [illegible] the width on the bottom is reduced to 78 feet; an[illegible] [illegible] width is 13 feet. Again, for [illegible] [illegible] will be seen from a preceding table to be [illegible] the lower 27.26 miles, and [illegible] bottom and have a side slope of 5 to 1.

[illegible] FOR OPEN CHANNEL.

[illegible], an open 8-foot channel by dredg[illegible] [illegible] of navigable water have been consider[illegible] [illegible] dredging supplemented by [illegible] [illegible] these two plans are [illegible] [illegible] wing dams and training [illegible] may prove necessary. Estimat[illegible] [illegible] by dredging. The location [illegible] [illegible] is indicated on the maps. After wbridges at Grand Haven, it is proposed to pass up the left channel to channel, and thence up the middle channel to the main river channel. of this middle channel is about 4,400 feet. It already has a maximum re than 10 feet throughout its whole length, and a mean depth of 10 feet in width in the lower 2,700 feet, and a mean depth of 8 feet for the same e upper 1,700 feet. The upper end of this channel should be widened tened. The expense would be small and is fully covered by the estimates. g the middle channel the line follows approximately the existing one. wa Boom" has been removed, and all logging interests in the river are nd. With the exception of the few hundred feet at the head of the middle mentioned above, a more than 10-foot channel already exists for 6½ Grand Haven. Above this point as far as the mouth of Bass River, or ther, a 7 to 8 foot channel exists. Above Bass River the depth of channel but excepting at the shoalings and bars given in the following table a nel exists to Grand Rapids:

tement of the location of shoalings and bars with less than 4 feet of water.

	Distances below foot of Ganoes Canal, Grand Rapids.		Length.	Depth at crossing.	Location.
	Beginning.	End.			
	Feet.	*Feet.*	*Feet.*	*Feet.*	
......	0	270	270	3.0	
......	800	1,200	400	3.6	
......	2 900	3,400	500	3.0	
......	4,300	4,750	450	3.9	
......	5,550	5,950	400	3.5	Mouth of Plaster Creek.
......	8,200	9,600	1,400	3.0	Opposite Lower Plaster Mill.
......	13,500	15,100	1,600	2.5	Just below Lake Shore and Micingan Southern Railroad Bridge.
......	16,500	17,350	850	2.7	
......	17,800	21,300	3,500	2.0	
......	24,750	25,000	250	3.8	
......	27,600	28,050	450	2.9	Clam Shell Bar.
......	36,100	36,600	500	3.8	
......	39,350	40,000	650	3.6	At Weatherwax's.
......	41,400	43,200	1,800	3.0	At Boynton's.
......	49,000	50,100	1,100	3.0	
......	56,400	56,900	500	3.8	At Haire's.
......	74,600	77.100	2,500	2.6	At Bridge Street Ferry.
......	77,450	77,700	250	3.6	
......	79,500	80,700	1,200	3.2	
......	85,050	89,700	4,650	2.3	Just above Lamont.
......	95,700	96,500	800	2.7	Do.
......	100,400	103,000	2,600	2.8	
......	113,900	114,400	500	3.0	Just below Eastmanville.
......	....	....	27,120		

and Haven to Grandville, about 33 miles, the slope assumed for a 10-foot annel is 0.000007, or 0.44352 inch per mile, or about the mean existing e river in the lower 27½ miles. From Grandville to Grand Rapids the ken at 0.000011, or 0.69696 inch per mile. For the low-water discharge r, as obtained at the gauging above Grandville, the former gives a channel wide on the bottom and side slopes of 3 to 1 and the latter a channel 90 n the bottom and side slopes of 2 to 1. From the nature of the material determined by the borings, it is thought that these side slopes will in be quite permanent. The 90 and 100 foot width of bottom and correp width of 130 and 160 feet are thought to be sufficient. To dredge this ll require the removal of 4,000,000 cubic yards, which at 10 cents per will cost $400,000.

redged channel would lower the water at Grandville about 2.1 feet, and apids about 4.6 feet at low-water stages, this effect decreasing with higher stream.

pids a basin large enough to accommodate boats in passing and turnined by the excavation of about 70,000 cubic yards of material, which cubic yard would cost $14,000.

ith lock and dam a similar basin can be obtained by the excavation ards at a cost of $8,000.

of the proposed dam estimated for is formed of two rows of piles and about four feet apart, between which the earth is excavated and the in with concrete. Below the core two rows of piles are placed, one at the lownstream slope of the over fall and the other at the lower edge of the ween the piles of this lower row and a similar row above the core wall is driven. Estimates are made for gravel and stone filling with a suit- ng of planking and rock filling below the apron.

Estimated cost of dam.

Material.	Unit.	Price.	Quantity.	Cost.	Total.
	One	$6.25	160	$1,000.00	
	do	4.00	240	960.00	
	M. B. M	40.00	92,160	3,686.40	
	do	40.00	62,400	2,496.00	
	do	60.00	80,000	4,800.00	
	Cubic yard	4.50	680	3,060.00	
tone filling	do	.75	1,616	1,212.00	
below dam	do	1.75	1,112	1,946.00	
					$19,160.40
ation	do	.50	364	182.00	182.00
paving bank at end of dam	Cubic yard	3.00	278	834.00	834.00
					20,176.40

hat similar dam, but with only one central row of piles and sheet piling, t the concrete core, will cost $15,200.

ESTIMATE FOR 8-FOOT CHANNEL BY DREDGING.

s are made for an 8-foot channel by dredging. From Grand Haven to of Sand Creek (27.26 miles) the slope taken is .000007 (0.44352 inches per ce to Grandville (5.88 miles) it is .000019 (1.20384 inches per mile). One et at the base and side slopes of 3 to 1 is the section assumed for the above From Grandville to Grand Rapids the slope is .000026 (1.64736 inches per the section has a 90-foot base, with side slopes of 2 to 1. The sur- water at Grand Rapids would be lowered about 1.8 feet. The removal of ubic yards of material would be required, costing, at 10 cents per yard, A winding basin at the upper end would cost $8,000.

WING DAMS AND TRAINING DIKES.

nining the inclination and the dimension of the section of a channel that rge the low-water flow of the river, the assumption of course is that the ntity of water discharges through that section. A dredged channel of the ize selected would not be more than 130 to 160 feet wide at the surface. t width of the river varies from about 350 to about 600 feet at low water. herefore to confine the flow to a sufficiently narrow channel and at the to prevent the dredged material from finding its way back into it, wing aining dikes, or both, may be required at various places to maintain a requisite depth. Such works would especially be needed at crossings and ide and straight portions of river where shoaling occurs. In the whole he river there are about twenty crossings. The lower seven of these, being 2 to 3 feet of dredging will be required to open a 10-foot channel and in he river where there is little current even at high water, will probably re- rticular works, as it will be less expensive and more satisfactory to re- redging from time to time any slight shoaling that may occur at these

the upper 5 miles of river, where five crossings occur and where the project a 10-foot channel contemplates the lowering of the bed of the stream at from 2 to 4 feet, and where, too, the material to be dredged is com- ly of clay, coarse gravel, cobblestone, and bowlders, it is thought that a osition of the dredgings, supplemented by the encouragement of a willow growth on the dredge dumps and portions of the river bed which for low be out of water, may secure a practically permanent channel without the ms or dikes. At and in the vicinity of the remaining eight crossings, tributed over a distance of about 18 miles of river and where the large fraction of this distance is largely sand, works more or less

[illegible]

[illegible] with deck and [illegible]

[illegible]

[illegible] Grand Rapids [illegible]

[illegible]

[illegible]

[illegible] with deck and [illegible]

[illegible]

[illegible] Grand Rapids [illegible]

[illegible]

Total [illegible]

[illegible]

[illegible]

[illegible] Grand Rapids [illegible]

[illegible]

[illegible]

[illegible]

ikes or to contract the channel width, and that some of them are from 2 bove low water, and have young willows growing upon them, strongly that a permanent channel when once formed can be maintained with small

arison of soundings taken in 1884 previous to dredging, and again in 1889, s after dredging had been done, indicate that, except at crossings, the fill- he excavated channel has not been great.

mated first cost of improvement with lock and dam being somewhat greater of the open channel, the inconvenience to navigation of a lock, added to l cost of maintaining and operating it, make the open channel preferable more economical. There is also the following consideration in favor of the ot channel: The lowering of the river bed 4.5 feet at Grand Rapids, as ontemplates, would make a water power there which might be utilized in in- he already large manufacturing interests of that city. Taking the minimum discharge of the river, viz, 980 cubic feet per second=61,152 pounds per d 4.5 feet head, we have a theoretical horse power $=\frac{61,152\times4.5}{550}=500.3$, h an efficiency of 80 per cent, gives 400.2 as the actual horse power at-

g 5 pounds of coal to the horse power per hour, if this power be used 24 y for three hundred and ten days in the year, the quantity of coal to give power will be 7,440 tons, worth, at \$2.25 per ton, \$16,740, yearly. If the ised only 10 hours a day for 310 days in the year, it will be equivalent to of coal, worth \$6,975 yearly. For a large part of the year the available uld be considerably larger, but even this amount, if capitalized at 5 per ld justify the expenditure of \$334,800, or \$139,500 for the open channel in the cost of a channel with lock and dam.

owing gentlemen assisted in the field work: E. C. Dunbar, assistant engi- ert L. Sackett, E. L. Allor, F. A. Sager, H. Baldwin, and H. B. Beecher. oddard, assistant engineer, and R. Stierle assisted in part of the office

y respectfully, your obedient servant,

FRED MORLEY,
Assistant Engineer.

ILLIAM LUDLOW,
ps of Engineers, U. S. A.

Statement of the jobbing business of Grand Rapids for 1891.

Nature of business.	No.	Capital employed.	Amount of business of 1891.	No. of employés.
, and rubbers	4	\$200,000	\$325,000	56
stationery	1	100,000	300,000	49
	2	150,000	275,000	168
produce	7	118,000	1,000,000	174
	2	165,000	345,000	56
	4	800,000	1,400,000	295
	2	165,000	500,000	27
	6	900,000	5,000,000	143
	2	500,000	908,000	117
nd furs	2	25,000	60,000	12
, and wool	4	525,000	800,000	22
	1	10,000	25,000	5
ment	4	50,000	200,000	16
	4	200,000	500,000	31
	1	35,000	150,000	6
	2	73,000	375,000	41
	2	92,000	350,000	23
ils, etc	3	200,000	500,000	31
supplies	1	10,000	25,000	6
eddlers' supplies	3	10,000	50,000	24
rdware	2	100,000	350,000	29
	2	25,000	150,000	23
	3	10,000	25,000	11
	67	4,463,000	13,613,000	1,365

[illegible]

ent of the manufacturing industries of Grand Rapids for 1891—Continued.

Nature of business.	No.	Capital employed.	Amount of business of 1891.	Number of employés.
	1	$9,000	$11,000	13
	1	8,000	35,000	7
nt	2	350,000	385,000	54
fluid	2	25,000	50,000	7
	4	13,000	76,000	27
	3	30,000	52,000	35
	1	4,000	12,300	6
	1	65,000	215,000	60
and truck	1	10,000	25,000	15
l	1	6,000	25,000	10
xtract	2	55,000	75,000	15
	1	25,000	75,000	10
nd feed mill	10	950,000	2,200,000	152
	46	6,160,300	10,010,000	6,613
lamp	1	2,500	8,500	4
wood trimmings	8	176,000	238,500	106
iron, etc	25	72,400	357,750	152
	1	600,000	175,000	41
	2	2,000	4,800	7
	1	25,000	25,000	10
r	1	10,000	25,000	20
	14	102,150	342,150	116
	1	1,000	6,000	4
ornament	1	2,000	5,000	4
	1	10,000	10,000	14
	16	778,000	1,116,200	567
l granite	8	56,100	141,000	91
urifier	1	25,000	65,000	13
aper	1	3,000	....	5
licine	7	34,500	172,200	29
	1	15,000	25,000	25
	2	2,500	6,200	27
ll, sash, door, etc	27	2,867,000	4,950,000	1,554
l	5	450,000	215,000	141
ouse	1	5,000	21,000	7
	1	2,000	8,000	4
	2	8,000	27,000	23
	1	5,000	10,000	7
	1	5,000	18,000	12
	1	10,000	15,000	9
rs and windows	3	2,500	24,500	16
e	1	1,500	2,700	4
	5	25,400	233,000	127
n fastener	1	25,000	25,000	15
	2	3,000	14,500	17
beadings	2	70,500	292,000	76
ncil	3	12,200	22,000	9
	5	35,000	146,000	40
	2	345,000	470,000	102
	2	18,400	53,000	22
	1	2,000	6,500	2
	1	6,000	18,000	9
	1	100,000	200,000	100
ng compound	1	225,000	575,000	174
istern brick	2	2,300	11,600	12
ow	1	17,000	51,000	32
d rattan (not furniture)	1	7,000	21,000	15
nade	1	200	1,000	2
	1	15,000	40,000	12
s	2	4,200	13,500	9
ing	8	3,000	32,000	16
oes	3	3,450	27,000	17
are (not enumerated)	17	78,000	172,000	61
r	1	10,000	15,000	12
ng	1	2,000	5,000	4
	498	18,228,000	33,555,900	14,990
ents included by the U. S. Census Bureau in 1890, hedule of manufactures, but which are local in their vill add to this table with a corresponding increase	465	347,000	1,642,650	2,898
l	963	18,575,000	35,198,550	17,888

H. D. C. VAN ASMUS,
Secretary Board of Trade, Grand Rapids, Mich.

APPENDIX L L.

[IMPRO]VEMENT OF CERTAIN RIVERS AND HARBORS IN EASTERN MICHIGAN.

[REPOR]T OF COLONEL O. M. POE, CORPS OF ENGINEERS, OFFICER IN [CHA]RGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892, WITH OTHER [DOCU]MENTS RELATING TO THE WORKS.

IMPROVEMENTS.

[1. St.] Marys River, Michigan.
[2. Ope]rating and care of St. Marys Falls [C]anal, Michigan.
[3. Dry] dock at St. Marys Falls Canal, [M]ichigan.
[4. Hay] Lake Channel, St. Marys River, [M]ichigan.
[5. Har]bor at Cheboygan, Michigan.
[6. Har]bor at Thunder Bay, Michigan.
[7. Th]under Bay River, Michigan.
[8. Har]bor at Au Sable, Michigan.
[9. Sag]inaw River, Michigan.
[10. Har]bor of refuge at Sand Beach, Lake [H]uron, Michigan.
11. Black River at Port Huron, Michigan.
12. Mouth of Black River, Michigan.
13. St. Clair Flats Canal, Michigan.
14. Operating and care of St. Clair Flats Canal, Michigan.
15. Clinton River, Michigan.
16. Grosse Pointe Channel, Michigan.
17. Rouge River, Michigan.
18. Detroit River, Michigan.
19. Removing sunken vessels or craft obstructing or endangering navigation.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., July 16, 1892.

[GEN]ERAL: I have the honor to transmit herewith the annual reports [relatin]g to the works of river and harbor improvements under my [charg]e, for the fiscal year ending June 30, 1892.

* * * * * * *

I am, sir, very respectfully, your obedient servant,

O. M. POE,
Colonel, Corps of Engineers,
Bvt. Brig. Gen., U. S. A.

[Bri]g. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

L L 2.

IMPROVEMENT OF ST. MARYS RIVER, MICHIGAN.

The project for obtaining a navigable channel of 16 feet depth between Lakes Superior and Huron had been barely completed when the demands of commerce so enormously increased that the work of obtaining a depth of 20 feet throughout was undertaken, with the full sanction of both legislative and executive authority.

A necessary part of the project is the construction of a new lock upon the site of the old State locks, to have a length of 800 feet between gates, a width of 100 feet throughout, a depth of 21 feet on the miter sills, and a single lift approximating 18 feet. The canal is to be deepened to correspond. The estimated cost of this enlargement of the canal system is $4,738,865, for the details of which see page 229 et seq. of the Annual Report of the Chief of Engineers for 1887.

Prior to June 30, 1890, a total of $1,250,000 had been appropriated for the work. The river and harbor act of September 19, 1890, appropriated an additional $900,000 for continuing the improvement with the provision "that such contracts as may be desirable may be entered into by the Secretary of War for materials and labor for the entire structure and approaches, or any part of the same, to be paid for as appropriations may from time to time be made by law;" and the sundry civil act of March 3, 1891, appropriated $600,000 for continuing the improvement during the fiscal year ending June 30, 1892. The total amount appropriated up to date, therefore, is $2,750,000, with authoritiy to contract for all or any part of the work.

For the time being the work is confined to the improvement of St. Marys Falls Canal and its approaches. On June 30, 1891, its condition was as follows, viz: The cofferdam surrounding the site of the 800-foot lock was in good condition; the excavation of the lock pit had been carried below grade, except a small area at the eastern incline, and the contractors were engaged in removing a considerable amount of loose and broken stone below grade; and a considerable amount of filling yet remained to be done behind Fort Brady Pier.

The contractors for the masonry of the lock walls had a considerable portion of their plant in readiness for use; had begun quarrying face stone at Kelly Island, Lake Erie, and backing stone at Drummond Island, Michigan; were receiving cement and had begun laying concrete in the lock foundations, but no estimate had yet been made for payment therefor.

The following contracts were in force during the year, viz:

Contractor.	For—	Entered into.	Remarks.
Collins & Farwell	Excavating	Mar. 1, 1889	In force.
H. D. Edwards & Co	Ship chandlery	Mar. 7, 1891	Closed October, 1891.
R. G. Ferguson & Co	Zinc and galvanized iron	June 15, 1891	Closed July, 1891.
Hughes Bros. & Bangs	Building masonry	Feb. 9, 1891	In force.
George Kemp	Coal	Mar. 7, 1891	Closed December, 18
Jno. H. Killmaster & Co	Timber and plank	May 1, 1891	Closed September, 1
King Iron Bridge & M'f'g Co	Gate anchorages	Oct. 29, 1891	Closed June, 1892
Chas. Hebard & Son	Lumber and shingles	Mar. 7, 1891	Closed January, 18
P. M. Church & Co	Ship chandlery	Mar. 25, 1891	In force.
James R. Ryan	Delivering clay	Nov. 28, 1891	Closed February, 1
John P. McGuire	Valve frames and valves	Mar. 10, 1891	In force.
Richards & Co., limited	Chemicals	Mar. 25, 1891	Closed May, 1892.
R. G. Ferguson & Co	Hardware	do	Do.
James Strachan	Machine work	do	In force.
Chas. Hebard & Son	Lumber and shingles	do	Do.
George Kemp	Coal	do	Do.

S MADE DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

the Collins & Farwell contract but little was done. The con-
topped the work of excavation on July 8, 1891, and made no
ither to make good with concrete the excessive excavation, or
te the filling behind Fort Brady, both of which were required
:ms of their contract.
the contract of Hughes Brothers & Bangs work on the ma-
the lock walls has been pushed with vigor. They have a fine
ise at the canal and at the Drummond Island Quarries. A
n of it is given in detail in the appended report of Assistant
E. S. Wheeler. Although the information is not at hand for
ration of a similar description of their plant at the Kelly's
iarries, yet I know, from personal inspection, that it is quite
g with the rest of it.
the fiscal year the following quantities represent the work

:	Cubic yards.
pit	3,161
np well	2,603
l	5,764
ndations of lock walls	7,970
n backing and rock face of excavation	244
of pump well	264
l	8,478
aid	2,242
one laid	7,305

backing stone laid the contractors furnished 6,591 cubic yards
Government furnished 714 cubic yards, the latter being stone
m the walls of the old State locks (of 1855).

id stone in "the rough"—	Pieces.
ed July, August, September, and October, 1891	1,912
ed April, May, and June, 1892	3,033
l received during fiscal year	4,945

ere carried in thirty-seven cargoes.

gest stone contained 183 cubic feet, and weighed about 14¼
ter being cut its volume was 105.26 cubic feet and the weight
ed to about 8¼ tons.

id stone "cut"—		
fiscal year	pieces..	2,414
ning	cubic yards..	3,229¾

horages—all have been delivered at the canal, the weight being about

eived and used—	Barrels.
id	2,159
l	19,200
l	21,358

ditional cement house was built.

PRESENT CONDITION OF THE WORK.

am.—The process of "stock-ramming" the clay wall of the
i was continued throughout the year with great confidence in its
The operation is described in detail in the appended report
ant Engineer E. S. Wheeler. The party engaged upon this

cofferdam, excluding, however, the site occupied by the mov-
which it is not intended to disturb at present.

WATER LEVELS.

ater gauge readings above and below the locks were continued
year, and the annual means for the calendar year 1891 and
ly means for the various months in the fiscal year have been
and added to the water-level tables appended to my annual
1890. In order that these published tables may be kept up
e various monthly and annual means are submitted herewith,
follows:

Elevations above sea level.

Month.	Lake Superior.	St. Marys River.	Lake Huron.
	Feet.	*Feet.*	*Feet.*
	601.292	582.760	580.43
	601.304	582.792	580.33
1	601.238	582.617	580.14
	601.294	582.516	579.77
1	601.185	582.354	579.46
	600.920	582.209	579.40
mean	601.042	582.694	580.03
	600.815	582.518	579.42
	600.457	582.465	579.36
	600.277	582.475	579.42
	600.429	581.794	579.50
	600.940	582.037	579.63
	601.300	582.530	580.16

Difference in elevation.

Month.	Between Lake Superior and Lake Huron.	Between Lake Superior and St. Marys River.	Between St. Marys River and Lake Huron.
	Feet.	*Feet.*	*Feet.*
	20.86	18.532	2.33
	20.97	18.512	2.46
1	21.10	18.621	2.48
	21.52	18.775	2.75
1	21.72	18.831	2.89
1	21.52	18.711	2.81
mean	21.01	18.348	2.66
	21.40	18.297	3.10
1	21.10	17.992	3.11
	20.86	17.802	3.06
	20.93	18.635	2.29
	21.31	18.903	2.41
	21.14	18.770	2.37

gs showing the water-level curves for lakes Superior and
e former platted from observations taken above the locks at
from January, 1889, to date, the latter from observations
Sand Beach, Mich., during same time, are also submitted.*
neous.—The series of characteristic photographs of the work
s has been kept up. The negatives become the property of
nment and are preserved with the records.
rk is under local charge of Assistant Engineer E. S. Wheeler,
ided by Assistant Engineers Joseph Ripley and J. L. Callard,

*Not printed.

part of the work does nothing else, because the dam is so vital to other operations that it demands and receives unremitting atten About 6 cubic yards of clay are rammed into the dam each working The dam is now as tight as it ever was, and the leakage through or mediately under it is remarkably small.

Pumping plant.—The water which is now pumped from the lock comes almost entirely through seams in the rock, and from that wa in the operations connected with the construction of the lock. pumping plant in position for the purpose of keeping the lock pit has not been required to operate one-fourth of the time during the fi year. It is not liable to get out of order, and the greatest dange be apprehended is from fire which might consume the buildings wh house all but the 8-inch piston pump. For greater precaution this been placed in the pump well of the new lock, at a distance from buildings containing the other pumps.

There are four cement houses, all in excellent condition, with a ca ity for the storage of 8,200 barrels of cement at one time.

Masonry.—The first stone was laid in the lock September 2, 1 The stonecutting for the first five courses is practically completed, the exception of the piers under the miter wall of the upper lock g and the stone for the main miter wall. Work on the sixth cours well advanced.

The greater portion of the south face wall of the lock is built courses high and the backing completed to correspond. In like m ner the greater part of the opposite wall has been carried four cou high. Two courses in the bottom of these walls are laid througl nearly their whole length, but portions are not yet backed. The cou are uniformly 2 feet high, except the lower course downstream f the "drop" in the lock floor, which course is 1½ feet thick. Part the two lower courses of the upper guard gate miter wall have b laid.

Pump well and pumping plant.—The concrete walls of the pre well have been carried up to the level of the lock floor and the int thereto from the lock chamber is completed. The preparation of plans for the pumping plant has been intrusted to Mr. Julian Kenne of Pittsburg, Pa., and he now has them under consideration.

Lock gates.—The designs for the lock gates are being prepared in office, and are now well advanced.

Gate anchorages.—The anchorages for the ten gates have been de ered at the canal. The anchor plates and the lower series of eyel for the lower guard gates have been set in place. They are in keep with the massive character of the whole work. The anchorages ha total weight of about 275 tons, costing, at the contract prices, $20,768

Valves and valve frames.—These are under construction in accorda with a contract entered into March 10, 1892, with John P. McGuir Cleveland, Ohio. The contract provides for 14 valves and 12 va frames, the estimated weight of the whole being nearly 136 tons, will cost, at the contract price, $26,862.96, subject to a slight variat however, in case any modifications are made during the process of m ufacture.

Valve and gate engines.—The designs for these are in course of pr ration in this office, and the drawings are well advanced.

Deepening the canal prism.—In accordance with advertisement d June 2, 1892, proposals will be opened on July 2, 1892, for deepe the canal prism from a cross section about 275 feet west of the wes

the cofferdam, excluding, however, the site occupied by the mov-
m, which it is not intended to disturb at present.

WATER LEVELS.

water gauge readings above and below the locks were continued the year, and the annual means for the calendar year 1891 and thly means for the various months in the fiscal year have been ed and added to the water-level tables appended to my annual for 1890. In order that these published tables may be kept up , the various monthly and annual means are submitted herewith, as follows:

Elevations above sea level.

Month.	Lake Superior.	St. Marys River.	Lake Huron.
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	601.292	582.760	580.43
91	601.304	582.792	580.33
, 1891	601.238	582.617	580.14
91	601.294	582.516	579.77
, 1891	601.185	582.354	579.46
1891	600.920	582.209	579.40
ual mean	601.042	582.694	580.03
892	600.815	582.518	579.42
1892	600.457	582.465	579.36
2	600.277	582.475	579.42
	600.429	581.794	579.50
	600.940	582.037	579.63
	601.300	582.530	580.16

Difference in elevation.

Month.	Between Lake Superior and Lake Huron.	Between Lake Superior and St. Marys River.	Between St. Marys River and Lake Huron.
	Feet.	*Feet.*	*Feet.*
	20.86	18.532	2.33
91	20.97	18.512	2.46
. 1891	21.10	18.621	2.48
91	21.52	18.775	2.75
, 1891	21.72	18.831	2.89
1891	21.52	18.711	2.81
ual mean	21.01	18.348	2.66
1892	21.40	18.297	3.10
1892	21.10	17.992	3.11
92	20.86	17.802	3.06
2	20.93	18.635	2.29
	21.31	18.903	2.41
	21.14	18.770	2.37

ings showing the water-level curves for lakes Superior and the former platted from observations taken above the locks at al, from January, 1889, to date, the latter from observations t Sand Beach, Mich., during same time, are also submitted.*

llaneous.—The series of characteristic photographs of the work ress has been kept up. The negatives become the property of vernment and are preserved with the records.

work is under local charge of Assistant Engineer E. S. Wheeler, s aided by Assistant Engineers Joseph Ripley and J. L. Callard,

* Not printed.

Appropriations for improving St. Marys River, Michigan.

, 1886	$250,000
1, 1888	1,000,000
er 19, 1890	900,000
1891, sundry civil bill	600,000
tal	2,750,000

of bids for furnishing ten gate anchorages for the 800-foot lock at St. Marys Falls Michigan, received and opened on October 19, 1891, in accordance with advert dated September 19, 1891.

me and address of bidder.	Wrought steel, rolled shapes, etc. (210,240 pounds), price per pound.	Cast iron (332,188 pounds), price per pound.	Total.	Remarks.
	Cents.	*Cents.*		
King Iron Bridge and Manufacturing Co., Cleveland, Ohio.	5	3	$20,477.64	Recommended for acceptance.
Walker Manufacturing Co., veland, Ohio.	$6\frac{1}{10}$	$2\frac{1}{2}$	21,129.34	
tone Bridge Co., Chicago, Ill.	$6\frac{38}{100}$	3	23,336.90	Informal as to signature to bid: not witnessed.
nix Iron Co., Trenton, N. J.	$6\frac{8}{10}$	$2\frac{7}{10}$	23,475.64	Informal as to certificate; not signed.
el Wheel and Foundry Co., troit, Mich.	$7\frac{7}{10}$	$2\frac{83}{100}$	25,589.40	
. Hopkins, St. Louis, Mo.	$7\frac{1}{8}$	$2\frac{37}{100}$	26,474.94	
Passaic Rolling Mill Co., terson, N. J.	$6\frac{1}{2}$	$4\frac{1}{2}$	28,614.06	
Dock Engine Works, Detroit, ch.	$8\frac{1}{4}$	$3\frac{1}{4}$	28,666.51	
ard S. Pope, Detroit, Mich	$10\frac{1}{4}$	$3\frac{1}{4}$	32,345.71	Informal as to modification of clause 15 of specification.

of bids for delivering clay for improving St. Marys Falls Canal, received and on November 21, 1891, in accordance with advertisement dated October 22, 1891.

Name and address of bidder.	Strip and dispose of 300 cubic yards, more or less, bank measure (price per cubic yard B. M.).	Deliver 5,000 cubic yards, or more, clay (price per cubic yard).	Approximate total.
	Cents.	*Cents.*	
s R. Ryan, Sault Ste. Marie, Mich	$0.94	$0.47	*$2,632
r R. Whiteman, Sault Ste. Marie, Mich	.23	.57	2,919
iam Howlett, Sault Ste. Marie, Mich	.43	.62	3,229
Armstrong, Sault Ste. Marie, Mich	.74	.64	3,422
s Rye, Sault Ste. Marie, Mich	.42	.72	3,726
nell & Wynn, Sault Ste. Marie, Mich	.47	.73	3,791
s T. & Nelson Eagle, Sault Ste. Marie, Mich	.50	.85	4,400
D. Rains, Sault Ste. Marie, Mich	.75	.85	4,475
tt & Murphy, Sault Ste. Marie, Mich	.59	.80	4,627
ox & Burgess, Sault Ste. Marie, Mich	.50	1.00	5,150

* Recommended for acceptance.

Strachan, Sault Ste. Marie, Mich.

[illegible] or acceptance. (Incomplete [illegible]

[illegible] for furnishing twelve valve frames and fourte[illegible] [illegible] Falls Canal, Michigan, received and open[illegible] [illegible] advertisement dated January [illegible]

[Total weight 271,348 pounds.]

Name and address of bidder.

[illegible]veland, Ohio
[illegible] Manufacturing Company, Cleveland, Ohio
[illegible], Mich
[illegible] Machine Company, Philadelphia, Pa
[illegible] Company, Detroit, Mich
[illegible], Mich
[illegible] Company, Cleveland, Ohio

has been used continuously during the year, keeping the lock pit dry at all , and never being used to more than one-fourth its capacity. Three men have employed, each standing a watch of eight hours per day; 436$\frac{448}{1000}$ tons of coal been used.

PHOTOGRAPHS AND MODELS.

otographic views showing the progress of the work have been taken each month work was in progress. Models of the lock of 1881 and the 800-foot lock are prepared for the Columbian Exposition. The woodwork of these models is advanced.

COFFERDAM.

he cofferdam has remained without any leak of any magnitude during the entire . No repairs have been necessary except replacing two broken washers on tie . In November the dam was covered with brush so as to hold the snow to a h of 3 or 4 feet during the winter, which effectually prevented the freezing of clay. When the brush was removed in May the clay was found unfrozen.

STOCK RAMMING.

he stock-ramming apparatus has been somewhat improved and perfected since year. The accompanying plates, Nos. 1 and 2, show it as it is now used. Plate 1 s the apparatus at work; the 3-inch pipe driven down to the bottom in the clay own in section. In the figure it is represented full of cylindrical molds of clay ped into it; the rammer is withdrawn; the workmen are upon the point of ing the rammer in the tube and forcing the clay out.

attempt has been made to show the form that the clay assumes after being driven of the bottom of the pipe, since no part of the dam, which has been stock rammed, yet been examined.

he pipe is composed of several short sections, which are coupled together in the l manner of pipe coupling; this enables the pipe to be shortened or lengthened so deposit the clay at any required depth. The manner of making the cylinders of is shown in sketch "A," Plate 2. An ordinary shovel has its blade cut and rolled a ring a little less than 3 inches in diameter and about 3 inches in length; some of e shovels are shown in the sketch. The workman pushes the shovel into the tened clay and forces the cylinder of clay through the ring; when the cylinder is t 1 foot long and lying on the upper part of the blade it is taken off and placed in eelbarrow and is then wheeled to the stock rammer and put in the tube by hand, own in the sketches.

he rammer is an iron rod 30 feet long and about 2¼ inches in diameter; about 3 feet s lower end is enlarged to 2¾ inches in diameter, so that it will work easily in the 3- pipe.

he weight which pushes the rammer down is an ordinary pile-driver hammer and ghs about 1,900 pounds; the derrick which is used is an ordinary pile-driver. A k is so arranged at the top of the derrick that it is slipped under the hammer and ds it when it is up; this block is moved with lines from the ground; a workman h these lines in his hands is shown in Plate 1. The rammer is operated by steam; engine for this purpose is shown in the small house in Plate 1. Seven men are re- red to work this apparatus.

he system which is being used this year is as follows:

he pipe is first pushed down to the bottom of the dam; about one-third of a cubic d of clay is driven in the pipe; it is then raised about 10 feet and another third ven in; it is again raised 10 feet and the operation repeated, making 1 yard in h hole. The apparatus is then moved forward 5 feet and the operation repeated. en soft spots are found in the clay intermediate holes are sometimes driven. his does not lift the clay, crack it, or strain the cribs any appreciable amount. ter the entire length of the dam has been gone over in this way the operation is eated a second time and even a third time; in this way the clay is constantly ing compressed and no injurious strains are created at any time. The total amount so rammed during the season is about 1,000 cubic yards.

LOCK-PIT EXCAVATION. CONTRACT DATED MARCH 1, 1889.

time of completion of this contract was extended from June 1, 1890, to 1, 1891, and on account of break in cofferdam was again extended to 891, and extended a third time to June 15, 1891.

The contractors, Messrs. Collins & Farwell, stopped work on July 8, 1881 without having completed the required excavation, filling, etc., as per terms of contract.

A careful survey was made in June, and levels taken every [illegible] feet over the pit, dumping ground, and the fill back of Fort Brady Pier. The levels were reduced, cross sections plotted, and check computations made for final estimate of the amount of—

Rock excavation above grade and within specified side slopes.
Rock excavation below grade.
Rock excavation outside of side slopes.
Earth excavation above grade and within side slopes.
Earth excavation outside of side slopes.
South wall removed outside of side slopes.
Earth remaining between certain cross sections.
Filling back of Fort Brady Pier.
Earth necessary to complete back of Fort Brady Pier.

[illegible] report was submitted, giving all written orders issued to the contractors, [illegible] of methods of doing work, and amounts of final estimate, [illegible] of extra amounts claimed.

RANGE TARGETS, BUOYS, ETC.

[illegible] to Mud Lake. All the range targets placed by the United States [illegible]; also, all the channel buoys were located by transit [illegible] shore triangulation stations. The locations were first plotted [illegible] St. Marys River survey of 1879 and then transferred to the [illegible]

LOCATION OF WRECKS.

[illegible] Pontiac, sunk at head of Little Lake George, the [illegible] Flats, and the schooner Helena, at Dark Hole, [illegible]

SURVEY OF CANAL.

[illegible] the ice from the head of the canal [illegible] of the Southwest Pier [illegible]

[illegible]

[illegible] completed. There [illegible] the last 14 sheets [illegible] by 72 inches [illegible]

[illegible] from time to time [illegible] stone [illegible] have been cut.

[illegible]

[illegible] 4,000 gallons capacity [illegible]. The water is pumped [illegible] steam from the [illegible] pipes [illegible] the attachment

[illegible]

[illegible] placed in [illegible] by the [illegible] these are of [illegible] operated [illegible] The other four are of

city each and are operated by 9-inch by 12-inch double-drum, double-cylin-
es. They are of 16-foot gauge and travel on 5-inch rails laid on trestles
he level of the top of the first course of masonry.
ry steam derricks.—Four steam derricks are used for unloading stones from
d scows and loading them on the cars for shipment into the lock pit. Two
one at each end of the work, are provided with turntable and steam swing-
hment. Each derrick is operated by an 8½-inch by 10-inch double-drum,
linder Lidgerwood engine. They are all of the same size and make; booms
ng; mast, 68 feet high; two stiff legs, each 66 feet long, supported by A
feet long.
ower derricks.—There are now being assembled on the north side of the
ll at the east end four stiff-legged derricks, each having a 35-foot mast and
boom, and will be operated by single-drum horse-power hoists. These are
ment the traveling cranes in laying backing stones on the wide wall. A
errick is placed at the pile of Government backing stone (face stone taken
old State lock) for the purpose of loading them on the cars for shipment
lock pit.
ushing plant.—The rock-crushing plant consists of two Gage rock-crushers,
d a No. 4. They are operated by two horizontal boilers and engines. The
are on the north side of the lock pit.
ow.—The sand scow is 100 feet long and 34 feet wide and is provided with
nd pump and a rotary engine.
derrick is used for unloading the sand near the head of the west incline.
ated by a small rotary engine.
d scows.—The tug *Arthur*, of the Moiles line, is chartered by the season.
ployed in towing sand scow, pumping sand, towing scow laden with cut
m the stone yard to the place of unloading for shipment into the lock pit,
r necessary work. She also makes a weekly trip to the Drummond Island
arry. Three scows are used in carrying cut stone.
aneous plant.—Besides the above enumerated plant there is a large miscella-
ant, engine houses, shops, tool houses, duplicates of various parts of ma-
horses, harnesses, dump carts, wheelbarrows, tools, etc.

LOCK CONSTRUCTION.

. Hughes Bros. & Bangs began grading and laying tracks, assembling
y, and other preliminary work on May 1, 1891, but the work of actual
tion was not begun until June 24, when the first batch of concrete was laid.
e.—The stone used for the concrete was the sandstone from the lock-pit
on. An inspector was stationed at each crusher to see that good stone was
n leaving the crusher the broken stone passed through a revolving screen
ng and 2 feet in diameter, the openings in the screen being about three-
of an inch square, so that not the dust alone, but a considerable portion of
ler pieces of stone were removed. The crushed stones were thoroughly
when loaded into dump carts to be taken to the mixing boards.
ux Pins sand is used both for the concrete and for the laying of the masonry;
ped from the bottom at a short distance from shore, and is a good quality
even-grained, coarse, sharp, and clean.
ncrete for the foundations of the lock walls is laid to a line 3 feet out from
of the masonry, to insure against crushing the edges. The average thick-
he concrete for the foundations of the lock walls is about 3 feet. The greater
the concrete was laid in the following manner: Three mixing boxes for
ng were placed side by side on the completed concrete, their forward ends
en with the front edge of the concrete. An area about 15 feet long and the
th of the foundation to be laid was then prepared by having all loose and
rated rock removed, the surface washed with a stream of water from a hose,
le wet a thin coating of mortar applied and rubbed in with a broom to in-
filling of all cracks in the rock and a good bond between the concrete and

ncrete was of one part Milwaukee natural cement, one and one-half parts
d four parts broken stone. A batch consisted of 5.25 cubic feet of cement,
ic feet of sand, and 21 cubic feet of broken stone. The sand was spread
ver the bottom of the mixing box and the cement spread evenly on top of
cement and sand were first thoroughly mixed dry and then into a rather
tar. The mortar was spread evenly over the bottom of the mixing box and
s spread over it. The stones and mortar were then mixed by four shovel-
casting in and then casting out again. When carefully done the two cast-
e sufficient to insure a thorough mixing, but this largely depended upon the
he shovelers. The concrete was then cast direct from the boards into place,

[illegible] walls and [illegible] walls of the [illegible] leading [illegible] and cement mixed in the [illegible] parts sand and [illegible] stone. A batch [illegible] of sand and 21 cubic [illegible]

Laying of [illegible].—The first stone was laid Septem[illegible] stone was stopped for the season [illegible] 15 and resume[illegible] [illegible] have been laid. The mortar used [illegible] cement and one part sand.

An inspector is stationed with each gang of masons la[illegible] each stone is laid true as to alignment and elevation and [illegible] He also sees that the mortar is properly gauged, and reco[illegible] cement used and number of stones laid each day, the num[illegible] the stone is laid, together with its patterns and running [illegible]

Laying of backing stone.—The laying of backing stone [illegible] and stopped for the season October 1; it was resumed Ma[illegible] 7,305 cubic yards have been laid, of which Hughes Broth[illegible] cubic yards and the United States 714 cubic yards.

The mortar used is of one part natural cement and one [illegible] is stationed with each gang of masons laying backing sto[illegible] properly gauged, and that the stone is properly laid as to [illegible] the joints are carefully filled; he also keeps a daily record [illegible] volume of backing furnished by the United States.

According to the specifications payment is to be made o[illegible] occupied by the stone in the completed wall. The meth[illegible] the volume of backing laid for the monthly estimate is to [illegible] masonry laid and from this volume deduct the volumes [illegible] [illegible]

[illegible]ing. The pointing is being done by the United Sta[illegible] [illegible] cut stone the masons are required to rake out the face j[illegible] [illegible]. After the mortar has hardened the joints are car[illegible] composed of two parts Portland cement and one part of [illegible] No. [illegible] sieve and thoroughly washed. The mortar is mix[illegible] [illegible] calking iron and mallet are used in filling th[illegible] [illegible] and polish the bead.

ed in this contract the removal of some soft material and shattered rock e upper guard-gate miter wall and the west end of the lock pit. Total cavated under this contract up to date, 3,161 cubic yards. This work is pleted.

tone quarry.—The backing stone is brought from Drummonds Island. os. & Bangs leased the ground from Mrs. Johnson and developed the is located about midway between the quarries from which was obtained g stone for the old State lock and the lock of 1881. It has a face 700 feet feet high, of which 1 foot is earth stripping, 16 feet is of mixed stone, e strata of which can be used, and 13 feet of good stone.

is a compact, bluish gray, crystalline limestone, having a conchoidal nd weighs about 170 pounds per cubic feet.

quarry.—Hughes Bros. & Bangs have built a good substantial pile dock ng and 75 feet wide in 14 feet of water, and an approach to the dock 700 nd 30 feet wide.

lock are two steam derricks to unload the stone from the cars and load e scows. These derricks are of the same make and size, and are operated e-sized engine as those used for unloading stone at the lock.

nine derricks for handling the stone in the quarry. These are all opergle drum horse-power hoists.

track is laid from the dock and extends the whole length of the quarry, ecessary side tracks, crossings, and switches. There are also all tracks for disposing of earth strippings and refuse stone. There are in use tform cars of 10 tons capacity each and thirty dump cars. Five barges are required to transport the stone from the quarry to the lock. There built five boarding camps, one hospital, one ice house, and one blackp.

torage.—The gate anchorages were furnished by the King Iron Bridge and ring Company, Cleveland, Ohio, and consists of 40 anchor castings, 112 ings, 240 eyebars, 40 eyebolts, 160 pins, 4 wrenches, and 1 box of washers. it anchor castings for the lower guard gates, together with the two eyeed to each, have been placed in position in the lock walls.

CUT STONE.

e-cutting has all been done on the canal lands. The stone used was transn Kelly Island in the rough, the first cargo arriving in the schooner *Fred*, July 17. The area occupied by contractors for stone yard was a strip of 1,100 feet long and 150 feet wide, lying just back of the Fort Brady Pier. it used consists of two stiff-leg derricks of 15 tons capacity each, one Mceling crane, four stone planers, manufactured by the Rutland Iron Works, t; a 100 H. P. automatic cut-off engine, and boiler for driving the same. eg derricks are placed at each end of the yard, 18 feet from the face of nd have booms about 50 feet long. The booms can make a complete revd are raised and lowered by steam. Three-fourths inch wire cable, spring swinging gear are used on each. The track for the traveling crane is about n the face of the pier and 1,000 feet long. It runs between the two stiffts. A 5-inch rail and 16-foot gauge are used. The McMyler crane can feet per minute, although its usual speed is about 400 feet. Its reach is m the center line of track, at which point it is able to raise 4 tons, which e weight of the ordinary header or stretcher in the rough. It is supposed to lift a load of 10 tons when situated not more than 30 feet from the center the track. The machinery for planing stone is situated in the center of The four planers are completed and two of them in operation, but the belting, and minor fittings will not be completed before July 7. At the te of progress the entire plant will be ready for operation by that date. struction of these machines is similar to that of an iron planer. Work on tions was begun April 1. The first machine was completed May 11. The ne 6, and the third and fourth June 30. The yard is lighted by electricity, ng crane and planers being worked night and day. The capacity of the n not be determined at this date, as they are not yet fully equipped. All chinery is suitably housed. The office, pattern room, storeroom, and h shop are in one building, situated near the center of the yard. The enin yard has been erected during the fiscal year.

tractors began cutting July 30 with a force of 25 cutters, and continued mber 30, with the exception of a delay from the 9th to 12th of September, k was practically suspended for want of stone, one of the vessels having red. The number of cutters employed did not exceed 70 at any time, the ding 47. The work of cutting was resumed April 5 with a force of 31 cut-with o [illegible] was [illegible] one [illegible] assist [illegible] and

Date.			Date.	
1891.			1892.	
August	[illegible]			
September	[illegible]			
October	[illegible]			
November	[illegible]			
Total	[illegible]			

Total number of pieces [illegible]
Total number of cubic yards [illegible]

The total number of pieces re[illegible] will be about 172 different patterns. [illegible] will be about [illegible] inch thick are used for all stones [illegible] sheet zinc [illegible] cut stone was sent to lock pit August [illegible] in form. [illegible] the yard during the winter.

They were piled four deep and three abreast. The space betw[illegible] was calked with hay, was 2 inches, the lewis holes being covered w[illegible] of that thickness. The lewis holes in the top layer were filled [illegible] covered with a thin layer of cement. The top of the pile had a [illegible] manure, the sides were banked lightly with same, while the nor[illegible] sides were protected by boards.

The following table shows the amount of stone in the rough rec[illegible]

Date.	Number of loads.	Number of pieces.	Date.	
1891.			1892.	
[illegible]	2	286	April	[illegible]
[illegible]	3	[illegible]	May	[illegible]
[illegible]	4	[illegible]	June	[illegible]
[illegible]	5	[illegible]		
[illegible]	14	[illegible]	Total	[illegible]

[illegible] in the rough 183 cubic feet, wei[illegible] 26 cubic feet, weighing 16,5[illegible] were computed, in order to [illegible] results: [illegible] to compare them with that for 800-foot lock. The following table s of these tests:

Classification.	Number of samples tested.	Weight per cubic foot.
		Pounds.
foot lock, from Kelly Island	38	157.36
ot lock, from Drummonds Island	2	170.31
of 1881. Samples taken from the pile of rejected stone	3	154.79
old State lock	3	153.96
, from excavation for 800-foot lock	3	157.50
at Sault Ste. Marie, Ontario, a limestone from Amherstburg	3	147.71
at Sault Ste. Marie, Ontario, a limestone from Manitoulin	2	175.50

from old State lock one sample was very light, weighing only 143.12 ic foot. Rejecting this the weight of the other samples would averds per cubic feet.

of the Potsdam sandstone from lock pit were close grained and hard. t sent from the Watertown Arsenal shows the ability of the face 0-foot lock to resist compression to be as follows:

per.	Marks.	Dimensions.			Sectional area.	First crack.	Ultimate strength.	
		Height.	Compressed surface.				Total.	Per square inch.
		Inches.	*Inches.*	*Inches.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Pounds.*
	0	2.98	2.98	2.98	8.88	105,800	105,800	11,910
	1	2.99	2.99	2.99	8.94	115,280	115,280	12,890
	3	2.98	2.99	2.98	8.88	112,490	112,490	12,670
	4	2.95	3.00	2.98	8.94	58,000	74,100	8,290
	6	3.00	2.97	2.97	8.82	89,000	96,900	10,980
	17	2.98	2.98	2.98	8.88	111,260	111,260	12,530
	22	2.97	2.96	2.99	8.85	111,590	111,590	12,610
	27	3.00	2.98	2.98	8.88	117,200	117,200	13,200
	30	2.98	2.98	2.99	8.91	128,200	129,300	14,510

nate strength 12,177 pounds per square inch. The compressed surl with plaster of Paris.

ting for the first five courses of masonry is practically completed of the piers and main miter wall. A few stone for the piers have none for the main miter wall. Work on the sixth course is well

ners leave a very smooth surface, and all work coming from them contact with cement is afterwards bush hammered in order to insure

r L. Fleming has prepared the following estimate of the cost of the t the close of the season of 1891:

Name of plant.	Cost.
g plant	$3,715.44
	602.50
track	8,723.24
ine houses	403.39
	2,311.57
rs (permanent plant)	11,655.02
derricks	202.62
d pumping plant	2,159.01
ck pit	3,939.50
mes	26,000.00
erwise enumerated and labor account construction	12,354.60
st of plant at lock pit	72,066.89

CEMENT.

Cement has been received from the [illegible]

Portland .... [illegible]
Natural .... [illegible]

A fourth cement shed has been built, making a total [illegible] Government of 8,200 barrels.

The following item upon cement tests has been [illegible]

The report of Gen. Gilmore's committee of the Ame[illegible] on a "Uniform system for tests of cement" has [illegible] have been able to interpret it and the tests made in [illegible] report of January 5, 1891, which was approved.

Although the report of Gen. Gilmore's committee has [illegible] uniformity in apparatus and methods in use in this [illegible] be desired in this direction, and considerable experiment[illegible] some of the best equipped laboratories of the United States [illegible] the testing of cement on a truly scientific basis.

The methods and apparatus as applied here are described below:

COLOR.

[illegible] brand of cement is carefully observed. This is do[illegible] [illegible] It is possible that some importance attaches to [illegible] is by no means simple or certain. Variations in shad[illegible] [illegible] have a slight significance, but different brands may be [illegible] [illegible] and vice versa.

[illegible] seems to exist among masons for [illegible] [illegible] best results are obtained with the lightest ce[illegible]

WEIGHT PER CUBIC FOOT.

[illegible] per cubic foot is shown [illegible] Mr. [illegible]

FINENESS.

culty has been experienced in obtaining sieves suitable for use in sifting sand. Five wire cloth sieves were first received marked Nos. 20, 30, 50, Upon counting, the meshes per linear inch each way were found to be 1.

TABLE 1.

Number of sieve.	Meshes per linear inch.	
	Across web wires.	Across woof wires.
	20	19¾
	30	28¾
	50	57¾
	80	67
	100	89

ose meshes should be more nearly accurate to count were asked for to re- st four numbers. The manufacturer said no complaint had ever been , but sent four sieves of the same make whose meshes counted as given

TABLE 2.

Number of sieve.	Meshes per linear inch.	
	Across web wires.	Across woof wires.
	30	28¼
	50	34¾
	80	67
	100	90

00 was a trifle better as to count, but the meshes appeared to be more ir- n those of the first No. 100.
ird lot received the last three were of a different style. It was explained ad been procured of a "party in New York who claimed to have had the especially for such work." Table 3 gives the results for this lot.

TABLE 3.

Number of sieve.	Meshes per linear inch.	
	Across web wires.	Across woof wires.
	30	28½
	50	47
	80	80
	101	88½

eters of the wire in some of the sieves were measured with a microscope a micrometer attachment. Results are given in Table 4.

[illegible] wool and
[illegible] be dr
[illegible]
[illegible] was tested by
[illegible] mesh was fou
[illegible] and in the
[illegible] meshes were [illegible] It shoul
[illegible] arements were made [illegible] had become

If we assume that the N[illegible] table 2
across the woof wires [illegible] having
stead of being .012 [illegible] .012 inc
as wide as long. [illegible] meshes p
thus seen to be of gre[illegible] than would

The committee of [illegible] Society of Civ
[illegible] Uniform system for tests [illegible] recommend
57, and 40, [illegible] This seems to
certain on account [illegible] determining
[illegible] B. Shelley, professor [illegible] King's Co

Of late years [illegible] there th
with [illegible] value
[illegible] wha
[illegible]

of this labyrinth in indetermination it is impossible to know, except ly, the size of holes in sieves that have been used and are being used. An measure and determine the dimensions of the holes in his own sieve, not certainly know within a large percentage the sizes of the holes in by other experimenters with whom he may wish to compare.
t seem out of place, then, to endeavor to formulate what is desirable in a en to inquire how it may best be obtained. It is thought that the fol- ifications define an ideal sieve: (1) holes of uniform size and shape (2) sides of the holes very smooth, (3) space between holes of such size at particles will not easily rest there.
y deviate from the ideal and still be a good one. As regards uniformity, that the largest holes determine the character of the sieve. For example, half its holes 0.01 inch in size and the other half 0.02 in size, would, if ough, separate the cement exactly the same as it would if all the holes .02 inch in size. If even a very small percentage of the holes are larger mal, it seriously impairs the accuracy of the sieve by introducing an in- on. On the other hand, holes smaller than the normal have no greater an that, as the sifting proceeds, they become spaces between the real or , and as such do not fulfill the third specification. Therefore, while are not admissible, smaller holes may be allowed to the extent of, say, 10 l the sieve still be good and accurate. Concerning the second specifica- s of the holes must be so smooth as not to allow particles of cement to thus clog the hole. The third requirement is for convenience, but might ideration if the style of sieve were changed.
l metal plate has been suggested as a substitute for wire cloth, and is dis- rially in Engineering News for September 26, 1891. An objection is there ange in the shape of the hole. I do not see the validity of this objection. l quartz, recommended by the American Society of Civil Engineers' and which is coming into use for sand tests in this country, has practically grains, and it is not probable that the *shape* of the grains passing round be materially different from those passing square holes. If it is argued ould be difficulty in adjusting the size of openings to correspond with the re holes in current use, it may be returned that sieves now in use purport- the same size of mesh differ so widely that they are hardly worth serious n in any changes which may seem desirable. A punched metal plate could made to fulfill the first specification almost perfectly, and would be less ary from use than a wire sieve, but the former might not so fully comply ond and third requirements. On the other hand, a wire-cloth sieve read- with the last two, but, as has been seen, is apt to be wide of the mark I have been informed, however, by Edward Darby & Sons, wire manu- iladelphia, that they are prepared to make "a cloth accurate in number the inch" at an advance in price of about 30 per cent over the ordinary believed that though there are possibilities in the punched metal plate, cloth should be adhered to if sufficient accuracy can be obtained by its

ne question of sieves might be put upon a better basis if the following done, viz:
acturers of wire cloth should be encouraged to make cloth which will rly as may be the foregoing specifications; and
rers should be urged to designate their sieves by the *size and shape of the*

TIME OF SETTING.

nore's wires are used for this test, the apparatus being as simple as it can The neat cement is gauged with the same percentage of water for this test aking briquets. Care is taken that the water and cement and the room e test is made shall vary only slightly, if at all, from 65° F. The effect nges in temperature on the setting of cement is marked.

CHECKING, ETC.

hat are made for determining the time of setting are immersed, when t tendencies to expand. This test is of the highest importance, as it is etter to use a cement that is sound, even if it is not very strong, than to igh strength that will ultimately "blow." Immersed in water of the mperature, a pat may not show signs of unsoundness until it has been issue the cement for use. It is therefore desirable that some method ich will give certain and quick results.

... that have been found that ...

... used are neat cement ... sand three ... by weight ... one briquet from each sam... additional is made to allow ... can be made from one ... of material are determined ... at an early date on account of ... used is determined by trial ... when it is tapped with the ha... when finished shows a little ... one simple way to specify ... conveys different ideas to ... that an apparatus similar ... in this country. For ...

... crushed quartz recommend... is that held between s... samples of this quartz w... trade numbers. The ... as follows: No. 3, 46 per cen... sample 70.9 per cen... in different barr...

...

... shown in fig. 2, with a ... water ad... tests of cem... were found ... not ... made ... given. The ... the first ... We ... and ...

MOLDS.

the form recommended by General Gilmore's committee of the Ameri-
Civil Engineers, and now in general use in the United States. Fifty-
lds fasten with an iron clamp and the other two halves are completely
rty are hinge molds with a fastening at one end. The latter are neater
and occupy less space on the slab when in use, but are more difficult
is a matter of some moment when making a large number of briquets.

MOLDING.

he practice to put about one-sixth of the mortar into the mold at a
it in firmly with the fingers, finishing the top with a small pointing
tly I have had this method compared with the method specified by
ociety committee, which is to use the trowel for pressing the mortar
Two neat natural cement briquets were made from the same mixing,
thod and the results of one hundred briquets at seven days show
ement in the two methods.
are covered with a damp cloth when made and are in general removed
Natural briquets may generally be removed the same day, but slow
ds are left in the molds over night, the cloth being well dampened.
om the molds the briquets are placed on metal covered as before and
ty-four hours after molding.

TEMPERATURES.

ture of the room is kept as nearly as may be at 65° to 70° F. For this
t watchman was employed all winter. Hourly readings of the ther-
recorded during the night and a reading recorded for each set of
during the day. Four readings a day were also made of the tempera-
n air where some special test briquets are exposed.
and water used in gauging were also at 65° F. except in some special
very quick setting cement it was found necessary to use colder ma-
the briquets to be moulded before signs of setting appeared.
r immersing were tiered seven high in the test room, but it was found
nce in temperature between the top and the bottom boxes was enough
d the use of the bottom three was discontinued. All the boxes are
the same level and have a nearly uniform temperature.

TESTING MACHINE AND CLIPS.

are broken on a Riehlé 1,000-pound machine. It has worked well,
ion being that it requires considerable space. A pair of pulleys with
be thrown in and out of gear by the feet facilitates working consider-
0 briquets, having an average strength of 100 pounds, can be broken
hout exceeding the rate of applying strain of 400 pounds, per minute.
d are the Riehlé style, furnished with the machine, and are shown in
iquets often break at the gripping points of the clips. It is not known
t a clip break is due. It may be, and probably is, due to the briquet
d to compression at that point, but other theories are also advanced.
re not usually accompanied by an exhaustive series of tests, as this
ult to make. With the hope of obtaining more truthful results in
ets a pair of evener clips, designed by Mr. S. Bent Russell, of the St.
orks extension, were purchased. These clips are shown in Fig. 6, and
n Engineer News for July 3, 1891.
thought by some experimenters that the insertion of a rubber strip
nd briquet would be advisable. There is no doubt that this does
p breaks, but the results are lower than without the rubber. Two
have been made to compare the three styles of clip mentioned. (Call-
clip with rubber cushion a style by itself.) These will be reported
y have been reduced. At present it is sufficient to say that the rigid
ise.
which the strain is applied is 400 pounds per minute, as has previously
. This rate is maintained constant by means of a pendulum, in ac-
which the hand wheel is turned that moves the weight applying the
riquet.

...nd is from Point aux Pins, about 3 miles above the lock, ...w water. In general it contains but little gravel and is ...ntage of the grains are quartz, but they are not sharp. ...11 per cent is retained on the No. 20 sieve (mentioned in ...r cent passes the No. 30 sieve. When a measure is loosely ...voids occupy 35 to 40 per cent of the measure.

...rel of Portland cement weighing about 380 pounds net is ...et of sand. This amount of sand dry would weigh about ...t of sand varies greatly with the moisture contained. Ac- ...riments made in France the presence of 1 per cent of water in ...n of 19 per cent of sand by measure to obtain the same per- ...ement. When the sand is perfectly dry the proportions as ...k are about one to one by weight.

...ilar results for a different cement. Nos. 12 and 13 show ex- ...o parts Point aux Pins sand. Nos. 14 to 18 are the results of ...s of sand which could be used for pointing. The sandstone ...ted below the screen of the stone crusher which is crushing ...for use in making concrete. Considerable of this sand is ex- ...alf of it passes No. 30 sieve (Table 4), 35 to 40 per cent passes ...of this passes No. 100. It is seen that the results are about 20 ...the finest portions are removed. The Water Power sand was ...ank, is clean, but too fine for general use. Sand A is a very ...rounded grains. It is believed a similar sand was used for ...n the lock of 1881.

TABLE 6.—*Sand tests—Portland cement.*

[illegible]	Molder.	Sand.		Mortar.		Age.	Number averaged.	Tensile strength.	
		Kind.	Fineness.	No. of parts of sand to one of cement by weight.	Per cent of water.			Means in pounds per square inch.	Average of the error in per cent of breaking strain.
17	L	Point aux Pins.	Pebbles removed.	1	12.5	7 days	5	318.4	6.0
17	L	....do	....do	1	12.5	28 days.	10	424.9	3.9
17	L	....do	....do	1	12.5	3 mos..	5	549.4	3.5
17	L	....do	....do	1	12.5	9 mos..	10	604.0	5.6
18	L	....do	....do	3	11.1	7 days	5	145.4	5.7
18	L	....do	....do	3	11.1	28 days.	10	213.6	5.4
17	L	....do	....do	3	11.1	9 mos..	9	345.7	3.0
22	N	....do	....do	3	11.4	7 days	5	147.4	7.6
22	N	....do	....do	3	11.4	28 days.	10	213.4	4.3
22	N	....do	....do	3	11.4	6 mos..	5	291.2	2.1
21	N	Standard	20-30	3	11.1	6 mos..	7	379.2	....
6	N	Point aux Pins.	Pass 10	2	10.0	6 mos..	5	479.0	4.6
6	N	....do	Pass 10	2	10.3	6 mos.	5	477.6	3.2
9	N	Sandstone screenings	Pass 40	2	18.5	6 mos.	5	388.0	8.0
9	N	do	40-100	2	17.5	mos..	5	478.2	1.0
		...r	Pass 40	2	13.3	mos..	5	433.4	4.2
		...r ...x	Pass 40	2	12.1	6 mos..	5	382.0	2.7
		...	Pass 40	2	13.3	6 mos..	5	398.4	3.7

...rifle too stiff.

... —Sand tests—Natural

The bar...
every bar...
sample is...
marked t...
supposed...
a core al...
in a serie...
sampled.
for a bri...
breaking ...
then sa...
whether t...
that it ...
Of the sa...
considere...
cements o...

Briquets...
record be...
ment, whe...
bers of ba...
briquets, ...
the temper...
the tank w...
ing and ag...
tensile stre...

The result...
books. One...
book. In t...
record of an...

If the tests...
barrel book ...
Each sample...
through tests o...
...

sequence the results are somewhat fragmentary. During the winter more ailable, and some of the most important work is done at that time. Series started as follows: To show the comparative strength of about fifteen Portland cement when mixed neat and with one and three parts of sand t. A similar series for seven brands of natural cement, ages being seven our years. Several series from different barrels of the same brand for long time tests, made to aid in the interpretation of the regular short-time tests me brands. Series to show the effect of salt, the strength of brine required it injury from frost, effect of heating of materials, and tests to illustrate ints which have come up in the practical use and testing of cements. Some riquets of a few of these series have been broken, but the results are not they would now be incomplete and might be misleading.

OFFICE WORK.

ition to the routine office work the following special work has received at-

letter books used during the construction of the lock of 1881, most of which indexed, have been completed in this respect, and these records are now in pe for reference.

report on claims of Collins & Farwell was submitted to you under date of ember, 1891. A special report by Subinspector L. Fleming on cost of work s. Hughes Brothers & Bangs for the season of 1891, was submitted. This is d as a part of the report of Clerk Common.

* * * * * *

ems upon "excavation" and "surveys" in this report have been prepared ant Engineer Joseph Ripley. The items concerning "lock" construction n prepared by Assistant Engineer J. L. Callard. The items "office work" tracts" have been prepared by Clerk Richard Common. The item "cut as been prepared by Inspector F. H. Reed. The item "cement" has been by Inspector L. C. Sabin, and the item of "cost" of contractors' plant prepared by Subinspector L. Fleming.

have been employed upon this work during the year, Assistant Engineers nd Callard, Clerk Common, Inspectors F. H. Reed, Rohnert, Sabin, Shene-on, and Birton Reed, Draughtsman Mangelsdorf, Subinspectors Fleming, Spencer, Porter, Pomeroy, St. John, Barnes, Reals, Fowle, and Johnson.

ry respectfully, your obedient servant,

E. S. WHEELER,
Assistant Engineer, etc.

. M. POE,
rps of Engineers, U. S. A.

REPORT OF COLONEL O. M. POE, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., November 10, 1891.

I have the honor to submit the following report upon the recent de of shipping in St. Marys River, Michigan, caused by the of the steamer *Susan E. Peck* in the natural channel about 550 below the point known as "the Elbow" at the lower end of the al channel dredged across Lake George Flats, about 21 miles t. Marys Falls Canal. The exact location of the wreck is shown accompanying Lake Survey chart (No. 1) of river Ste. Marie.

accident occurred about 1:10 p. m. on Saturday, October 10, 1891, son of a collision between the *Susan E. Peck*, bound down, laden rain, and the schooner *G. W. Adams*, upward bound, light.

sumed to fix the blame for the deplorable event, yet if the tow of which the *G. W. Adams* formed a ard instead of the windward side of the chan-ot have happened.

g less than 6 feet forward at the time, while In consequence of these conditions the in-

The result was almost universal satisfaction upon the part erested.

n Lynch, superintendent of St. Marys Falls Canal, with its, proceeded to the point of obstruction. Two tugs were patch boats, and by visiting all waiting vessels obtained nasters the time of their arrival respectively, and an orgement was determined upon for the passage of boats wreck as soon as the channel should become available.

distance above and below where the wreck was lying the oo narrow for vessels to safely pass each other, and it would ery unwise to run the chance of another collision which ably undo all that had already been done. It was, therel advisable not to try to pass the vessels alternately up and nstead to arrange them in groups of ten in the order of l, and then pass these groups alternately—first one group the next one down. This arrangement having been made of vessels were informed that a tug would notify them turn had come. The great majority of masters were ened with this arrangement, and quietly awaited their turn, time using their influence to preserve order. There were liscreditable exceptions, and these made the question of the of order critical for one day only. In one case a master vessel through before his turn, and great disquiet arose e others, who felt that if it was to be a scramble they must it to get an early passage. For a short time it seemed as control would be lost and discipline destroyed. But when known that the offending vessel had gained nothing, but eld at the canal until her turn came, in accordance with the arrival at the obstruction, all signs of dissatisfaction dis-

ow and curved channel around the bow of the wreck and urrent made it advisable to use tugs in passing large boats, accidents should happen, and it was mainly due to this that none of any consequence occurred. The operation arily a slow one, and it was not until noon of the 21st that ting vessel had passed. Mr. Lynch and his assistants reil the 22d.

of each vessel delayed was recorded, together with the me delayed, the registered tonnage, and value of each.

time of delay was not as accurately determined as in the al records, because the time of arrival of many of the vesthe wreck was not noted until after they had been stopped as three days, and then it was obtained from their masters ed upon their recollection. There were no large errors, howhe results are believed to be quite trustworthy.

stics have been tabulated in a manner similar to those ree interruption of navigation by the breaking of a lock valve he tables are long and are therefore not given in detail, but can be supplied if desired. The following is a summary of tion derived from them:

ssels delayed	275
same	$23,294,000
'	827 days 5 hours and 12 minutes.

nual report for 1890 I estimated the loss caused by the the lock valve at $56,000. The value of the delayed fleet was $16,489,000 and the total time lost by delayed vessels

s charged for the dredges and tugs, as stated above, include ivate plant and all supplies therefor.

n to the sum of $6,455 there was an indirect cost to the t, due to the use of the United States tug *Myra*, but it is necessary to estimate it.

asked why we dredged a channel around the wreck when e been entirely removed in as short a time. The answer is gh. The laws of the United States require thirty days' no- ny of their agents can proceed to remove a wreck. This rovision was quite sufficient to prevent any attempt in that d limit us to the only course left to our discretion.

rance companies and others interested in the wreck were icted, however; yet it was five days after the collision be- recking outfit reached the ground, and it was not until nine r fourteen days after the accident, that the wreck was swung s to partially clear the channel. In this position it remained ys longer, causing more or less annoyance to passing vessels, on one occasion, for half a day completely blockading the nce to the channel.

great credit is due to vesselmen for the patience and for- isplayed during a period which must have severely tried y three instances have come to my knowledge of violation ngement made for the orderly passage of the vessels, and of as due to pure selfishness, one appears to have resulted nderstanding, and another from an attempt upon the part to obey a telegraphic order from the owner of the boat. In se, the offending vessel, being upward bound, was stopped l and detained there thirty-six hours by the canal authori- er turn came exactly in accordance with the time when she e passed the obstruction. In this case there was no miti- umstance. The second vessel would also have been stopped , but she had passed through before notice was received. The ie third appeared determined to disregard the arrangement been made to secure orderly passage, and paid no attention eler's directions, who then called upon the vessel captains , and to the number of 25 they accompanied him on a tug to decisive interview with the offender. After this there was rouble.

g this report I take occasion to again invite attention to the vices of Mr. Martin Lynch, superintendent of St. Marys Falls possesses in a high degree the confidence of the vesselmen. ullivan, who so freely gave his time and experience to the ith tireless energy pushed it ahead when he might, without , have left it to his employés, I desire to express my thanks. Engineer E. S. Wheeler acted with his usual judgment ted the operations to my entire satisfaction.

icism has been indulged in by persons who were themselves r some of the bad features of the matter. I can only think oped by this course to divert attention from their own de-

art taken by the representatives of the Government I have ndation, and, after the event, with all the light we now have, to see where they could have done better.

und annoyance to shipping interests were great, but the ac- rred at a point where no improvement has ever been made ient. The depth of water was ample and the width of

ORGANIZATION.

zation remains practically the same as last season, only a having been made among the lockmen. The regular of 1 superintendent, 3 assistant superintendents, 1 clerk, enginemen, 7 watchmen, and 27 lockmen, a total of 45. A arty averaging 10 men, during the working season, has d in making current repairs to buildings and piers and in ds. The regular force is divided into three watches of 8 nd this arrangement has proved very satisfactory.

ACCIDENTS AND DELAYS.

have lost their lives in the canal during the year: July 5, y the name of Malcolm McDonald was found drowned in ve the locks. April 24, 1892, a sailor was drowned near e canal. April 30, a sailor was crushed against the pier er *Pasadena* and instantly killed.

ter in the canal has caused an unusual amount of ground- atforms. On this account the lock has been delayed on one-half a day per month during the season of navigation. elbow was broken in the pipe connecting with the engine emptying valve, and in order to repair it it was necessary lock out; this was done and the pipe repaired, making a f twenty-five hours and thirty-six minutes. In addition en the usual number of small delays caused by obstruc- the miter sill, foul tow lines, jamming of boats in the lock, 26th of May the *S. R. Kirby* (bound down) in passing out appeared to ground on the inner platform. When her nearly stopped her stern rose about 12 inches and then again, and she passed on without any further difficulty. rs from the platform came up. A diver was immediately determine the cause. A piece of iron 2 inches thick, 2½ l 14 inches wide was found embedded in the platform so was necessary to saw a number of the timbers before it ed out. This iron was evidently broken off the shoe of This incident, though only causing a delay of one hour and utes, shows the importance of the platform, for without sill would undoubtedly have been carried away and the until a new sill could have been put in.

STAGE OF WATER.

n the lock during the season has averaged lower than ever . On account of this lower stage it has been impossible sels to load to their full capacity; for this reason, light- ave been returned to this route, and the apparent falling gistered tonnage of boats using the canal is probably due

ber 16 and 17 there were unusual fluctuations, the water lling 3.65 feet in two hours.

elevation of the surface of the water below the lock for the ril was 581.79 feet above mean tide at New York, which lower than ever before during the season of navigation.

MOVABLE DAM.

n has been tested monthly and kept in perfect order. e winter on the 30th of December. The wickets were

ESTIMATES.

[illegible]e project for operating and care of the canal for the fiscal year [illegible]ng June 30, 1893, contemplates maintaining the present organiza-[illegible], purchasing the requisite supplies, moving any buildings belong-[illegible] to the canal that may stand in the way of the work in progress in [illegible]ection with the construction of the proposed new lock, possibly [illegible]structing a new set of lower gates for the existing lock (of 1881), [illegible]hasing the timber necessary for repairing canal piers, adding two [illegible]ies to the present machine house, and employing such labor as may [illegible]equired in making current repairs and policing the grounds.

[illegible]e estimated cost of the foregoing is as follows:

[illegible]f regular lock force	$30,000
[illegible]f labor party	6,000
[illegible]ral purchases	5,000
[illegible]irs and additions to machine house	10,000
[illegible]er for repairing canal piers, etc	4,000
[illegible]tional electric-light plant	4,000
Total	59,000

[illegible] estimate is included for extraordinary repairs which may be ren-[illegible]d necessary by accident. Such can not be foreseen, and, there-[illegible] can not be estimated for.

[illegible] case of injury or damage to the canal beyond that due to ordinary [illegible] and tear, it must be promptly made good at whatever cost.

[illegible]ll expenses of operating and care are provided for by indefinite [illegible]opriation, under section 4 of the river and harbor act approved [illegible] 5, 1884.

[illegible]l expenditure to June 30, 1891	$316,015.34
[illegible]ended during fiscal year, exclusive of liabilities outstanding June [illegible], 1892	57,870.99
Total expenditure to June 30, 1892	373,886.33

[illegible]. Marys Falls Canal is in the collection district of Superior, Mich. The nearest [illegible]t of entry is Marquette, but Sault Ste. Marie is a subport. Two beacons stand [illegible]n the piers at the western end of the canal and Fort Brady is within half a [illegible]e.

[illegible]unt required for fiscal year ending June 30, 1893		$59,000.00
[illegible]nce remaining from allotments of preceding year, exclu[illegible]ve of outstanding liabilities	$9,559.01	
[illegible]standing liabilities	4,876.53	
		4,682.48
[illegible]tment required for fiscal year ending June 30, 1893		54,317.52

Appropriations for operating and care of St. Marys Falls Canal, Michigan.

[illegible]ended during fiscal year ending June 30—	
1882	$31,207.48
1883	35,509.70
1884	31,212.93
1885	27,242.45
1886	25,400.95
[illegible]	22,138.92
[illegible]	29,898.72
[illegible]	30,749.45
[illegible]	34,323.85
[illegible]	48,330.89
[illegible]	61,389.74
[illegible]	377,405.08

[illegible] St. Marys Falls Canal [illegible]

[illegible]

[illegible]:

[illegible]

[illegible]

[illegible]:

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

COMMERCIAL [illegible] ST. MARYS FALLS CANAL, [illegible]

THE [illegible] OF [illegible].

[illegible]

UNITED STATES [illegible]

[illegible]

GENTLEMEN: I have the honor to submit the following [illegible] commerce passing St. Marys Falls Canal during the [illegible] just closed. [illegible] statistics for the season [illegible] of the calendar year.

The canal opened for navigation April [illegible], and [illegible]. The season was therefore [illegible] days long, or [illegible] days [illegible].

The average number of vessels passing per day for [illegible] was [illegible] and for the months of June, July, August, [illegible] average was [illegible].

The size of the vessels continues to increase, as is [illegible] ing statistics:

The average registered tonnage per vessel was—

In [illegible]	[illegible]
In [illegible]	[illegible]
In [illegible]	[illegible]
In [illegible]	[illegible]
In [illegible]	[illegible]

The total registered tonnage for the season falls [illegible] that for [illegible], and the freight tonnage was [illegible] lowing discussion of the appended statistics may not [illegible]

For the whole period since [illegible] the iron ore carried [illegible] has been [illegible] per cent of the total freight, and in [illegible] oregoing relates solely to tonnage. If we consider the value of son's freight we find a very large increase over any other.

verage yearly increase in the value of the freight transported 81 was about 15 per cent, but for the season of 1891 it was about ent. The cause of this great increase in valuation is plainly the very large wheat crop. Since we are not likely to be imly favored with another such crop, a decrease in valuation may onably predicted for next year.

he failure to maintain the record of annual increase in freight is due, in a great degree, to three causes other than the den iron-ore tonnage.

irst of these is the fact that the stage of water in the lakes, and ently the depth available at the canal, was the lowest of which any record. In 1889 the average available depth was 15.14 1890 it was 15.06 feet, and in 1891 it was 14.42 feet. The aver-1891 was, therefore, 0.64 foot, or 7.6 inches lower than in 1890, at a reasonable estimate of 20 tons to an inch of draft, correto an average of, say, 150 tons for each registered vessel; that e available depth of water in the canal during 1891 had been that of 1890 (the next lowest recorded), the same 9,744 vessels arried 8,888,759 tons in 1891, would have carried 1,461,359 tons an they did, or an aggregate of 10,350,359 tons, or, say, 10,000,000. no violent estimate, but is, I think, quite within the truth.

ext cause was the intentional delay of the vessel men in putir vessels in commission in the spring. This amounted to quite ks in the case of many of the largest carriers. No attempt is estimate the effect of the delay, but it must have been consid-

hird cause was due to the sinking of the steamer *Susan E. Peck*, Elbow," in St. Marys River, by which navigation was totally led from 1:10 p. m., October 11, to 3 p. m., October 15, a period ive days. Two hundred and seventy-five vessels were delayed

* *Valuation based on estimates of 1885.*

for—

....	$53,413,472.13
....	69,080,071.95
....	79,031,757.78
....	82,156,019.97
....	83,732,527.15
....	102,214,948.70
....	128,178,208.51

as open to navigation during season of 1890, 228 days; 1891, 225 days.

COMMERCIAL STATISTICS.

ve statement of traffic through St. Marys Falls Canal for fiscal years ending June 30, 1891, and June 30, 1892.

Items.	Fiscal years.		Increase.		Decrease.	
	1891.	1892.	Amount.	Per cent.	Amount.	Per cent.
..........numbers..	9,541	11,557	2,016	21	....	......
..........do....	4,614	5,615	1,001	22	....	......
ed ....net tons..	7,431 423	9,828,874	2,397,451	32	....	......
..........do....	8,338,981	10,107,603	1,768,622	21	....	......
..........number..	26,226	25,697	....	......	529	2
..........net tons..	2,298,487	2,717,029	418,542	18	....	......
..........barrels..	3,460,238	4,184,612	724,374	21	....	......
..........bushels..	18,184,989	48,466,240	30,281,251	167	....	......
than wheat)..........do....	1,291,084	952,891	....	......	338,193	26
d and pig iron...net tons..	108,441	73,047	....	......	35,394	33
..........barrels..	188,292	236,169	47,877	25	....	......
..........net tons..	48,816	65,667	16,851	35	....	......
..........do....	3,873,044	4,142,797	269,753	7	....	......
..........M feet, B. M..	383,461	399,985	16,524	4	....	......
..........net tons..	3,076	1,330	....	......	1,746	57
ne ....do....	45,506	38,678	....	......	6,828	15
freight..........do....	354,375	443,212	88,837	25	....	......

of the number of vessels passed through St. Marys Falls Canal, with number and cost of lockages for fiscal year ending June 30, 1892.

f vessels..........	11,557	
f lockages..........	5,615	
l tonnage..........	9,828,874	
nnage..........	10,107,603	
	Hrs.	**Min.**
during which lock was operated..........	3,860	8
ime occupied in making a lockage..........		41
spent by vessels in the lock..........	6,833	20
ime spent by vessels in passing lock..........		36
ockage..........	$10.93	
essel..........	$5.31	
	Mills.	
egistered ton..........	6.25	
freight ton..........	6.07	

Cost includes all repairs and improvements made by the operating and labor party, and purchases therefor.

eight exceeds that of any other fiscal year by 1,768,622 tons. The total the season of 1891, that is, during that calendar year, was about 2 per the preceding season; but the traffic so far in 1892 has been so ciency is more than made up, and the traffic for the fiscal year is, than ever before.

DISCUSSION OF TRAFFIC THROUGH ST. MARYS FALLS CANAL DURING CA
1891.

This discussion was made by Clerk Andrew Jackson, and is similar
mitted each year since 1887. The prime object has been to obtain the
ing a ton of freight 1 mile; taking as a basis the entire traffic to a
Superior which has passed the canal and reported in proper form to
thorities.

The method used to obtain this result is precisely like those used in p
which have been given in all former reports, in minute detail.

The results have been carefully compared and checked and, I believe
correct as they can be made from the data in possession of this office, c
that necessarily obtained from outside sources. Quite a disappointme
caused in the failure of shippers, owners, and managers to reply as ge
letters requesting freight rates for the different articles of commer
last season. A comparison of the tables, however, for 1890 and 189
proof that the information furnished for the latter year, although only
reported by twenty-one different parties, is fully as complete and relia
the thirty-three furnishing information for the previous season.

The data thus obtained is shown in the following table; the mean
derived from a general discussion of the rates given in answer to our r
separate examination and report by Assistant Engineer E. S. Wheel
drew Jackson, and Watchman McMahon, the variation in the conclu
being so small as to leave little doubt as to the correctness of the avera

The mean thus adopted, which is shown on the bottom line of the ta
lows:

Miscellaneous merchandise, $3.58 per ton; coal, 43 cents per ton; f
per barrel; wheat, 4.6 cents per bushel; grain (other than wheat), 3½ cen
manufactured iron, $2.30 per ton; pig iron, $1.17 per ton; salt, 18 cen
copper $2 per ton; iron ore, 98 cents per ton; lumber, $2.70 per M
silver ore and bullion, $2.25 per ton, and building stone, $2 per ton.

After the average rate had been adopted, a table was formed from w
tained the total amount paid for the transportation of freight whic
canal during the season of 1891, amounting to $9,849,022.81.

Freight rates on articles of commerce for the season of 1891.

Unclassified freight, net ton.	Coal, net ton.	Flour, barrel.	Wheat, bushel.	Grain, bushel.	Manufactured iron, net ton.	Pig iron, net ton.	Salt, barrel.	Copper, net ton.	Iron ore, net ton.	Lumber, M ft. B. M.	Silver ore, etc.
	Cts.	Cts.	Cts.	Cts.			Cts.				
$2.40	38	15	[illegible]		$2.33		18	$2.25			$2.
	30		[illegible]								
			4½						$0.90		
										$1.75	
	47[illegible]		4[illegible]						83½	3.10	
	39[illegible]		4[illegible]	4½					1.15		
	33					$0.90			1.11½		
	45		3		1.97						
	68										
	29[illegible]		4[illegible]						97½	2.50	
	34[illegible]	14[illegible]	3	2[illegible]				1.80			
4.00		20	3	3	3.00	1.33	18	1.80			
	45								85		
3.78	25		7	4½						2.50	
									1.12½	2.25	
	45		3[illegible]						1.00		
									98		
	47[illegible]		4[illegible]						86[illegible]		
	39[illegible]		3[illegible]						88[illegible]	2.83	
	44[illegible]		7[illegible]								
	45		3[illegible]						1.06[illegible]		
									96[illegible]		
3.58	43	15	4[illegible]	3½	2.30	1.17	18	2.00	98	2.70	2.[illegible]

Adopted means.

, season of 1891. Cost of carrying freight transported throug... ys Falls Canal.

Items.	Unit.	Quantity.	Price per unit.	Amount.
...	Net tons	2,507,532	$0.43	$1,078,238.76
...	Barrels	3,780,143	.15	567,021.45
...	Bushels	38,816,570	.04	1,785,562.22
er than wheat	...do	1,032,104	.03	36,123.64
ured iron	Net tons	42,560	2.50	106,400.00
...	...do	27,181	1.17	31,801.77
...	Barrels	234,528	.18	42,215.04
...	Net tons	69,190	2.00	138,380.00
...	...do	3,560,213	.98	3,489,008.74
...	M feet	366,305	2.70	989,023.50
and bullion	Net tons	1,731	2.25	3,894.75
stone	...do	44,080	2.00	88,160.00
eous merchandise	...do	417,093	3.58	1,493,192.94
al				9,849,022.81

-In this table "tons" means net tons, or tons of 2,000 pounds.

otal amount of freight paid, $9,849,022.81, divided by the total mile tons, 2,269, gives the cost per mile ton as 1.35 mills.
verage distance freight was carried was 820.4 miles, which was 23.2 miles than in 1890.
ature of the data from which the preceding result was found is such that it the cost of loading and unloading.
sults obtained were as follows:

ile tons		7,292,462,269
ight paid		$9,849,022.81
mile ton	mills..	1.35
distance freight was carried	miles..	820.4

tal number of registered craft which used the canal during the season was—

s	396
sels	256
otal	652

American craft.

Class.	No.	Registered tonnage.	Freight tonnage.	Number of passengers.	Valuation.
...	358	325,697	6,129,521	13,817	$26,879,100
...	237	142,667	2,396,557	...	5,068,200
al	595	468,364	8,526,078	13,817	31,947,300

-Eleven thousand seven hundred and twenty-nine net tons of freight were also carried by unregistered craft in 447 passages, the average cargo being $26\frac{187}{1000}$ tons.

Canadian craft.

Class.	No.	Registered tonnage.	Freight tonnage.	Number of passengers.	Valuation.
...	38	18,489	291,418	12,373	$1,771,500
...	19	8,255	59,534	...	348,000
al	57	26,744	350,952	12,373	2,119,500

Summary.

mber of registered craft		652
ssages by unregistered craft		447
ight carried by registered craft	tons..	8,877,030
ight carried by unregistered craft	do...	11,729
ssengers carried		26,190
f craft (registered)		$34,066,800

[illegible]

[illegible]

[illegible]

No.	[illegible]	Supplies
[illegible]	[illegible]	Hardware
[illegible]	[illegible]	do
[illegible]	[illegible]	do
[illegible]	[illegible]	do
[illegible]	[illegible]	Ship chandlery
[illegible]	[illegible]	do
[illegible]	[illegible]	Paints, oils, etc.
[illegible]	[illegible]	do
[illegible]	[illegible]	do
[illegible]	[illegible]	do
[illegible]	[illegible]	do

...zed statement of expenditures incurred on account of appropriation for operating and ...e of canals and other works of navigation, indefinite, applied to operating and care ...St. Marys Falls Canal, Michigan, for the fiscal year ending June 30, 1892.

...e.	No. of voucher.	From whom purchased.	Articles.	Amount.
		Part of first quarter, 1892.		
...l. 24	3	Morris Machine Works, per William F. Morris, sole owner and proprietor.	For furnishing and delivering at St. Marys Falls Canal, Michigan, 2 No. 12 centrifugal pumps with engines, boilers, boiler feed pumps, foot valves, flap valves, ejectors, elbows, pipe, gaskets, bolts, etc., complete for an agreed price of.	$7,905.00
18	4	Emery D. Weimer..........	Furnishing and delivering at St. Marys Falls Canal, Michigan—	
			106 cedar fence posts, at 20 cents each.	21.20
			102 pieces round white oak timber 8 feet long, 16 inches in diameter at one end, at $4.45 each.	453.90
18	5	Emery D. Weimer..........	Furnishing and delivering at St. Marys Falls Canal, Michigan—	
			10,000 shingles, at $2.50 per M........	25.00
			10,200 feet, B. M., pine lumber, common stock, 1 inch by 12 inches by 16 feet, at $16.75 per M.	170.85
			1,045 feet, B. M., pine lumber, common stock, 2 inches by 14 inches by 16 feet, at $14.50 per M.	15.15
			6,112 feet, B. M., pine lumber, common stock, 2 inches by 12 inches by 16 feet, at $16.50 per M.	100.85
			4,116 feet, B. M., pine lumber, common stock, 4 inches by 4 inches by 16 feet, at $15.50 per M.	63.80
			72,284 feet, B. M., square timber, 12 inches by 12 inches by 16 feet, at $18.25 per M.	1,319.18
			269,376 feet, B. M., square timber, 12 inches by 12 inches by 24 feet and upwards, at $21 per M.	5,656.90
...28	6	O. M. Poe, Colonel Corps of Engineers, etc.	Mileage from Detroit, Mich., to Grand Rapids, Mich., and return, being 316 miles, at 8 cents per mile.	25.28
31	7	Frank M. Dunlap...........	Services as draftsman from July 1 to July 31, 1891 (both days inclusive), being one month.	125.00
3	8, 9	Pay rolls, July, 1891........	1 superintendent..........................	150.00
			3 assistant superintendents, at $100 per month.	300.00
			1 clerk..................................	150.00
			1 engineman..............................	90.00
			1 engineman..............................	80.00
			1 engineman..............................	75.00
			4 foremen, at $75 per month..............	300.00
			1 watchman...............................	75.00
			3 watchmen, at $50 per month.............	150.00
			2 watchmen, at $45 per month.............	90.00
			3 lockmen, 2 months and 28½ days, at $60 per month.	177.00
			3 lockmen, 2 months and 21 days, at $50 per month.	135.00
			21 lockmen, 20 months and 28 days, at $45 per month.	942.00
			10 laborers, 9 months and 27½ days, at $45 per month.	446.25
			2 divers, 10½ days, at $7.50 per day.......	78.75
			1 scrubber, 10 days, at $1.20 per day......	12.00
			1 carpenter, 25¼ days, at $2.50 per day....	63.00
			1 tinner, 14 7/12 days, at $3 per day.........	43.75
			1 machinist, 8 1/20 days, at $3 per day......	24.15
... 4	10	John Hickler & Son........	One kitchen sink with waste pipe and fixtures.	9.30
... 31	11	Frank M. Dunlap...........	Services as draftsman, from August 1 to August 31, 1891 (both days inclusive), being 1 month.	125.00
...t 3	12, 13	Pay rolls, August, 1891.....	1 superintendent..........................	150.00
			3 assistant superintendents, at $100 per month.	300.00
			1 clerk..................................	150.00
			1 engineman..............................	90.00
			1 engineman..............................	80.00
			1 engineman..............................	75.00
			4 foremen, at $75 per month..............	300.00
			1 watchman...............................	75.00

Itemized statement of expenditures incurred on account of appropriation for operating and care of canals and other works of navigation, etc.—Continued.

Date.	No. of voucher.	From whom purchased.	Articles.	Am[illegible]
		Part of first quarter, 18[illegible]—Continued.		
18[illegible]. Sept. [illegible]	[illegible]	Pay rolls, August, 18[illegible]	[illegible] watchmen, [illegible] months and 22 days, at $[illegible] per month.	[illegible]
			2 watchmen, at $45 per month	
			[illegible] lockmen, at $[illegible] per month	
			[illegible] lockmen, [illegible] months and [illegible] days, at $[illegible] per month.	
			[illegible] lockmen, [illegible] months, and [illegible] days, at $45 per month.	
			[illegible] laborers, [illegible] months and [illegible] days, at $45 per month.	
			[illegible] diver, [illegible] days, at $[illegible] per day	
			[illegible] carpenter, [illegible] days, at $[illegible] per day	
			[illegible] [illegible]smithier, [illegible] days, at $[illegible] per day	
			[illegible] [illegible]ksmith, [illegible] days, at $[illegible] per day	
[illegible]	[illegible]	Thomas [illegible] Forsyth	[illegible] [illegible]nishing and delivering at Sault Ste. [illegible]arie, Mich., [illegible] feet, B. M., white [illegible] timber, at $[illegible] per M feet, B. M.	
[illegible]	[illegible]	C. W. [illegible], proprietor	Rent of telephone, [illegible] months, from June 1 to August [illegible], 18[illegible] (both dates inclusive), at $[illegible] per year.	
[illegible]	[illegible]	Russel Wheel and Foundry Company, by George H. Russel, president.	Constructing and delivering at St. Marys Falls Canal, Michigan, four (4) valve frames for the sum of.	[illegible]
[illegible]	[illegible]	Justin [illegible] Smith	Rent of 1 storage room at Detroit, Mich., from July 1 to September 30, 18[illegible] (both days inclusive), being 3 months, at $[illegible] per month.	
[illegible]	[illegible]	Frank M. Dunlap	Services as draftsman from September 1 to September 30, 18[illegible] (both days inclusive), being 1 month.	
		Second quarter, 18[illegible].		
Oct. [illegible]	1, 2	Pay rolls, September, 18[illegible]	1 superintendent	
			3 assistant superintendents, [illegible] months and [illegible] days, at $100 per month.	
			1 clerk	
			1 engineman	
			1 engineman	
			1 engineman	
			4 foremen, at $75 per month	
			1 watchman	
			[illegible] watchmen, at $50 per month	
			2 watchmen, at $45 per month	
			[illegible] lockmen, [illegible] months and [illegible] days, at $[illegible] per month.	
			3 lockmen, 2 months and 29½ days, at $50 per month.	
			21 lockmen, 20 months and 25 days, at $45 per month.	
			9 laborers, 8 months and 12¾ days, at $45 per month.	
			2 divers, 1 day	
			1 scrubber, 10 days, at $1.20 per day	
			1 tinner, 4½ days, at $3 per day	
			2 machinists, 28¼ days, at $3 per day	
			1 carpenter, 26 days, at $2.50 per day	
June 9	3	Board of Public Works, by F. M. Taylor, deputy secretary.	One ¾-inch tap from city water-main to curbstone.	
Oct. 1			Water-rent from July 1 to September 30, 1891 (both dates inclusive), at $9 per year.	
31	4	Frank M. Dunlap	Services as draftsman from October 1 to October 31, 1891 (both days inclusive), being one month.	
Nov. 3	5, 6	Pay rolls, October, 1891	1 superintendent	
			3 assistant superintendents, at $100 per month	
			1 clerk	
			1 engineman	
			1 engineman	
			1 engineman	
			4 foremen, 3 months and 27 days, at $75 per month.	
			1 watchman	
			3 watchmen, at $50 per month	
			2 watchmen, at $45 per month	

zed statement of expenditures incurred on account of appropriation for operating and care of canals and other works of navigation, etc.—Continued.

e.	No. of voucher.	From whom purchased.	Articles.	Amount.
		Second quarter, 1892—Cont'd.		
3	5, 6	Pay rolls, October, 1891	3 lockmen, at $60 per month	$180.00
			3 lockmen, at $50 per month	150.00
			21 lockmen, 20 months and 28 days, at $45 per month.	942.00
			9 laborers, 8 months and 25 days, at $45 per month.	397.50
			1 scrubber, 12½ days, at $1.20 per day	15.00
			1 carpenter, 27 days, at $2.50 per day	67.50
			4 calkers, 37½ days, at $2.50 per day	93.75
			2 teams, 2¼ days, at $4 per day	9.00
			1 tinner, 1½ days, at $3 per day	4.50
			1 diver, 3 days, at $7.50 per day	22.50
5	7	George Kemp	5 tons anthracite coal (chestnut), at $5.60 per ton.	28.00
			45 tons anthracite coal (stove), at $5.50 per ton.	247.50
			20 tons bituminous coal (Massillon), at $3.75 per ton.	75.00
			6 tons cannel coal (West Virginia) at $5.25 per ton.	31.50
7	8	James Strachan	1 suction pipe, 5 feet 9 inches long, 15 inches in diameter, of boiler plate ¼-inch thick, with cast-iron flanges.	38.50
			One tank, 10 feet long, 8 feet wide, and 4 feet high, of ¼-inch boiler iron.	287.00
3 16	9	The Richmond and Backus Company, by Charles F. Backus, secretary and treasurer.	2,000 ½-sheet paper, plain, unruled, at $2 per M.	4.40
			25 sheets paper, carbon, at $4 per hundred.	1.00
3	10, 11	Pay rolls, November, 1891	1 superintendent	150.00
			3 assistant superintendents, at $100 per month.	300.00
			1 clerk	150.00
			1 engineman	90.00
			1 engineman	80.00
			1 engineman	75.00
			4 foremen, at $75 per month	300.00
			1 watchman	75.00
			3 watchmen, at $50 per month	150.00
			2 watchmen, at $45 per month	90.00
			3 lockmen, at $60 per month	180.00
			3 lockmen, 2 months and 29½ days, at $50 per month.	149.17
			21 lockmen, 20 months and 29½ days, at $45 per month.	943.50
			9 laborers, 6 months and 25 days, at $45 per month.	307.50
			1 diver, ½ day, at $7.50 per day	3.75
			1 scrubber, 8¾ days, at $1.20 per day	10.50
			1 carpenter, 23½ days, at $2.50 per day	58.75
			3 caulkers, 11¼ days, at $2.50 per day	28.14
			1 tinner, 5⅗ days, at $3 per day	16.80
			1 machinist, 14$\frac{7}{10}$ days, at $3 per day	44.10
			1 team, ½ day, at $3 per day	1.50
-24	12	O. M. Poe, Colonel Corps of Engineers, etc.	Mileage from Detroit, Mich., to Sault Ste. Marie, Mich., and return, being 774 miles, at 8 cents per mile.	61.92
30	13	C. W. Farr, proprietor	Rent of three (3) telephones from May 1 to November 30, 1891 (both days inclusive), at $90 for the season of navigation (or 7 months).	90.00
31	14	Justin E. Smith	Rent of one storage room at Detroit, Mich., from October 1 to December 31, 1891 (both days inclusive), being 3 months, at $10 per month.	30.00
		Third quarter, 1892.		
5	1, 2	Pay rolls, December, 1891	1 superintendent	150.00
			3 assistant superintendents, at $100 per month.	300.00
			1 clerk	150.00
			1 engineman	90.00
			1 engineman	80.00
			1 engineman	75.00
			4 foremen, at $75 per month	300.00
			1 watchman	75.00
			3 watchmen, at $50 per month	150.00
			2 watchmen, at $45 per month	90.00

ized statement of expenditures incurred on account of appropriation for operating and care of canals and other works of navigation, etc.—Continued.

e.	No. of voucher.	From whom purchased.	Articles.	Amount.
		Third quarter, 1892—Cont'd.		
2. 13	11 and 12	February, 1892	3 lockmen, 1 month and 23 days, at $45 per month.	$79.50
			1 carpenter, 17 days, at $2.50 per day	42.50
			1 scrubber, 5 days, at $1.20 per day	6.00
			1 blacksmith 18⅘ days, at $3 per day	56.40
			1 tinner, 1¼ days, at $3 per day	3.75
			4 machinists, 96 days, at $3 per day	288.00
91. 4	13	James Strachan	383¾ hours' work with steam hammer, at at 70 cents per hour.	268.62
31			11 hours' work with planer, at 35 cents per hour.	3.85
			34½ hours' work with steam-power drill, at 35 cents per hour.	12.07
			113½ hours' work with bolt cutter, at 35 cents per hour.	39.73
			16½ hours' lathe work, at 40 cents per hour.	6.60
30	14	James Strachan	4 sets of slides for valve engines, cast, planed, and fitted.	119.50
92. 23	15	The Richmond and Backus Company, by Charles F. Backus, secretary and treasurer.	50 sheets paper, carbon, at $4 per hundred.	2.00
31	16	Justin E. Smith	Rent of one storage room at Detroit, Mich., from January 1 to March 31, 1892 (both days inclusive), being 3 months, at $10 per month.	30.00
		Fourth quarter, 1892.		
4	1 and 2	Pay rolls, March, 1892	1 superintendent	150.00
			3 assistant superintendents, at $100 per month.	300.00
			1 clerk	150.00
			1 engineman	90.00
			1 engineman	80.00
			1 engineman	75.00
			4 foremen, at $75 per month	300.00
			1 watchman	75.00
			3 watchmen, 2 months and 29½ days, at $50 per month.	149.17
			2 watchmen, 1 month and 8 days, at $45 per month.	57.00
			3 lockmen, at $60 per month	180.00
			3 lockmen, at $50 per month	150.00
			21 lockmen, 20 months and 21 days, at $45 per month.	931.50
			1 scrubber, 6¼ days, at $1.20 per day	7.50
			1 team, 2 days, at $4 per day	8.00
			1 machinist, 23 13/15 days, at $3 per day	71.60
4	3 and 4	Pay rolls, April, 1892	1 superintendent	150.00
			3 assistant superintendents, at $100 per month.	300.00
			1 clerk	150.00
			1 engineman	90.00
			1 engineman	80.00
			1 engineman	75.00
			4 foremen, at $75 per month	300.00
			1 watchman	75.00
			1 watchman, 4/10 months, at $55 per month.	22.00
			4 watchmen, 3 months, at $50 per month.	150.00
			2 watchmen, 1 month and 12 days, at $45 per month.	63.00
			3 lockmen, 2 months and 25½ days, at $60 per month.	171.00
			3 lockmen, 2 months and 25½ days, at $50 per month.	142.50
			21 lockmen, 20 months and 26¼ days, at $45 per month.	939.37
			11 laborers, 3 months and 16¾ days, at $45 per month.	160.13
			2 divers, 9 days, at $7.50 per day	67.50
			1 carpenter, 4 days, at $2.50 per day	10.00
			1 scrubber, 12 days, at $1.20 per day	14.40
			3 machinists, 54 days, at $3 per day	162.00
	5	Board [illegible]blic Works, by F[illegible]lor, deputy re-	Water rent for first quarter, 1892, from January 1, to March 31, 1892 (both dates inclusive), at $9 per year.	2.25

[illegible]

L L 3.

DRY DOCK AT ST. MARYS FALLS CANAL, MICHIGAN.

position to locate a dry dock in immediate proximity to the stem is as objectionable as ever; but if it should be decided hen the location heretofore referred to, at the eastern end of ransferred from the Fort Brady military reservation to the rvation, is the least objectionable.

construction of a pier in front of the Fort Brady reservation completed, and a portion of this work would have to be re- ns increasing by $20,000 the probable cost of a dry dock, and te therefor should be increased accordingly.

imated) required for the construction of a dry dock at the point	$343,872
t can be profitably expended in fiscal year ending June 30, 1893.	150,000

should be added to the $65,000 (more or less) which it is d the State of Michigan holds in readiness to transfer to the ates for the purpose of constructing a dry dock at St. Marys al.

not be improper to add that I am strongly opposed to the on of a dry dock to be operated in connection with the canal.

L L 4.

IENT OF HAY LAKE CHANNEL, ST. MARYS RIVER, MICHIGAN.

improvements were commenced the channel through Hay restricted in depth at Sugar Island Rapids and at Middle At these two places a maximum draft of but 8 or 9 feet arried, if a very irregular course was taken, and, practically, awing more than 6 feet of water would not attempt the In addition to the places above mentioned there were some Hay Lake requiring removal to make the channel available s navigating St. Marys River.

ginal estimates for this improvement were based upon a a channel 300 feet wide and 17 feet deep, leaving the present channel of St. Marys River at Sugar Island Rapids (about elow the canal) through those into Hay Lake, and then by ddle Neebish, rejoining the present navigable channel at the gar Island, thus saving a distance of 11 miles and obtaining hich can be so marked by lights as to be navigable by night, n impracticable with the present channel, except by the use ghts.

imated cost of this project was $2,127,292. The project was tly modified to increase the navigable depth to 20 feet, the cost being $2,659,115, subject to change, however, in case d difficulties are developed during the progress of the work. June 30, 1890, $975,000 had at various times been appro- r the work. The river and harbor act of September 19, 1890, ted an additional $400,000 for continuing the improvement, rovision, "That such contracts as may be desirable may be to by the Secretary of War for materials and labor for the or any part of the same, to be paid for as appropriations

:CAVATION UNDER CONTRACTS STILL IN FORCE.

ie fiscal year excavation has been carried on under six con-
ed into February 6, 1891. Each of these contracts covers
ections into which the work has been divided, as shown on
pended to this report. A depth of 20 feet was required ex-
bed rock occurred, where a depth of 21 feet was called for
it a 20-foot navigation might be established. At the close
year the condition of work on the different sections was as

ion.—The material to be removed consisted of about 190,000
s of sand, gravel, bowlders, hardpan, and sandstone bed
known proportions, and a great deal of blasting was neces-
depth of 21 feet is called for by the specifications; a rough
2,040 feet in length, is required to be constructed on the
f the channel between cross sections 286 and 490, and the
ce for excavation is $1.20 per cubic yard, bank measure,
ction of the dike being included without additional charge.
actors began operations May 6, 1891, and, except for inter-
the winter, work on this section has been in progress ever
total to June 30, 1892, of the estimates for excavation is
ic yards, bank measure, of which 150,696 cubic yards have
ited during the fiscal year. The dike construction required
contract has been entirely finished, and the total length of
now 6,140 feet.

ction.—The material to be removed consisted of about
ic yards of sand, gravel, bowlders, hardpan, and sandstone
unknown proportions, and some blasting was necessary. On
depth of 21 feet is required; elsewhere 20 feet, and the
ice is 57 cents per cubic yard, bank measure. The con-
ssrs. Dunbar & Sullivan, began operations May 15, 1891, and,
nterruption by the winter, work on this section has been in
er since. The total to June 30, 1892, of the estimates for
is 66,875 cubic yards, bank measure, of which 57,028 cubic
been excavated during the fiscal year. The actual amount
s really much greater than this, but owing to certain con-
ie specifications the additional amount can not yet be paid

ction.—The material to be removed consisted of about
ibic yards of silt, sand, clay, and gravel. The depth of 20
red, and the contract price is 14¾ cents per cubic yard, bank
The contractors, Messrs. Carkin, Stickney & Cram, began op-
iy 27, 1891, and, except for interruption by the winter, work
ion has been in progress ever since. The total to June 30,
estimates for excavation is 303,846 cubic yards, bank meas-
:h 288,399 cubic yards have been excavated during the fiscal

ction.—The material to be removed consisted of about
ic yards of sand, clay, gravel, and bowlders. The depth of
equired, and the contract price is 13 cents per cubic yard,
ure. The contractors, Messrs. Carkin, Stickney & Cram,
itions July 16, 1891, and, except for interruption by the winter,
s section has been in progress ever since. The total to June
the estimates for excavation is 329,163 cubic yards, bank

ion.—The material to be removed consisted of about 710,000 ıg reports, and are so universally admitted, that it is not ›essary to repeat them. It is an important part of the sys- improvement of the navigation of the great lakes, and if it vailable during the fiscal year just closed, it would have by vessels carrying 10,107,603 tons of freight and 25,697 pas-

nate for the work is $2,659,115, of which $1,675,000 has been ed, leaving $984,115 to be provided. To pay the various it employés and contractors, $500,000 will be required for the ending June 30, 1894. This amount should be appropriated, roviso that any portion of it not required for Hay Lake uld be expended elsewhere between lakes Superior and places where excavation is needed to obtain the navigable feet. This entire amount can be expended to advantage fiscal year ending June 30, 1894.

iture to June 30, 1891		$828, 823. 08
ring fiscal year (exclusive of outstanding liabilities)		280, 983. 01
xpenditure to June 30, 1892		1, 109, 806. 09

Channel is in the collection district of Superior, Mich. The nearest r is Marquette, but Sault Ste. Marie is a subport. The nearest light-beacon on the pier at the western end of St. Marys Falls Canal.

Money statement.

balance unexpended		$849, 695. 80
, amount expended during fiscal year		284, 370. 24
balance unexpended		565, 325. 56
outstanding liabilities	$84, 820. 07	
amount covered by uncompleted contracts	480, 505. 49	
		565, 325. 56
ropriated by act approved August 5, 1892		115, 000. 00
stimated) required for completion of existing project		869, 115. 00
at can be profitably expended in fiscal year ending June 30, 1894		500, 000. 00

in compliance with requirements of sections 2 of river and cts of 1866 and 1867.

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ions for improving Hay Lake Channel, Sault Ste. Marie River, Michigan.

82	$200, 000
	125, 000
86	150, 000
388	500, 000
), 1890	400, 000
1, sundry civil bill	300, 000
	1, 675, 000

[illegible]

Lathe, 100 hours

[illegible]

rork is in the Michigan collection district, Michigan. The nearest port of Grand Haven, Mich., and the nearest light-house stands on the pier head the outer end of the channel.

Money statement.

1891, balance unexpended	$18,340.43
1892, amount expended during fiscal year	12.70
1892, balance unexpended	18,827.73

Appropriations for improving harbor at Cheboygan, Mich.

, 1871	$10,000	June 14, 1880	$6,000
1872	15,000	March 3, 1881	6,000
, 1873	15,000	August 2, 1882	10,000
1874	15,000	July 5, 1884	5,000
, 1875	15,000	August 5, 1886	15,000
14, 1876	10,000	August 11, 1888	15,000
, 1878	8,000		
, 1879	3,000	Total	148,000

COMMERCIAL STATISTICS.

Commerce of the harbor at Cheboygan, Mich., for the season of 1891.

[Compiled from the report of Mr. Jno. W. Loucks, deputy collector of customs.]

Articles.	From custom-house books.		From warehouse books.		Total tons.
	Quantities.	Tons.	Quantities.	Tons.	
Shipments.					
foot B. M.	115,974,607	173,961	3,000,000	4,500	178,461
wood ... do.	1,723,000	3,876			3,876
e ... pieces	15,988,550	3,997	2,500,000	625	4,622
ties, cedar ... do.	236,600	11,830			11,830
sts ... do.	313,619	7,840			7,840
pine ... do.	5,136,000	898	35,000,000	6,125	7,023
h poles, cedar ... do.	1,900	285	1,500	225	510
, hemlock ... cords	1,442	1,081			1,081
eous				7,000	7,000
al shipments		203,768		18,475	222,243
Receipts.					
bushels	11,700	351			351
do.	5,000	140			140
do.	41,500	664			664
d and soft ... tons		5,861			5,861
sacks ... bags	1,513	75			75
barrels	500	100	1,200	240	340
d ... tons		537			537
barrels			2,000	300	300
do.			500	75	75
ster ... do.			300	45	45
do.			2,000	200	200
eous				15,000	15,000
al receipts		7,728		15,860	23,588
gregate					245,831

that the depth of 16 feet that has been obtained in the river idered available, the next appropriation should be expended ng the channel across the bar to the full depth of 16 feet for width. The river and harbor act of September 19, 1890, parate appropriations for the river and the harbor, seemed to absolute division between the two, and this division was ast of the light-house crib. It is evident, however, that the he law was to render the 16-foot depth required in the river o commerce, and should no such distinction be made again ie two portions of the work, future appropriations should be with this understanding.

r and harbor act of September 19, 1890, although separating nto two portions—permitted the grouping in one contract of k of a similar character situated in the same region. A ld therefore be used on this work to the best advantage by the harbor during fair weather and in the river during bad By being thus prevented from lying idle the cost of the work ed nearly one-half.

of the commercial importance of the city of Alpena, which is the mouth of the river, the river and harbor are well worthy litional appropriation of $20,587.48, which, if made at one not restricted as to the portion of the work on which it must ed, will probably suffice to make a continuous depth of 16 entire amount can be profitably expended during the fiscal g June 30, 1894.

liture to June 30, 1891	$20,785.81
ring fiscal year	3,403.69
penditure to June 30, 1892	24,189.50

ay River is in the collection district of Huron, Mich. The nearest port ort Huron, and the nearest light-house is at the work.

Money statement.

balance unexpended	$5,372.50
2, amount expended during fiscal year	4,548.87
balance unexpended	823.63
stimated) required for completion of combined projects for Bay River and harbor	10,587.48
at can be profitably expended in fiscal year ending June 30, 1894	10,587.48
in compliance with requirements of sections 2 of river and cts of 1866 and 1867.	

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ppropriations for improving harbor at Thunder Bay, Michigan.

876	$4,500
82	15,000
9, 1890	5,500
	25,000

COMMERCIAL STATISTICS.

practicable to obtain statistics for the calendar year 1891, but they e substantially the same as for the preceding year, when the com- Michigan, at the mouth of Thunder Bay River, was estimated at value at over $5,000,000.

River is in the collection district of Huron, Mich. The nearest port Huron, Mich., and the nearest light-house is at the mouth of the

Money statement.

ance unexpended	$9,608.50
nount expended during fiscal year	8,328.80
ance unexpended	1,279.70
riated by act approved July 13, 1892	10,000.00
le for fiscal year ending June 30, 1893	11,279.70

nated) required for completion of existing project* ......
an be profitably expended in fiscal year ending June 30, 1894*
compliance with requirements of sections 2 of river and of 1866 and 1867.

---

propriations for improving Thunder Bay River, Michigan.

890 ... $10,000

COMMERCIAL STATISTICS.

ıpracticable to obtain statistics for the calendar year 1891, but they be substantially the same as for the preceding year, when the com- , Mich., at the mouth of the river, was estimated at 500,000 tons and r $5,000,000. A large portion of this commerce enters Thunder Bay impossible to determine its amount.

L L 8.

ROVEMENT OF HARBOR AT AU SABLE, MICHIGAN.

beginning of improvements the mouth of Au Sable River wide, with a depth of 5 feet over the bar. Above the mouth of a mile 7 to 10 feet of water was found, and above this or 6 feet.

t project for the improvement of the harbor was adopted nodified in 1879, the object being to obtain a channel of 10 feet in depth for a width of 100 feet from Lake Huron Road Bridge at Au Sable.

heretofore expended on this improvement has given tem- s only, and a permanent channel can not be secured except cost as to be disproportionate to the benefits to be ob-

ents from this port are large and important, but are prin- from private piers built into the lake entirely outside of Were there a fair prospect of securing a permanent im- t a reasonable cost I would take pleasure in recommending opriations for this harbor, but can not clearly see my way

ure to June 30, 1892 ... $114,786.12

in the collection district of Huron, Mich. The nearest port of entry and the nearest light-house is at the work.

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* See Thunder Bay Harbor.

of Engineers recommended that a channel be made 200 feet a depth of 14 feet from Saginaw Bay to Bay City and with of 12 feet thence to the head of the river, a total distance of niles.

ns to this project have been made at various times. These for the repair, extension, and reconstruction of the revetment, the Carrollton Channel, and for the construction of similar the head of Crow Island for the improvement of Zilwaukee

e 30, 1891, dredging was in progress on the bar at the mouth er and at Zilwaukee Bar, and repair work at Carrollton re- nd extension of wing dam.

the fiscal year the following contracts were in force, all under priation of September 19, 1890:

ntractor.	Contract for—	Entered into.	Remarks.
ubbell	Dredging above Bay City	Feb. 21, 1891	Closed Dec. 7, 1891.
	Timber and plank	....do	Closed Nov. 6, 1891.
ey & Cram	Iron bolts and nails	....do	Closed Oct. 5, 1891.
ee	Dredging bar at mouth	Apr. 9, 1891	In force.

gress made during the fiscal year was as follows:

ted on the bar at the mouth, 75,982 cubic yards, scow measure, t the contract price of 34 cents per cubic yard, $25,833.88. yet completed.

ted at Zilwaukee Bar, 25,368 cubic yards, scow measure, t the contract price of 36 cents per cubic yard, $9,132.48 and in a channel 200 feet wide and 12 feet deep for the whole ex- e bar.

ted at Bristol Street Bridge, in the city of Saginaw, 13,019 ls, scow measure, costing, at the contract price of 36 cents yard, $4,686.84, resulting in a navigable channel 12 feet deep dge cuts wide nearly half a mile in length.

ted from the channel of Saginaw River below Melbourne, oic yards, scow measure, costing, at the contract price of 36 cubic yard, $8,504.28.

nt superstructure of the Carrollton revetment was repaired, the wrecked portion of the lower end of the old wing dam at of Crow Island, and the latter was extended downstream, ng upon the west shore of the island. The original length of dam was 900 feet. It is now 1,685 feet long, with a shore arm ng.

sent condition of the improvement is as follows:

at mouth of the river.—A channel 14 feet in depth and about ide has been made across the crest of the bar from deep water uth of the river to a point on the light-house range—or axis of sed channel—12,300 feet from the front light, terminating in 13 ter; thence northward one dredge cut, 14 feet deep and about le, nearly on range and east of axis, extends 3,800 feet farther foot curve in Saginaw Bay.

t survey of the channel was made in January and February, was then found that in order to complete the width of the 14-foot o the projected 200 feet, and extend it to the 14-foot curve, at a distance of 16,100 feet from the front light, it will be remove about 180,000 cubic yards of material, two-thirds feet along the track followed by tugs in are not connected. The bottom consists so far made to secure a channel of the successful. It is estimated that a chan- wide will involve the excavation of about ial. Whether such a channel would be per-

Shoal.—The improvement of this reach of ring the season of 1891. A survey made in the channel had not deteriorated during the Based upon the survey referred to, it is esti- hannel 12 feet deep and 200 feet wide will in- 9,300 cubic yards of sand. Whether it will be is very doubtful.

—Nothing has yet been done toward improving immediately above Mackinaw Street Bridge. In l 12 feet deep and 200 feet wide at this locality al of about 100,000 cubic yards of material, and ce made it will require frequent redredging to

ong West Bay City.—This is not a part of the origi- n of $15,000 has been expended in dredging it and test survey (in January, 1891) it was found in much n expected. It can not be regarded as permanent,

mount of material yet to be removed to complete ated at about 640,000 cubic yards, at an estimated ut it is perfectly well understood that considerable can never be considered as permanently completed, less dredging will always be required after each probable cost of not less than $5,000 per year.

eport by Assistant Engineer B. H. Muehle, gives in detail necessarily omitted from this. Particular d to his schedule of dredging heretofore done, and required to complete the original project; including est Channel along West Bay City, and $18,500 for ille Bar, neither of which were comprised in the origi- will be observed that the total exceeds the balance original estimates; but if the amounts already ex- West Channel along West Bay City, the amount for its further improvement, the amount of the esti- exville Bar, the amounts of the annual expenditures d hereafter to be made for redredging—referred to in rt as necessary, and estimated at $5,000 per year—and pended in keeping the several revetments and wing and the sum of the incidental expenses pertaining to regated and the total deducted (as it should be done) required as shown by the schedule, the remainder will within the proportion of the original estimates yet re- credit.

al year ending June 30, 1893, the sum of $150,000, in- for West Channel along West Bay City and $18,500 ar, can be profitably expended upon the improvement.

o June 30, 1891	$503,331.78
al year (exclusive of outstanding liabilities)	52,326.00
res to June 30, 1892	555,657.78

[illegible]

Money statement.

[illegible]

[illegible] appropriation [illegible]

[illegible] [illegible] [illegible]

June [illegible]	[illegible]	[illegible]	June [illegible]
March [illegible]	[illegible]	[illegible]	March [illegible]
July [illegible]	[illegible]	[illegible]	August [illegible]
July [illegible]	[illegible]	[illegible]	July [illegible]
June [illegible]	[illegible]	[illegible]	August [illegible]
March [illegible]	[illegible]	[illegible]	August [illegible]
August [illegible]	[illegible]	[illegible]	September [illegible]
June [illegible]	[illegible]	[illegible]	
March [illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

[illegible] Saginaw River. [illegible]

[illegible]

The following contracts were [illegible]

McCallum & [illegible] [illegible] across the bar at the mouth of the Saginaw River [illegible] [illegible]

Thomas [illegible] [illegible] Bay City [illegible] per [illegible]

[illegible] Saginaw, Mich. [illegible] delivering white timber at [illegible], pine plank at [illegible] feet, board measure.

[illegible] of Saginaw, Mich. [illegible] and left wrought-iron screw and w[illegible] nails at [illegible] per pound.

The improvements which were made under these [illegible] described as follows:

[illegible] *across the bar at the mouth of the river.*—Th[illegible] one tug, and two dump scows, continued the fourt[illegible] axis of the proposed 200-foot channel, northward to t[illegible]

12,300 feet from the front range light; brought the unfinished first, :d cuts to the same terminus, and made a complete second and partial ıf the range, closing operations for the season of 1891 on November thority of the Chief of Engineers—the contract having been extended 392—the contractors resumed dredging on the 21st day of April, 1892, t to the end of the fiscal year; completing the third cut east of range ırve, and extending the fourth cut to a point 11,200 feet distant from light. All excavated material was dumped in Saginaw Bay, about the outer end of the dredged channel. The result of the work of this contract may be summarized as follows:

	Date.	Linear feet.	Cubic yards.
....	July 1-Sept. 21, 1891	5,859	17,821
....	Aug. 29-Sept. 21, 1891	1,332	3,734
....	Aug. 15-26, 1891	1,371	2,792
....	Aug. 22-25, 1891	364	578
....	Sept. 26-Nov. 7, 1891	8,540	16,550
....	Nov. 7-21, 1891	2,610	5,846
....	Apr. 21-June 8, 1892	4,724	13,661
....	June 8-30, 1892	4,320	15,000
....	....	....	*75,982

which cost, at the contract price of 34 cents per cubic yard, the sum of $25,833.88.

above Bay City."—Under contract with Thomas M. Hubbell, dredging at the beginning of the fiscal year with one dredge in the channel aukee Bar at the head of Crow Island. This work was completed a channel 200 feet wide and 12 feet deep having been made in accord-pproved project, by excavating 25,368 cubic yards of sand, at a cost 'he same dredge was then employed in commencing the improvement across a shoal at the Bristol Street Bridge, in the city of Saginaw, for l allotment was made from the appropriation for Saginaw River ty." Between September 17 and November 2, 1891, 13,019 cubic yards xcavated at an expense of $4,686.84, resulting in a navigable channel l two dredge-cuts wide, and nearly half a mile in length. On the , 1891, the same contractor furnished a second dredge, as he was by the terms of the specifications. This dredge was used in improv- of Saginaw River below Melbourne, and worked there continuously r 27, 1891, when the season's operations were terminated on account n of ice, and the contract was closed. On the 2d of November, 1891, joined the plant at Melbourne, and worked there to the end of the ›erations at Melbourne resulted in making a navigable channel 12 ›t wide, and about 2,575 feet long across the crest of the shoal imme-he Melbourne lumber docks, this partially removing the most serious ıavigation in this locality. The dredges excavated 23,623 cubic yards, 504.28.

›unt of dredging done, under contract with Thomas M. Hubbell dur-›ar, was 62,010 cubic yards, and its cost $22,323.60.

on of the excavated material, principally clay, was put into dump ed a distance of about 14 miles to the dumping ground in Saginaw ›ortion was transferred to the City Hall Dock and grounds, adjacent Street Bridge, in the city of Saginaw, and the balance dumped in slips, and with the aid of an elevator dredge, redredged and used er docks, wharves, and swamp land. The following schedule shows hus disposed of:

	Cubic yards.
umping ground	19,948
, Saginaw	13,355
Vall, at Crow Island	11,408
....	9,601
....	7,401
ıt Carrollton	297
....	62,010

ıppropriate in this connection to note the fact that the selection of a ɔf deposit for the excavated material is a difficult problem to solve for improving Saginaw River "above Bay City" are being made.

h was used almost daily, transferring materials and men engaged on the provement, during examinations and surveys incident thereto, and on ection by the assistant engineer between the city of Saginaw and the e river. At the close of the season of 1891 the launch was laid up, and, Jnited States property, placed in charge of a watchman at Zilwaukee. s slightly damaged by the ice, and frequent pumping did not keep her at she was allowed to settle to the river bottom, in shoal water. Partly of this damage and partly of her having been found unsuitable and inade-e service required, owing to insufficiency of speed, it was deemed advis-ose of her at the opening of the season of 1892, and her sale at public ordered by the Chief of Engineers, under date of June 6, 1892. June 28, at was sold, accordingly, for the sum of $250.

e months of January and February, 1892, ice surveys were made in ac-th your instructions dated January 11, 1892, at the following places in ver:

t Bristol Street Bridge, in the city of Saginaw.

ront of Saginaw (east side) below the Genesee avenue and the Flint and ette Railroad bridges.

t the New York Works.

iear the mouth of the river, between the light-houses and the village of

hese surveys were made by me during the closing months of the fiscal ier with computations of quantities of materials yet to be removed by a order to complete the present approved project for improving Saginaw

the latest examinations of the different localities, I have prepared a de-' the present condition and brief history of all the obstructions to navi-aginaw River, for the purpose of showing how complicated, difficult, the river improvement has been and will continue to be until such time e considered satisfactorily and finally completed.

oved project consists in providing a dredged channel 14 feet deep and 200 om Saginaw Bay to the Portsmouth Bridge at South Bay City, and thence 2 feet deep and 200 feet wide to the head of navigation, a distance of 25

named reach of river has been entitled the "General improvement" and above Bay City." This separation is due to the fact that the Saginaw through two Congressional districts, the Representatives of which have erred a division of the appropriation for Saginaw River, and have the rticularly specified in every river and harbor bill passed by Congress; so hough there is but one general project for the improvement of the river, n is regulated by the terms of the appropriations, and forms two sepa-s of the work.

A. GENERAL IMPROVEMENT.

mouth.—This is unquestionably the most important part of the improve-ding as it does for the passage of all vessels navigating the Saginaw River outer bar to and from Saginaw Bay and Lake Huron. A channel of 14 h and about 160 feet wide has thus far been made across the crest of the ep water at the mouth of the river, to a point on the light-house range, he proposed channel, 12,300 feet from the front light, terminating in 13 er; thence northward one dredge cut 14 feet deep and about 22 feet wide, ange and east of the axis, extends 3,800 feet farther to the 14-foot curve gs in Saginaw Bay.

urvey of the channel was made in January and February, 1891; it was in order to complete the width of the 14-foot channel to the projected 200 tend it to the 14-foot curve—which is at a distance of 16,100 feet from ght—it will be necessary to excavate 180,000 cubic yards, two-thirds of ard clay, and one-half of this with only 1.5 feet depth of excavation he examination also developed the fact that the crest of the bar along de of the channel is slowly but constantly being raised by accumu-deposit of sand and even sewage brought down by the current, causing nk of the dredged channel to cave in within a linear distance of about The dredging records show that the second, third, and fourth dredge cuts range line have been and the last-named is now being dredged to 14 feet ater for the third time.

lle Bar.—This is a shoal, located between the village of Essexville and ouses near the mouth of the river, and was not included in the original aving come into notice within the last two years, during the prevailing ow water. The first, last, and only examination (since the lake survey

[illegible]

[illegible] Lum.—[illegible] remaining at that time [illegible] [illegible] permanent and [illegible]

[illegible]

1. Sho[illegible] M[illegible]—[illegible] made in [illegible] [illegible] docks to [illegible] channel being [illegible] Boom Company. During the season of [illegible] channel 12 feet deep and 2[illegible] feet wide [illegible] was 97,760 cubic yards; of this quantity [illegible] leaving 74,137 cubic yards yet [illegible]

Willow Island.—Since the last [illegible] dredging has been done, and the [illegible] complete project was 35,790 cubic yards. However [illegible] the channel along Willow Island was dredged [illegible] movement, as far as it has progressed, appears [illegible] complaints have been made as to its insufficiency [illegible]

N[illegible] York Works Bar.—Although considerable [illegible] boats, loaded vessels were frequently delayed [illegible] [illegible] on the lower end of this bar. A [illegible] survey [illegible] 188[illegible] for the purpose of learning its present [illegible] had deteriorated to a considerable [illegible] opposite a middle ground, the [illegible] To dredge [illegible] 29,100 cubic yards, [illegible] improvement can be [illegible] involving the construction [illegible]

[illegible] at the head of [illegible] which were found [illegible] of Saginaw River [illegible] its made to permanent[illegible] the Annual Report of [illegible] survey was made [illegible] was then submitted [illegible] 200 feet [illegible] extension [illegible] already [illegible] this locality is [illegible] from the last

[illegible] done with [illegible] of which [illegible] for 188[illegible] [illegible] will [illegible] road Bridge, was made in January, 1892. The map of soundings ile there are small areas with 12 feet depth of water along the trail of are used in towing rafts, these areas are not connected and do not nd convenient channel for loaded vessels, either those passing down aber and other products from the sawmills farther up stream or such oringing coal, limestone, and building materials to the wharves along of the city of Saginaw. The river bottom within this reach of the f fine sand and previous efforts in dredging a narrow channel for f were not attended with success, as the dredge cuts were soon filled e action of passing steamboats, from the apparently inexhaustible aterial adjacent thereto. It is estimated that a channel 12 feet deep le, can be made by excavating 86,000 cubic yards. Whether such a l will be permanent is considered very doubtful.

et Bridge Shoal.—This extends from a point 1,800 feet above to 1,000 Bristol Street Bridge, which spans the river in the central part of the . The improvement of this reach of the river was commenced dur- f 1881, as hereinbefore described. An ice survey was made in Jan- the map of the soundings shows that the dredged channel had not ring the two months intervening. The estimated quantity of ma- removed in order to make that channel the required width of 200 bic yards. Its permanency after completion is also an open question.

aw.—During the preliminary examination of the river, made in the ng reach of river immediately above the Mackinaw Street Bridge at was found to have less than 12 feet depth of water, and the esti- of material to be excavated in order to make a channel 200 feet wide , based on that examination of 1881, was 100,000 cubic yards. A sub- ation of the same locality resulted in an estimate of 70,000 cubic as been no attempt made to commence the improvement of the river vicinity, because the biennial appropriations for the improvement of have been too small to warrant an allotment for this purpose. In later examination, I am inclined to retain the larger estimate, *i. e.*, rds.

C. WEST CHANNEL ALONG WEST BAY CITY.

aents having been made from two appropriations for improving Sag- , $5,000 August 5, 1886, and $15,000 August 11, 1888, these amounts in accordance with a supplementary project for improving the west Saginaw River, dated April 11, 1887. An ice survey of the three west channel which were dredged was made in January, 1891. The as found in good preservation. The sum of $10,000 has been esti- aount required for completing this special project.

g schedule is a recapitulation of the estimated quantities required to sed on the present condition of the channel of Saginaw River and unts necessary to complete the approved project:

s of shoals.	Estimates.		Dredged since.		Estimates June 30, 1892.		
	Year.	Cubic yards.	Year.	Cubic yards.	Cubic yards.	Price.	Amount.
nprovement:						Cents.	
.	1891	180,000	1891 1892	56,523 28,661	94,816	50	$52,149
e	1892	48,000			48,000	35	18,500
	1884	81,600	1884 1885	15,416 24,620	41,564	30	13,716
l							84,365
y City:							
e	1891	97,760	1891	23,623	74,137	40	32,620
sland	1884	35,796			35,796	40	15,750
k works	1892	79,400			79,400	40	34,936
e	1891	30,000	1891	32,491			
n	1891						
(east side)	1892	86,000			86,000	40	37,840
treet	1892	49,300			49,300	40	21,692
ginaw	1881	100,000			100,000	40	44,000
l							186,838
annel along West ty							10,000
ad total							281,203

nate of the probable cost of the improvement was $1,442,500. f $1,155,000 has been appropriated for the work and it was completed in 1885 at a cost of about $975,000. Few ims have resulted in greater benefit to the lake commerce, as y the infrequency of disasters in the vicinity since it became

wing statement shows the various contracts in force during ear ending June 30, 1892, and the present condition of each:

contractor.	Contract for—	Date of contract.	Remarks.
itchell	Hire of dredging plant	June 16, 1890	Closed June 30, 1892.
	Coal	Mar. 7, 1891	Closed Dec. 31, 1891.
& Co.	Ship chandlery	Mar. 26, 1892	Closed Apr. 30, 1892.

ontract with Chauncey E. Mitchell, dated June 16, 1890, for dge and outfit by the hour, dredging was continued until f the season of 1891 and resumed upon the opening of the 1892. The work done consisted in removing shoals in and harbor, the material to be excavated being composed of bowlders, and sandstone bed rock, very similar in character ine. All the dredging contemplated for the fiscal year was , except upon the shoal at the main entrance to the harbor, ditional dredge cuts were made across this from west to east. was stopped on June 30, 1892, because the limit of the conreached on that day, and the dredge was then discharged. it of material removed during the fiscal year was 25,383 cubic measure, in 1,338 hours, 25 minutes, amounting to $10,573.49 tract price of $7.90 per hour of work, or nearly 41.7 cents per , scow measure, for the material removed. The total number vorked under the contract from its beginning was 1,899¼; amount of material removed was 31,547 cubic yards, scow the total amount earned by the dredge was $15,004.07, and e cost for the use of the dredging plant was a little more ents per cubic yard, scow measure. The apparent cost per l for the excavation was increased by the time spent during ear in removing the wrecked barge *Col. Brackett*, for which d be no equivalent in cubic yards.

by a diver were made to the main, west, and south piers season of 1891, prior to October 1. During the early part 92, the diver made a thorough examination of the pier found reported the result in detail. The damage done by the orms was much less than usual, doubtless due to the measures season and to the unusual immunity from severe storms year. In this latter respect the winter was quite exceptional, s fact, more than to any other, may be attributed the present ition of the structures and freedom from necessity for extenostly repairs.

ing crew was reorganized June 1, 1892, and from that time lose of the fiscal year was employed in repairing the damaged he foundation, using for this purpose bowlder stone purchased arket for the low price of $5 per cord.

t pier now appears to be in a less satisfactory condition than , and extensive repairs must soon be made to the portion er. The timbers are badly decayed, and the whole super-

Money statement.

, balance unexpended	$59,673.51
92, amount expended during fiscal year	15,511.88
2, balance unexpended	44,161.63
2, outstanding liabilities	3,778.42
2, balance available	40,383.21
propriated by act approved July 13, 1892	150,000.00
ailable for fiscal year ending June 30, 1893	190,383.21
hat can be profitably expended in fiscal year ending June 30, 1894	80,000.00

d in compliance with requirements of sections 2 of river and acts of 1866 and 1867.

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propriations for improving harbor of refuge, Lake Huron, Michigan.

71	$100,000	March 3, 1881	$50,000
72	100,000	August 2, 1882	75,000
73	75,000	July 5, 1884	75,000
74	75,000	August 5, 1886	75,000
75	100,000	August 11, 1888	70,000
1876	75,000	September 19, 1890	30,000
78	100,000		
79	75,000	Total	1,150,000
80	75,000		

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bids for supplies for improving harbor of refuge, Lake Huron, Michigan, re- d opened March 14, 1892, in accordance with advertisement dated February 23,

Name and address of bidder.	Contract for—	Total.
& Co., Sand Beach, Mich	Coal	*$425.00

* Recommended for acceptance.

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ord of vessels taking shelter in the harbor of refuge, Lake Huron, Michigan, from June 30, 1891, to June 30, 1892.

wind at time of tering.	1891. July.	1891. Aug.	1891. Sept.	1891. Oct.	1891. Nov.	1891. Dec.	1892. Jan.	1892. Apr.	1892. May.	1892. June.	Total.
	14	15	9	16	1			7	44	6	112
	7	5	1	5				1	1[illegible]	4	34
	8	3	1	13	2			4	16	4	51
											197
	13	19	25	63	47	5		2	4	4	182
	3	4	10	3	7	1		1		5	34
	11	9	17	64	20			2		1	133
											349

nage of vessels taking shelter in the harbor of refuge, Sand Beach, Lake Huron, Michigan.

ıdar year.	Steam.	Sail.	Tow.	Total.	Total number of vessels.	Average tonnage.
	Tons.	*Tons.*	*Tons.*	*Tons.*		
....	63,966	27,699	50,954	142,619	493	289
....	104,025	39,699	99,282	243,006	781	311
....	133,080	45,750	100,096	278,926	921	303
....	158,720	55,630	147,260	361,610	1,317	275
....	144,645	55,960	127,855	328,460	1,176	279
....	146,132	26,504	114,067	286,703	1,022	280
....	177,122	32,713	114,091	323,926	1,139	284
....	156,518	34,724	122,980	314,222	1,142	275
....	196,364	29,426	151,607	377,397	1,158	325
....	196,335	33,790	140,862	370,987	1,304	284
....	271,327	33,689	153,087	458,103	1,447	317
....	271,917	39,756	202,191	513,864	1,624	316
....	289,719	37,922	165,896	493,537	1,512	326
....	325,852	38,826	169,104	533,783	1,575	339
....	292,917	27,076	171,067	491,059	1,341	366
....	2,928,639	559,164	2,030,399	5,518,202	17,952	307

L L II.

:OVEMENT OF BLACK RIVER AT PORT HURON, MICHICAN.

improvements were commenced the lower reach of Black River, nouth to the Grand Trunk Railroad Bridge, a length of nearly varied in width from 120 to 150 feet, and had a navigable ıf from 10 to 14 feet in depth, except at a few points where it ructed by shoals or bars having only 8½ feet of water over

'er and harbor act of August 11, 1888, called for an examina- Black River at Port Huron, to deepen channel from mouth to 'unk Railroad Bridge to depth of 18 feet." After a prelimi- :nination of the locality had been made I reported that the :hin the limits indicated, while not worthy of improvement to ı depth as 18 feet, was worthy of improvement to a depth of nd a survey was consequently authorized to obtain data on base a project for this latter depth. As a result of this survey ate of $55,110 was made on May 9, 1889, for improving the the river in question to a depth of 15 feet.

'er and harbor act of September 19, 1890, appropriated $25,000 roving Black River at Port Huron, Mich., to deepen channel ıth to Grand Trunk Railroad Bridge to depth of 16 feet," 1 ter depth than that for which the estimate had been made. A ıroject for the improvement of the river to the depth named in ›priation was therefore submitted in January, 1891, and was roved. It contemplates excavating a channel 16 feet deep mouth of the river to the Grand Trunk Railroad Bridge, and varying between 160 and 75 feet, according to locality. On ıf the greater depth the estimate for the work was increased 0.

beginning of the fiscal year a contract with Chauncey E. for dredging was in force, under a project for the expenditure 0 appropriated for the work by the river and harbor act of ır 19, 1890. The work proposed to be accomplished was to

...el two dredge-cuts wide and 16 feet deep from the ...er upstream as far as the funds available would per... were more than sufficient to carry the two cuts to the ...ilroad Bridge, then to widen the lower reach of the ...until ... funds were exhausted, all in furtherance of the gen... ...ject. This contract has been extended to December 1, 1892. ...g has been in progress throughout the fiscal year and is not ...ted. It was stopped for the season on November 28, 1891, ...resumed April 16, 1892. On June 30, 1892, a channel 16 feet deep ...ended from the mouth of the river towards the Grand Trunk Rail... ...d Bridge, the whole length being about 6,200 feet. Its width from ... mouth of the river to Military Street Bridge, a distance of about ...0 feet, was 75 feet, and it was 50 feet wide for the further distance ...bout 4,500 feet.

	Cubic yards.
...unt of material removed prior ... 1891	18,2..
...unt of material removed durin...	73,0..
Total amount of excavation to ... 892	91,2..
...t of examination and survey p... ...riation for improvement..	$731.5.
...penditures to June 30, 1891, und... ...tion of September 19, 1890.	2,399.1.
...penditures and obligations duri... ...ending June 30, 1892	12,935..
Total cost to June 30, 1892	16,065..
...ated cost of the improvemen...	75,000.0.
...riated by act of Septembe...	25,000.0.
...mount to credit of estimate	50,000.0.

Of the balance remaining to the credit of the estimate the sum of $25,000 can be advantageously expended during one fiscal year.

Black River, at Port Huron, is in the collection district of Huron, Mich. The nearest port of entry is Port Huron, through the midst of which the river runs, and the nearest light-house is Fort Gratiot Light, distant about 2 miles.

Money statement.

July 1, 1891, balance unexpended		$23,831.2.
June 30, 1892, amount expended during fiscal year		9,456.7.
July 1, 1892, balance unexpended		14,374.50
July 1, 1892, outstanding liabilities	$2,309.88	
July 1, 1892, amount covered by uncompleted contracts	12,064.62	
		14,374.50
Amount appropriated by act approved July 13, 1892		10,000.00
Amount (estimated) required for completion of existing project		40,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Appropriation for improving Black River, Michigan, at Port Huron, etc.

September 19, 1890 .... **$**

COMMERCIAL STATISTICS.

Entered during calendar year, 1891.

Commodities.	Amounts.	Tons.
....feet, B. M..	16,000,000	37,000
....pieces..	2,908,000	385
....do...	1,800,000	100
....do...	6,000	125
....	....	13,000
....cords..	7,000	14,500
....	....	180
....cords..	700	4,700
....do...	5,000	10,000
....pieces..	400,000	9,895
....	....	89,885

:s were made from the river.

L L 12.

ROVEMENT OF MOUTH OF BLACK RIVER, MICHIGAN.

'er empties into St. Clair River, at Port Huron, Mich. At :s mouth, extending beyond the middle of St. Clair River, ar, or Middle Ground. Under former appropriations this dged to a clear depth of 15 feet. The main channel of St. is found between the Middle Ground and the Canadian

eposit of material brought down by the current of Black epth on the bar had been reduced an average of about 6 in conjunction with a low stage of water, became an im- navigation along the front of the city of Port Huron in

ance with projects approved in 1889 and 1891 it was pro- prove the bar by making a series of dredge cuts, of a uni- of 16 feet, along the dock front of Port Huron, from the e above to the same curve below the mouth of Black River, at a distance of about 50 feet from the wharves, and the ntinue the work outward as far as the available funds would

e project of 1889 (act of August 11, 1888) the bar was the full depth of 16 feet, for a width of 300 feet, the amount removed being 46,239 cubic yards, scow measurement.
e project of 1891 (act of September 19, 1890) a contract 1 11, 1890, with the Bay City Dredging Company, for dredg- force at the beginning of the fiscal year, and work was ntil November 14, 1891, when it ceased on account of the of the appropriation. The amount of material removed iscal year was 40,011 cubic yards, scow measurement, and te under this contract was 57,515 cubic yards. The result 120 feet to the width of the improvement, thus making it e.
amount of material removed under the two projects was c yards, scow measure. The dredging should be continued

[illegible]

[illegible]

[illegible]

[illegible]

Money statement.

1891, balance unexpended	$59,673.51
1892, amount expended during fiscal year	15,511.88
1892, balance unexpended	44,161.63
1892, outstanding liabilities	3,778.42
1892, balance available	40,383.21
appropriated by act approved July 13, 1892	150,000.00
available for fiscal year ending June 30, 1893	190,383.21
at that can be profitably expended in fiscal year ending June 30, 1894	80,000.00

tted in compliance with requirements of sections 2 of river and ior acts of 1866 and 1867.

Appropriations for improving harbor of refuge, Lake Huron, Michigan.

, 1871	$100,000	March 3, 1881	$50,000
, 1872	100,000	August 2, 1882	75,000
, 1873	75,000	July 5, 1884	75,000
, 1874	75,000	August 5, 1886	75,000
, 1875	100,000	August 11, 1888	70,000
14, 1876	75,000	September 19, 1890	30,000
, 1878	100,000		
, 1879	75,000	Total	1,150,000
1880	75,000		

of bids for supplies for improving harbor of refuge, Lake Huron, Michigan, re- and opened March 14, 1892, in accordance with advertisement dated February 23,

Name and address of bidder.	Contract for—	Total.
nks & Co., Sand Beach, Mich	Coal	*$425.00

* Recommended for acceptance.

Record of vessels taking shelter in the harbor of refuge, Lake Huron, Michigan, from June 30, 1891, to June 30, 1892.

of wind at time of entering.	1891.						1892.				Total.
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Apr.	May.	June.	
	14	15	9	16	1	......	......	7	44	6	112
	7	5	1	5	......	......	......	1	1[illegible]	4	34
	8	3	1	13	2	......	......	4	16	4	51
											197
t:											
	13	19	25	63	47	5	......	2	4	4	182
	3	4	10	3	7	1	......	1	......	5	34
	11	9	17	64	20	......	......	2	......	1	133
											349

No. [illegible]—[illegible] harbor of refuge, Lake Huron, Michi[illegible] from June [illegible], 18[illegible], to June [illegible], 18[illegible]—Continued.

[illegible]	1881.						1882.				Total.
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Apr.	May.	June.	
[illegible]:											
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......	......	3	7	2	[illegible]
[illegible]	[illegible]	......	[illegible]	[illegible]	[illegible]	......	......	1	2	3	[illegible]
[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	......	......	......	3	......	[illegible]
[illegible]:											
[illegible]	9	4	[illegible]	[illegible]	[illegible]	[illegible]	1	11	14	6	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......	5	14	5	[illegible]
[illegible]	......	......	[illegible]	[illegible]	[illegible]	[illegible]	......	23	1	......	[illegible]
[illegible]:											
[illegible]	[illegible]	......	[illegible]	[illegible]	[illegible]	1	......	......	......	2	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4	......	......	......	1	5	[illegible]
[illegible]	......	......	......	......	[illegible]	1	......	......	......	......	[illegible]
[illegible]:											
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......	......	4	19	11	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......	......	4	17	7	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......	......	......	9	5	[illegible]
[illegible]:											
[illegible]	[illegible]	[illegible]	[illegible]	......	......	1	......	2	2	1	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	......	......	......	......	......	5	1	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	......	......	[illegible]	......	......	......	......	[illegible]
[illegible]:											
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	......	9	6	7	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	5	[illegible]	......	......	7	1	11	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......	......	......	5	1	......	[illegible]
[illegible]:											
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......	......	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......	[illegible]	30	10	[illegible]
Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

No. [illegible] harbor of refuge, Sand B[illegible] [illegible] to June [illegible], 1882.

[illegible]	Steam.		Sail.		Tow.		Total.	
	[illegible]	[illegible]	[illegible]	Tons.	No.	Tons.	No.	Tons.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	35	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,331	[illegible]

nnage of vessels taking shelter in the harbor of refuge, Sand Beach, Lake Huron, Michigan.

endar year.	Steam.	Sail.	Tow.	Total.	Total number of vessels.	Average tonnage.
	Tons.	*Tons.*	*Tons.*	*Tons.*		
....	63,966	27,699	50,954	142,619	493	289
....	104,025	39,699	99,282	243,006	781	311
....	133,080	45,750	100,096	278,926	921	303
....	158,720	55,630	147,260	361,610	1,317	275
....	144,645	55,960	127,855	328,460	1,176	279
....	146,132	26,504	114,067	286,703	1,022	280
....	177,122	32,713	114,091	323,926	1,139	284
....	156,518	34,724	122,980	314,222	1,142	275
....	196,364	29,426	151,607	377,397	1,158	325
....	196,335	33,790	140,862	370,987	1,304	284
....	271,327	33,689	153,087	458,103	1,447	317
....	271,917	39,756	202,191	513,864	1,624	316
....	289,719	37,922	165,896	493,537	1,512	326
....	325,852	38,826	169,104	533,783	1,575	339
....	292,917	27,076	171,067	491,059	1,341	366
....	2,928,639	559,164	2,030,399	5,518,202	17,952	307

L L II.

ROVEMENT OF BLACK RIVER AT PORT HURON, MICHIGAN.

e improvements were commenced the lower reach of Black River, mouth to the Grand Trunk Railroad Bridge, a length of nearly s, varied in width from 120 to 150 feet, and had a navigable of from 10 to 14 feet in depth, except at a few points where it structed by shoals or bars having only 8½ feet of water over

iver and harbor act of August 11, 1888, called for an examina- "Black River at Port Huron, to deepen channel from mouth to Trunk Railroad Bridge to depth of 18 feet." After a prelimi- amination of the locality had been made I reported that the ithin the limits indicated, while not worthy of improvement to t a depth as 18 feet, was worthy of improvement to a depth of and a survey was consequently authorized to obtain data on o base a project for this latter depth. As a result of this survey mate of $55,110 was made on May 9, 1889, for improving the f the river in question to a depth of 15 feet.

iver and harbor act of September 19, 1890, appropriated $25,000 proving Black River at Port Huron, Mich., to deepen channel outh to Grand Trunk Railroad Bridge to depth of 16 feet," 1 ater depth than that for which the estimate had been made. A project for the improvement of the river to the depth named in ropriation was therefore submitted in January, 1891, and was pproved. It contemplates excavating a channel 16 feet deep e mouth of the river to the Grand Trunk Railroad Bridge, and h varying between 160 and 75 feet, according to locality. On of the greater depth the estimate for the work was increased 000.

e beginning of the fiscal year a contract with Chauncey E. l for dredging was in force, under a project for the expenditure 000 appropriated for the work by the river and harbor act of ber 19, 1890. The work proposed to be accomplished was to *for operating and care of Saint Clair Flats Canal, Michi*

cal year ending June 30—

.....	
1890	
1891	
1892	
Total	

Itemized statement of expenditures incu on account of appropriation fo and care of canals and other works o gation indefinite, applied to op care of Saint Clair Flats Canal, Michi or the fiscal year ending June 30

Date.	No. of voucher.	From whom purchased.	Articles.
1891.		*Part of first quarter, 1892.*	
Aug. 1	2	Payroll, July, 1891	ustodian arsman
Sept. 1	3	Payroll, August, 1891	ustodian arsman
		Second quarter, 1892.	
Oct. 2	1	Payroll, September, 1891	1 custodian 1 oarsman
Nov. 2	2	Payroll, October, 1891	1 custodian 1 oarsman
Dec. 2	3	Payroll, November, 1891	1 custodian 1 oarsman 2 carpenters, 10 days, at $2 per day
31	4	Payroll, December, 1891	1 custodian 1 laborer, 28 days, at $50 per month
1892.		*Third quarter, 1892.*	
Jan. 31	1	W. H. Mott, custodian	Services as custodian at St. Clair Flat Canal, Michigan, from January 1 t January 31, 1892 (both days inclusive) being one month.
Feb. 29	2	W. H. Mott	Services as custodian at St. Clair Flat Canal, Michigan, from February 1 t February 29, 1892 (both days inclusive) being one month.
Mar. 31	3	......do	Services as custodian at St. Clair Flat Canal, Michigan, from March 1 t March 31, 1892 (both days inclusive) being one month.
		Fourth quarter, 1892.	
May 4	1	Payroll, April, 1892	1 custodian
June 10	2	Payroll, May, 1892	1 custodian
		Month of July, 1892.	
July 1	1	Payroll, June, 1892	1 custodian 2 sub-inspectors, 24 days, at $90 pe month.
			Total

L L 15.

IMPROVEMENT OF CLINTON RIVER, MICHIGAN.

1870 the channel over the bar at the entrance to this river afforded pth of only 3½ feet, while the depth in the river for some distance ve was 10 feet.

project for dredging a channel across the bar was approved and ied into effect in 1870. A project for the general improvement of river from its mouth to the city of Mount Clemens was submitted 880 and renewed and approved in 1889. It contemplates a channel et deep and of navigable width for the entire distance of about 8½ s from the mouth of the river to Mount Clemens. Involved in this the closing of a gap opposite Mount Clemens and of Catfish (or d) Channel; also closing the main channel at, and making a straight across, Shoemakers Bend, constructing a revetment on the north of the mouth from the shore to the requisite depth in Lake St. ir, and dredging wherever necessary to attain the desired depth, the mated cost of the improvement being $32,926.

rior to the beginning of the fiscal year the work at Shoemakers nd had been completed; the gap opposite Mount Clemens had been sed, and some dredging had been done at the mouth of the river and various shoals between there and Mount Clemens.

At the beginning of the fiscal year the only contract in force was one th Mr. George Lockerbie, dated February 13, 1891, approved March 1891, for dredging. Under this contract operations had been begun ay 1, 1891, and were continued until October 4, 1891, when the funds re exhausted and the work ceased.

The result was a channel 8 feet deep and 75 feet wide or more, from mouth of the river to the bridge at Mount Clemens. Although the annel can not be considered permanent, yet no complaint of its terioration has reached this office up to the date of this report.

	Cubic yards.
volume of material removed during the fiscal year was	23,374
l the total volume under this contract was	38,401

al expenditures to June 30, 1891	$45,405.06
pended during fiscal year	6,006.54
Total expenditures to June 30, 1892	51,411.60

Eight thousand five hundred and sixty-four dollars and fourteen nts still remain to be appropriated to complete the improvement in cordance with the existing project, and in view of the relief already orded the river is worthy of the additional appropriation. This ount can be profitably expended during the fiscal year ending June , 1893.

But the good effect of the dredging already done is liable to be destroyed by deposits of material brought down by annual freshets in e river, for which reason the foregoing estimate can only be considd as approximate for the fiscal year, and is probably too low if the rk be deferred beyond that time.

The proposed navigable depth having been once obtained, no charges maintenance should be made against it. The balance named is eded only for the construction of the revetment on the north side the river at the mouth. The good effect of the dredging already done liable to be impaired by deposits of material brought down by annual freshets in the river, and the cost of restoring the depth shou[ld be] chargeable to future estimates and appropriations thereunder.

Clinton River is in the collection district of Detroit, Mich. The nearest [port of] entry is Detroit. The nearest light-houses are those at St. Clair Flats.

Money statement.

July 1, 1891, balance unexpended $7,
June 30, 1892, amount expended during fiscal year 7,

July 1, 1892, balance unexpended ....
Amount appropriated by act approved July 13, 1892 8,

Amount available for fiscal year ending June 30, 1893 .... $

Appropriations for improving Clinton River, Michigan.

August 30, 1852	$5,000	August 5, 1886	
July 11, 1870	5,000	August 11, 1888	
March 3, 1871	1,500	September 19, 1890	
March 3, 1881	8,000		
August 2, 1882	6,000	Total	

COMMERCIAL STATISTICS.

Articles entered and cleared during the season of 1891.

Articles entered.	Amount.	Tons.	Articles cleared.	Amount.
Lumber .... feet, B. M.	7,200,000	14,000	Flour .... barrels	1,800
Coal		10,500	Oats .... bushels	5,000
Salt .... barrels	800	110	Staves .... feet, B. M.	6,000,000
Cement .... do	500	50	Headings .... do	6,000,000
Stone .... cords	1,600	9,000		
Iron		650	Total	
Logs .... feet, B. M.	8,000,000	16,000		
Shingles .... do	4,000,000	500		
Laths .... do	6,000,000	520		
Heading bolts .... cords	5,000	10,000		
Total		61,330		

Number of vessels cleared during the season of 1891.

Steam ....
Sail ....

L L 16.

IMPROVEMENT OF GROSSE POINTE CHANNEL, MICHIGAN.

Between the lower end of St. Clair Flats and the deep water [of De]troit River, the only known obstruction to navigation is the shoal off Grosse Pointe, known as Grosse Pointe Flats. At or[dinary] stages of water vessels drawing 16 feet can cross this obstructi[on]

[wh]en the water is as low as it has been during the last few years, ves[sel]s drawing more than 15 feet can pass only with great care and [dif]ficulty.

The river and harbor act of August 11, 1888, appropriated $75,000 [for] "improving St. Clair Flats Ship Canal, * * * all or any por[tio]n of which may, in the discretion of the engineer, be expended in [dr]edging Grosse Pointe Channel." Five thousand dollars was conse[qu]ently reserved from this appropriation for the removal of any small [an]d well-defined obstruction that might be found at Grosse Pointe, [as] well as for making such surveys as might be necessary before making [a d]efinite project. A small shoal was removed in July, 1889, but no [mo]re such obstructions have since been found.

As the improvement of other connecting channels of the Great Lakes [be]gins to approach the 20-foot depth, which it is recognized that they [sho]uld ultimately have, the annoyance to shipping at Grosse Pointe [Fla]ts must increase, and the necessity for a channel at this point is [ur]gent. The number of vessels annually crossing these flats is enor[mo]us, and to insure a thoroughly satisfactory result a channel 800 feet [wi]de and nearly $5\frac{1}{2}$ miles long should be dredged. The material to be [ex]cavated consists of sand, gravel, and clay, and the approximate esti[ma]te of the cost of this work is as follows:

[Dr]edging 2,889,472 cubic yards, at 30 cents	$869,841.60
[Ad]d 10 per cent for contingencies	86,984.16
Total	956,825.76

In an estimate submitted February 10, 1888, I placed the cost of a [ch]annel $19\frac{1}{2}$ feet deep at $553,000, but remarked that to "gain an ad[di]tional half foot would materially increase the cost." That estimate [w]as based upon a price of 20 cents per cubic yard for dredging. For a [ch]annel 20 feet in depth the length of the channel is increased nearly [2] miles, over which the work would be merely "scraping," and there[fo]re disproportionately costly.

But the full depth of 20 feet should be obtained at whatever cost. [Th]e commerce which passes this point already exceeds 20,000,000 tons [an]nually, and steps can not be taken too soon for its accommodation.

To accomplish valuable results a large appropriation will be required [at] first, and unless this be granted the results will be unsatisfactory, [an]d the eventual cost will be greatly increased. With $300,000 avail[ab]le, a narrow channel of the proposed depth can be opened, and will [aff]ord immediate though insufficient relief. Its width can subsequently [be] increased to such an extent as may be necessary.

This improvement is both necessary and urgent, and will benefit [ne]arly the entire commerce of the lakes.

[G]rosse Pointe Flats are in the collection district of Detroit, Mich. Windmill Point [lig]ht-house and range lights are in close vicinity.

Money statement.

[Jul]y 1, 1891, balance unexpended	$3,844.05
[Jul]y 1, 1892, balance unexpended	3,844.05
[A]mount (estimated) required for completion of existing project	956,825.76
[A]mount that can be profitably expended in fiscal year ending June 30, 1894	300,000.00
[Sub]mitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

LL 17.

ROVEMENT OF ROUGE RIVER, MICHIGAN.

impr ements were begun Rouge River had a channel of ver the bar at its mouth, and from 10 to 17 feet thence to e of the St. Louis and Wabash Railroad, a distance of nearly 15, In earlier days vessels had ascended it to Dearborn, a distance out 15 miles.

The approved project for improvement contemplates dredging iver to a depth of 16 feet and width of 240 feet at the mouth, gra lly narrowing to 100 feet at a distance of about 1,150 feet above, n continuing this width to the bridge of the St. Louis and Wab ilroad.

On June 30, 1891, the dredged channel was 16 feet deep, 240 at the mouth, gradual ing to 100 feet at a distance feet above; thence to the gan Central Railroad bridge, onal distance of about et, it averaged 70 feet in wid wider at the curves. T length of the dredged chan out 12,650 feet.

No funds were available duri y part of the fiscal year endi June 30, 1892, for which reason rk was done, and some shoali has taken place in portions of th nnel already dredged.

To complete the improvement cordance with the original e mate will require the sum of $ 0.39, that being the differe between the original estimate a aggregate of the sums thus appropriated. In view of the sing number of manufactur establishments along its banks, and its availability as a winter har for vessels, the river is well worthy of the additional appropriat necessary to complete the project for its improvement. The wl amount can be profitably expended in one fiscal year.

Amount of original estimate		$31,69
Amount expended to June 30, 1892	$20,483 28	
Less cost of surveys and examinations prior to making the estimate	616 45	
Amount actually expended upon improvement		19,86
Balance to credit of estimate		11,82
Balance on hand		13
Amount to be appropriated		11,69

This work is in the collection district of Detroit, Mich. The nearest light-h is Grassy Island, and the nearest fort is Fort Wayne, each of which is in sight the work.

Money statement.

July 1, 1891, balance unexpended	13
July 1, 1892, balance unexpended	13
Amount appropriated by act approved July 13, 1892	11,69
Amount available for fiscal year ending June 30, 1893	11,82

Appropriations for improving Rouge River, Michigan.

August 11, 1888	$10
September 19, 1890	10
Total	2

COMMERCIAL STATISTICS.

ommercial statistics have not been obtained for the calendar year 1891, but they e practically the same as those reported in the preceding Annual Report for 1890, erein they were stated in detail. The freight tonnage for 1890 was 311,000 tons.

L L 18.

IMPROVEMENT OF DETROIT RIVER, MICHIGAN.

Originally the channel at Limekiln Crossing, Detroit River, could be depended upon for more than 13 feet of water, the ordinary pth being much affected by the direction of the wind. As originally jected in 1874 the improvement at this point was to consist of a ved channel 300 feet wide, with a uniform depth of 20 feet, and the ginal estimate was based upon this project.

n 1883 it was wisely determined to so modify the project as to se- e a straight channel, the least width of which should be 300 feet, h a somewhat greater width at each end, utilizing the work already ie.

n 1886 this was further modified to the end that the width of the nnel should be increased to 400 feet by removing an additional 100 t from the western (American) side; and in 1888 a further addi- nal width of 40 feet on the western side was authorized, as the low- t bid under the final appropriation was so low that the money in nd would pay for the increased excavation.

The estimated cost of a 400-foot channel was $1,374,500. The total mount expended up to June 30, 1891, was $702,122.04, and the result as been a channel 440 feet in width, thus accomplishing one-tenth ore work than was estimated for at a cost of but little more than half he estimate. Gratifying as this is, the benefit to commerce is far be- ond the amount of the original estimate, and since the excavation is rough rock the improvement will be permanent.

The only work in progress during the fiscal year was the preparation a map of the water front of Detroit River, from it head, at Windmill oint, to a point about 2 miles below the River Rouge, a total distance about 13 miles. For this purpose the total sum expended to June , 1892, was $64.48.

Water-gauge observations were made during the months of May and ne, 1892, at the light-house depot, Detroit, and at Windmill Point ght-House. Their cost is included in the above statement of expend- ures.

tal expenditure to June 30, 1891	$702,122.04
pended during fiscal year	64.48
Total expenditure to June 30, 1892	702,186.52

The project for Limekiln Crossing having been completed, no further timate is submitted for work at that point. The extreme low water last few years, however, has caused vessels to strike on a num- shoals in different parts of the river, whose existence had not ly been known; and, in view of the magnitude of the commerce all such shoals should be removed as soon as possible. As no information on this subject is at hand, an accurate estimate of work can not be made, but $50,000 would probably suffice for the removal of the more serious of the shoals between the of Detroit and Lake Erie, and an estimate of that amount is there submitted and strongly recommended.

The work is in the collection district of Detroit, Mich. The nearest port of is Detroit. The nearest United States light-houses are Mammy Judy and the r lights at the head of Grosse Isle, about 5 miles distant.

Money statement.

July 1, 1891, balance unexpended	$9
June 30, 1892, amount expended during fiscal year	6
July 1, 1892, balance unexpended	9
Amount appropriated by act approved July 13, 1892	30,0
Amount available for fiscal year ending June 30, 1893	30,9
Amount (estimated) required for completion of existing project	20,0
Amount that can be profitably expended in fiscal year ending June 30, 1894	20,0

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Appropriations for improving Detroit River, Michigan.

June 23, 1874	$25,000	July 5, 1884	$20
June 18, 1878	100,000	August 5, 1886	3
March 3, 1879	50,000	August 11, 1888	13
June 14, 1880	50,000		
March 3, 1881	50,000	Total	70
August 2, 1882	60,000		

COMMERCIAL STATISTICS.

Commerce of Detroit River during the season of 1891, comprising staples only and such as cleared from United States ports.

Commodities.	Amounts.	Tons.	Commodities.	Amounts.	To
Iron ore and finished iron		6,855,097	Stone		2
Coal		6,335,841	Provisions ..... hhds	69,000	
Wheat ..... bushels	79,184,912	2,363,180	Merchandise ... pkgs	6,618,296	1,8
Flour ..... barrels	9,847,343	984,734	Salt ..... barrels	408,361	1
Corn ..... bushels	40,288,760	1,151,167	Lumber ... feet. B. M	1,122,683,000	2,2
Oats ..... do	19,403,828	336,396	Laths ..... pieces	22,462,000	
Barley ..... do	12,193,053	292,633	Shingles ..... do	82,462,000	
Flaxseed ..... do	8,665,303	236,295	Silver ore		
Malt ..... do	73,000	1,460	Cement ..... barrels	692,956	
Oil cake ..... sacks	24,000	2,400	Telegraph poles . pieces	51,639	
Copper ore		69,000	Total		23,

Number of vessels, 34,251; registered tonnage, 22,160,000, exclusive of Can vessels. If the latter could be included, and the list of commodities made to in all that were carried, whether cleared from a custom-house or not, the total v be much greater.

Total number of vessels and tonnage cleared from all the collection districts on the of lakes.

Vessels	5
Registered tonnage	32,48

Number of loaded cars that crossed Detroit River during 1891.

bound	199, 173
bound	120, 956
Total	320, 129
nnage at an average of 12 tons per car	3, 841, 548
nnage at an average of 15 tons per car	4, 801, 935

L L 19.

MOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

Wreck of scow Hannah Moore.—The unladen wooden scow *Hannah* *oore* became water-logged and sunk in St. Clair River on July 3, 1891. lay off Port Huron, Mich., in about 16 feet of water, nearly at right gles to the channel, on her beam ends, her two masts pointing upream. She was about 450 feet from the Flint and Pere Marquette ilroad Dock, and 1,250 feet below Black River. Her dimensions re approximately as follows: Gross tonnage, 74.23; length, 88 feet; eadth 20 feet; depth, 6 feet 4 inches. She was built in 1868, at St. air, Mich., and hailed from Detroit, Mich.

When it became apparent that the owner of the scow did not propose remove her, a project for her removal at an estimated cost of $1,000, ompanied by the necessary specifications, was submitted to the ef of Engineers. This project having been approved, the thirty ys' notice required by law was published on August 22, 1891, and ecifications were issued.

Proposals for removing the wreck were opened on September 21, 891, and on September 28, 1891, a contract was duly entered into with he lowest bidder, Mr. Chauncey E. Mitchell, for the lump sum of $880.

The work of removal was begun October 15. The scow was broken nto two pieces by dynamite, and on October 21 and 23 the two portions ere raised and towed to a point near the shore, about 2 miles below lack River. On November 9 all the remaining portions of the wreck ere removed satisfactorily, and on November 16 the contract was losed. The total cost to the Government, including superintendence, rinting, advertising, etc., was $902.10. No articles of value were reovered.

This work was in the collection district of Huron, Mich. The nearest port of try was Port Huron, and the nearest light-house was Fort Gratiot Light, at the d of St. Clair River.

tract of bids for the removal of the wreck of the scow Hannah Moore from the St. Clair River, opposite the Flint and Pere Marquette Railroad Dock, Port Huron, Mich., received and opened on September 20, 1891, in accordance with advertisement dated August 22, 1891.

	Name and address of bidder.	Price.	Remarks.
1	Chauncey E. Mitchell, Detroit, Mich.*	$880	Will use dynamite. Dredge and lighters to be used when wreck will not float, after blasting.*
	Enoch Townsend, Somers Point, N. J.	980	Remove said vessel by dynamite, and pieces if necessary will lighter.
	Elijah Dunbar, Detroit, Mich.	1,490	Will use dynamite to break the vessel in pieces, and land same on bank of river with tug.

* Recommended for acceptance.

APPENDIX M M.

ıVEMENT OF RIVERS AND HARBORS ON LAKE ERIE WEST OF ERIE, PENNSYLVANIA.

ƐT OF LIEUTENANT-COLONEL JARED A. SMITH, CORPS OF ENGI- 'KS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 392, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

roe Harbor, Michigan.
ıdo Harbor, Ohio.
; Clinton Harbor, Ohio.
lusky City Harbor, Ohio.
lusky River, Ohio.
on Harbor, Ohio.
nillion Harbor, Ohio.
8. Black River Harbor, Ohio.
9. Cleveland Harbor, Ohio.
10. Fairport Harbor, Ohio.
11. Ashtabula Harbor, Ohio.
12. Removing sunken vessels or craft obstructing or endangering navigation.

EXAMINATIONS AND SURVEYS.

ınd River, Ohio, between Richıond and the mouth.
14. Conneaut Harbor, Ohio.

UNITED STATES ENGINEER OFFICE,
Cleveland, Ohio, July 9, 1892.

ɪERAL: I have the honor to transmit herewith, in duplicate, annual ;s for the year ending June 30, 1892, upon the improvement of and harbors in my charge.

Very respectfully, your obedient servant,

JARED A. SMITH.
Lieutenant-Colonel, Corps of Engineers.

g. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

M M I.

IMPROVEMENT OF MONROE HARBOR, MICHIGAN.

This improvement was commenced in the year 1835, at which t the Raisin River was considered an important stream, and Monroe a place of some prominence. The plan of improvement consiste straightening the river and making direct connection with Lake l by a canal 4,000 feet long and 100 feet wide, through a sand penins

A description in detail of the earlier operations heretofore carrie for the improvement of this harbor will be found in Annual Report 1880 and 1881.

Some minor repairs to the piers and revetment of canal were m in the fiscal year ending June 30, 1891, but nothing has been done ing the last fiscal year, and the project for repairs remains untouc

A project for a general repair of the piers and revetment of canal adopted in 1886, the cost at that time being estimated at $20,000. general repairs have been undertaken owing to lack of funds for s a purpose. Of course the condition of the superstructure of piers the canal revetment is constantly becoming worse. The amount mated as necessary for the general repairs in 1891 was $26,000. estimate appears to have been a general one only, as it is not eas determine in advance the exact extent to which the work must b newed.

As the officer in charge of the work has had no opportunity to m a critical examination of the situation, the last estimate is here peated.

The annual report of last year gave the least depths of wate June, 1890, as 9 feet to lower docks and thence to upper docks a feet. No examination for channel depths has been made since the mentioned.

The following is a statement of the amount and date of all appro tions for this improvement:

February 24, 1835	$30, 000. 00	August 14, 1876	$5, 0
July 2, 1836	15, 000. 00	June 18, 1878	2, 5
March 3, 1837	30, 000. 00	March 3, 1879	2, 0
July 7, 1838	15, 000. 00	June 14, 1880	2, 0
June 11, 1844	20, 000. 00	March 3, 1881	1, 0
August 30, 1852	14, 000. 00	August 2, 1882	1, 0
June 23, 1866	31, 015. 27	August 5, 1886	2, 0
June 10, 1872	10, 000. 00	August 11, 1888	5, 0
March 3, 1873	15, 000. 00	September 19, 1890	5, 0
June 23, 1874	10, 000. 00		
March 3, 1875	10, 000. 00	Total	225, 5

The commercial statistics are not sufficiently reliable to make nite comparisons from year to year.

Apparently the tonnage for last fiscal year was about 25 per less than in the year previous. The principal imports were teleg poles and the exports a small amount of fish and grapes. These fre are not of a kind to promise a great increase in the future.

The harbor of Monroe is in the collection district of Detroit, Mich. Th a light-house on the outer end of the west pier.

No new lines of transportation have been established in the last fiscal year.

Money statement.

Amount appropriated by act approved July 13, 1892	$10,
Amount (estimated) required for completion of existing project	16,
Amount that can be profitably expended in fiscal year ending June 30, 1894	16,
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

llowing statistics for the year 1891, relative to the commerce of Monroe Michigan, were compiled from information furnished by the collector of and others:

telegraph poles	tons..	18,000
fish and grapes	do...	22
ntering		83
eparting		84
ge not known.		
nage for 1891 (estimated)		20,000
given in last annual report		27,000

aft of the largest vessel using harbor is 12 feet.
pth of water in the harbor prevents the largest vessels from loading to full

r lines of transportation have been established during the year.

M M 2.

IMPROVEMENT OF TOLEDO HARBOR, OHIO.

ity and harbor of Toledo, Ohio, are near the mouth of the Mau-ver. The harbor occupies some distance on the river, and the part is about 5 miles from the mouth, where it empties into e Bay. From the mouth of the river to 17 feet depth of water ake is a little more than 7 miles.
tory of the earlier operations carried on in past years for the ement of this harbor will be found in the Annual Reports of 381, and 1883.
roject for the "old channel" has been amended from time to ice 1866. The latest plan provides for a channel 200 feet wide bottom and 16 feet deep through Maumee Bay to Lake Erie.
isiderable part of the cost is due to the deposits of silt from the id the filling caused by seas in the bay.
ld channel is now about 100 feet wide on the bottom and 260 the bends, with a least depth of 15.6 at the mean level of the lake. een obtained by dredging in a long course of years, with a total iture to June 30, 1892, amounting to $724,332.61.
rt of the old channel is now included in the straight channel Maumee Bay to deep water of Lake Erie.
ct of July 5, 1884, appropriated $25,000 to commence the work ing a straight channel for the Maumee River from its mouth to rie, and the act of August 5, 1886, provided for continuing the ement "by a straight channel along such line as may be ap-by the Secretary of War."
ject for the work was approved by the Secretary of War April 7.
roject consisted in dredging a straight channel through Maumee 0 feet wide at the bottom and 17 feet deep, referred to the mean the lake. The line was so located as to utilize the old channel as possible. The estimated cost of the work was $1,875,000. ount expended upon this project to June 30, 1891, was $286,470.55. xpense to June 30, 1892, including liabilities, $471,707.

incur any further expense upon the old channel projec

STRAIGHT CHANNEL IMPROVEMENT.

Dredging was continued from July 1, 1891, to Ju from December 1 to April 30, inclusive, when it was s winter.

The amount dredged during the fiscal year is as fol

Under contract with James Rooney	....
Under contract with L. P. and J. A. Smith	....
Total	....
Amount done by James Rooney under his contract is	....
Amount dredged by L. P. and J. A. Smith	....
Total under the contract with L. P. and J. A. Smith	....

As a result of this dredging the channel is now op with a depth exceeding 16 feet throughout, and a wid the botton, save in one section of 2,400 feet in the L where it is but 175 feet wide, and 1,300 feet of Turn where the width is but 170 feet.

It should be observed that the surface level of the la ble, and there seems to have been more than one plane ings in different years have been referred.

For further details of work during the fiscal yea report of Lieut. William V. Judson, Corps of Engine pended as part of this report.

It will be noticed that the channel is not 17 feet planned. This is primarily due to the fact that the d has been limited to a depth of 17 feet, and it is pract to obtain a perfectly uniform depth by dredging. As for less depth, there has been a constant deposition of dredged channel.

ıowing the fill since dredging. Copies of these sections and ɑap of Maumee River and Bay are forwarded to accompany rt, and I invite attention to Lieut. Judson's discussion of the

l in the channel from sliding in of the banks of the cut seems ıll, but it will be observed that the fill from all causes in two s a little more than eight-tenths of a foot.

ident that the dredged channel through Maumee Bay can not ained by natural or ordinary conditions.

ernative is then presented of permitting the channel to fill or ng considerable expense for its preservation. It is obvious method which offers most of certainty in maintaining the chan- dredging as necessities may require, and it is my opinion that ging can be done most promptly when needed and most satis- and economically at all times with a dredge and scows owned nited States and operated by hired labor. I believe that one dge, with the necessary scows, would be capable of removing aterial which may be required for maintenance of the channel, services of a tug, which can probably be hired to best advan- t may be needed.

oject for this channel left the question of its protection and nce open for determination after observation and experience. e revetment to retain the sides of the cut, whether by a low t, by piling, or by other means, would be of little or no value, uld neither prevent the sedimentary deposit nor the move- nud and sand under the action of the seas.

er any system of piers or dikes, submerged or otherwise, will ent to prevent the filling of the channel is doubtful, unless o constructed as to confine the river at its high stages suf- to maintain a strong current entirely across Maumee Bay to

system would be attended with many disadvantages in addi- ıe great cost. It would bring great inconvenience to many ssels and boats of light draft which navigate the bay, and hich is now deposited over all of Maumee Bay would be de- ear the end of the dikes, and sooner or later make further ex- ecessary.

of the channel in the lake subdivision was cut through a sand re the conditions would indicate the probabillty of a more than at other places under the action of the seas. It may be refore, to protect the channel over this bar by dikes, entirely d at first, as an experiment. The tops should be so arranged vide against injury from ice.

kes should be placed at considerable distance from the dredged In determining that distance, the régime of the river should ered. In other words, the distance between the dikes should me as would be used if the river were to be conducted between

g as the dikes are to be used only to protect the channel from ıe to the action of the waves, probably the cheapest and best onstruction may be a compact dump of stone upon mattresses These would break up the seas which wash across the chan- would permit any material washed over them to settle on the fore the channel is reached.

s the deposit in the channel, there now remains to be dredged of Turn-out Division on the south side of the light-house cribs in addition to amount required to complete the width at place bef mentioned.

No revision of former estimate has been made.

The estimate for completion of project is the same as was submit in last annual report.

The following is a list of the appropriations made for the old chan from 1866 to present time:

June 23, 1866	$20,000.00	March 3, 1879	$20,0
March 2, 1867	20,000.00	June 14, 1880	30,0
April 10, 1869	29,700.00	March 3, 1881	40,0
July 11, 1870	50,000.00	August 2, 1882	50,0
March 3, 1871	50,000.00	July 5, 1884	20,0
June 10, 1872	15,000.00	August 5, 1886 (see note	9,6
March 3, 1873	100,000.00	August 11, 1888	5,0
June 23, 1874	75,000.00	September 19, 1890	5,0
March 3, 1875	75,000.00		
August 14, 1876	60,000.00	Total	724,3
June 18, 1878	50,000.00		

Appropriations have been made for straight channel as follows,

July 5, 1884	$25,0
Deduct amount appropriated for old channel (see note)	9,6
	15,3
August 5, 1886	112,5
August 11, 1888	150,0
September 19, 1890	200,0
Total	477,8

NOTE.—By act of August 5, 1886, the balance then available of the $25,000 a priated July 5, 1884, for straight channel, was made available for clearing t channel.

Toledo is in the collection district of Miami. There is a fixed white light fourth order on Turtle Island, and three sets of range lights for parts of the ch

The tonnage of Toledo Harbor, as furnished for 1891, shows a considerable in over previous years.

Money statements.

OLD CHANNEL.

July 1, 1891, balance unexpended	$4,
June 30, 1892, amount expended during fiscal year	4,
July 1, 1892, balance unexpended	
July 1, 1892, outstanding liabilities	

STRAIGHT CHANNEL.

July 1, 1891, balance unexpended	191,
June 30, 1892, amount expended during fiscal year	176,
July 1, 1892, balance unexpended	15,
July 1, 1892, outstanding liabilities	9,
July 1, 1892, balance available	5,
Amount appropriated by act approved July 13, 1892	200,
Amount available for fiscal year ending June 30, 1893	205,
Amount (estimated) required for completion of existing project	1,200,
Amount that can be profitably expended in fiscal year ending June 30, 1894	400,

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

REPORT OF LIEUTENANT W. V. JUDSON, CORPS OF ENGINEERS.

TOLEDO, OHIO, *June 30, 1892.*

have the honor to submit the following report upon operations at this har- ıg the fiscal year ending June 30, 1892:

:e clearer what is to follow, I would first explain that the straight channel Maumee Bay diverges from the old channel at a point near the mouth of the River. From this point to the 17-foot contour of Lake Erie it is 40,270 ıe line of the channel. Between the river mouth and the "Black Can" nner section, 12,670 feet in length. Between the "Black Can" and a point southwest of the main crib light lies the middle section, 10,600 feet in From the last-named point to a point 2,400 feet beyond (*i. e.*, northeast of) crib light lies the turn-out subdivision, 3,400 feet in length. Beyond the subdivision, and extending 5,600 feet toward the lake, lies the crib subdivi- from the outer end of the crib subdivision to the 17-foot contour of the lake the lake subdivision, 8,000 feet in length.

ove-mentioned divisions of the straight channel are mentioned in reports racts for the past three years. At the beginning of the fiscal year dredg- being done under two contracts, one with James Rooney, and one with L. L. Smith.

contract.—Two dredges worked steadily upon this contract from July 1 tober 9, 1891, when the work of the contractor was completed. During 165,138 cubic yards (scow measurement) were removed from the crib sub- completing the excavation within the limits to a least depth of 16.4 feet; ıge depth being 16.9 feet.

contract.—Four dredges worked steadily upon this contract from July 1 to r 30, 1891, and these dredges resumed operations May 1, 1892, and worked usly thereafter until the completion of the contract, June 7, 1892.

angle between the old channel and the new, and at the inner end of the ıs situated a clay bank, which formerly deflected the water descending the River into the old channel. This clay bank constituted the river division, ı it was removed 111,967 cubic yards, whereby the approach to the straight has been widened, promoting ease of navigation, and tending to intro- river current into the straight channel for purposes of scour. The least this division at completion of dredging was 16.2 feet, with an average 16.8 feet.

the turn-out subdivision there was removed 106,640 cubic yards. About t of this subdivision is parallel to a pile-protection work that embraces the l east crib lights in Maumee Bay, and occupies a space 80 feet wide in the the straight channel. The north side of this pile work was chosen for ;, and at this locality the channel has a width of 170 feet, measured from work.

ırn-out has slanting approaches to the straight channel at either end each 0 feet long. The remainder of the turn-out subdivision is uniform in width rest of the straight channel, and was excavated to a least depth of 16.4 feet; ıge depth being about 16.8 feet.

:he lake subdivision there was removed 232,327 cubic yards. This yielded a ıth of about 16.4 feet with an average of 16.8 feet, but the full width of 200 not obtained throughout; 2,400 linear feet of this subdivision is but 175 ɔ.

:he old channel there was removed 20,356 cubic yards. Several shoal spots pened and the channel was made wider at the elbows. The result was a of 15.6 feet minimum depth throughout, the width varying from 100 feet in reaches to 260 feet at the turning points.

otection work.—The main and east crib lights of the Maumee Bay range are in the axis of the channel. To prevent vessels from colliding with these, a ection work was in progress at the beginning of the fiscal year. Repeated ıs of time were granted the contractor, who was not prepared to prosecute rapidly in the face of the serious difficulties that were consequent upon the location of the work. The work was finally satisfactorily completed Decem- 91. The crib lights are about 1,080 feet apart. Two rows of piles, each 40 ı the axis of the channel and parallel thereto, inclose the interval between e lights, and prevent vessels from getting between them. At either end the k is extended to an apex reaching 170 feet beyond the cribs. In bulkheads, treme apices stone and brush have been deposited to the water line. About ıt of stone and brush have also been deposited about each crib to maintain lations. Large oak piles were used throughout. In the parallel rows these 6 feet from center to center, bearing three heavy waling pieces and bound ach with iron tie-rods and wooden pieces supported upon intermediate piles. ıpices the piles are but 3 feet from center to center, and an additional waling strip is used. Cross pieces strongly bind the converging sides of the apic together.

An inspector employed upon this work by the United States was paid $85 per mont

Material dredged.—No rock and no bowlder were encountered. In the river div sion was found a stiff clay. In the turn-out subdivision was found clay and san The crib sub-division yielded principally sand, as did also the lake subdivision. the outer end of the lake subdivision the sand was singularly hard and difficult to d

Table showing areas and quantities dredged, etc.

Contractor.	Locality.	Length of channel dredged.	Area dredged.	Approximate face.	Depth immediately after dredging.	Remo (scow m urem
			Square feet.	*Feet.*		*Cubic y*
James Rooney	Crib subdivision	4,000	800,000	6	16.9	16
L. P. & J. A. Smith	River division	3,300	373,000	2 to 10	16.8	11
Do	Lake subdivision	8,000	152,800	1 to 5	16.8	2
Do	Turn-out subdivision	3,400	419,500	5 to 6	16.8	10
Do	Old channel	5,000	300,000	2	17.	3
Total		23,700	3,420,500			6

The result of the dredging.—The straight channel has now been cut throug the lake. In several places, as above mentioned, the channel has not its full wi nor does the full depth of 17 feet obtain throughout, because 17 feet was the n mum depth to which, according to their specifications, contractors have bee lowed to dredge, and because the work has been several years in progress an usual fill has been going on over the dredged portions. At the present tim channel is practicable for vessels drawing 15.6 feet with the water at the mean of 1860–1875. This is at least as good water as obtains in the old channel. The L House Establishment has not yet buoyed the straight channel, but when they and the proper lights are established, the channel may be regularly opened to igation.

Recent condition of channel.—During May and June, 1892, an examination has made to determine with all possible accuracy the fill that has taken place ove different parts of the channel bottom since the soundings were taken that i diately followed the dredging. Over the inner and middle sections this would the fill for two years, and over the turn-out subdivision, crib subdivision, and subdivision the fill would be shown for one year. About 10,000 soundings taken and plotted on five charts, each chart representing one of the above sec or subdivisions. The same charts show also the depths immediately after dred and therefore contain the data for obtaining the fill. An inspection of these c shows that—

(1) The fill is not far from uniform over the whole length of the channel.

(2) The banks have held very well. The greater part of the fill is not from ca banks.

(3) The fill is very soft and of a sedimentary character. A large part of Ma Bay is covered to a depth of a foot or more with this soft mud or slush, which lies the hard sand or clay, and which appears to have been brought by the Ma River. This slush is easily washed about, and the fill in the channel appears principally derived from this source, and directly by deposit from the river wa

(4) The fill over the whole channel averages a little over eight-tenths of a fo depth. I transmit herewith a tracing, which is intended to show the extent o fill and the present condition of the channel in characteristic sections. Each section drawn is the mean of from 9 to 12 actual cross sections.

Cross section A is typical of the manner of fill and present condition of the nel in the outer slope of the bar.

Cross section B is typical of the same through the bar.

Cross sections C, D, and E, represent the conditions respectively on the inner of the bar, in the middle section, and in the inner section near the river mouth. middle and inner sections are the only parts of the channel that have yet beer extensively by vessels. In cross sections D and E the path of vessels is seen ne center. The fill is so soft that it is readily pushed aside by the screws of steam

Straight channel work in the future.—From the amount of fill mentioned ab will be seen that as at present constituted the straight channel can not mai itself. Either extensive bank protection must be built or dredging to the ext 200,000 cubic yards or more must be done annually. Considering the magnit and the continuing charges for repairs and interest, it seems probable that d by dredging would be most economical to the United States. To accom- annual dredging I would recommend the purchase of a plant by the Gov- . The work demands the continuous employment of one good dredge, the f running which would be about $30,000 per season. More would be ac- d than contractors would do for the same money, and Government work done more cheaply at neighboring harbors if the contractors hereabouts, l well together, should see that the Government is not altogether depend- them.

River.—A considerable shoal exists at present about 1 mile below the ınia Railroad Bridge. A preliminary examination of the river between the s and Maumee Bay shows that about 40,000 cubic yards should be removed a 17-foot channel throughout. The current prevents any rapid accumula- t here, and this dredging will probably maintain the channel for several

ı.—For purposes of inspection, survey, etc., the steamer *Swansea* was em- the Government for a period of 222 days during the fiscal year. The aver- expense of this steamer to the Government was about $19. The crew of *ea* assisted in laying out the work, taking soundings, and making surveys. he year, in addition to her regular work, the *Swansea* removed eighteen n the river. An inspector was employed upon each dredge, whose duty it cord and supervise its work. These inspectors received from $80 to $100 h, according to their efficiency and length of service. During the past hile the extended examination of the harbor has been in progress, in addi- ıe above employés there has been a principal inspector on the work, at a $120 per month.

y respectfully, your obedient servant,

W. V. JUDSON,
Second Lieut., Corps of Engineers.

ıl. J. A. SMITH,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

ıowing statistics for the year 1891, relative to the commerce of Toledo Har- were compiled from information furnished by the collector of customs and

Articles.	Tons.	Articles.	Tons.
Imports.		*Exports.*	
	200,893	Flour and grain	578,079
	89,310	Coal	518,182
cement	17,268	Timber	15,350
	11,943		
	643		
	314,657		1,111,617

Shipping.	No.	Tonnage.
ering	2,189	968,810
arting	2,185	985,310
lt	4	922.56

ge for 1891	1,954,120
ge given in last Annual Report	1,542,617
ıse	411,503

ft of the largest vessel using the harbor is 21 feet.
ıth of water in the harbor prevents the largest vessels from loading to full

lines of transportation have been established during the year.

M M 3.

IMPROVEMENT OF PORT CLINTON HARBOR, OHIO.

Port Clinton, Ohio, is situated at the mouth of the Portage River, a stream which rises in the northwestern part of Ohio and empties into Lake Erie.

A history of the earlier operations heretofore carried on for its improvement will be found in Annual Reports of 1880 and 1881.

The present project, adopted in 1875, consists of a pile revetment 95[illegible] feet long, running from the north shore of Portage River opposite the town out into the lake, in a direction north 57 degrees east. This revetment then inclines toward the north and extends 301 feet farther, when a pile dike commences, which will be prolonged a total distance of 1,200 feet out to a depth of 10 feet at the ordinary level of the lake.

Parallel to this and 200 feet from it is an east pile pier, which will be about 2,600 feet long, its inner end resting on the south shore of the river. This east pier will be a simple pile structure of 2,450 feet; the outer 150 feet will be a strong pile dike 12 feet wide. A channel 10 feet deep will be dredged between the piers.

At the date of the last Annual Report, an agreement had been made with Messrs. Carkin, Stickney & Cram, of East Saginaw, Mich., to dredge through the bar and between the piers to obtain a channel depth of 10 feet.

Work under the agreement was commenced July 28 and completed in August. The amount of material dredged and removed from the channel was 11,705 cubic yards, measured in scows. The price paid was 25 cents per cubic yard.

The deepening of the channel causes no permanent improvement. Nearly the same conditions return annually, and with the present conditions annual expenditure for dredging will be required if the channel is to be maintained.

The project of 1875 was estimated to cost $90,000. The sum of $56,000 has been appropriated and expended since the adoption of the project, but a part has been for repairs and for dredging, which did not advance the constructions proposed.

The amount estimated in last Annual Report for completion of project was $37,000.

As the officer now in charge of the work has had no opportunity for a revision of the estimate, it is here repeated.

The following is a statement of the amount and date of all appropriations for this improvement:

June 10, 1872	$8,000	March 3, 1881	$5,000
June 10, 1872 (allotment)	2,000	August 2, 1882	6,000
March 3, 1875	5,000	August 5, 1886	2,000
August 14, 1876	5,000	August 11, 1888	5,000
June 18, 1878	10,000	September 19, 1890	3,000
March 3, 1879	10,000		
June 14, 1880	5,000	Total	66,000

Port Clinton is a port of entry in the collection district of Sandusky, Ohio. The nearest work of defense is Fort Wayne, Mich., 30 miles distant, and the nearest light-house is at Green Island, 10 miles distant.

The commercial statistics for the year 1891 indicate a slight decline in numbers from the previous year. The tonnage of vessels entering has not been ascertained.

Money statement.

July 1, 1891, balance unexpended	$3,000.00
June 30, 1892, amount expended during fiscal year	3,000.00
Amount appropriated by act approved July 13, 1892	10,000.00

t (estimated) required for completion of existing project $27,000.00
t that can be profitably expended in fiscal year ending June 30, 1894 27,000.00
tted in compliance with requirements of sections 2 of river and
or acts of 1866 and 1867.

COMMERCIAL STATISTICS.

lowing statistics for the year 1891, relative to the commerce of Port Clinton
Ohio, were compiled from information furnished by the collector of customs
rs:

Shipping.	No.	Tonnage.
tering	34	(*)
parting	32	Do.
ilt	1	13

* Not known.

	Tons.
—Fish and miscellaneous merchandise	3,753
ts—Lumber, flour, and miscellaneous merchandise	4,022

gregate tonnage of vessels given in last annual report was 5,149.
rgest vessels entering the harbor draw from 9 to 12 feet.

M M 4.

IMPROVEMENT OF SANDUSKY CITY HARBOR, OHIO.

usky Bay empties into Lake Erie about 40 miles from its western ty. It is a natural harbor, containing an area of about 22½ depth of from 8 to 12 feet, protected on the north and northwest ie gales of the lake by a long narrow peninsula, and on the st by what is known as Cedar Point.

project adopted in 1880 provides for a channel 200 feet wide and deep through the outer bar and in the bay, up to within 50 feet ine of docks, and then parallel to the docks, with a width of 100 l depth of 15 feet.

evised project, adopted in 1888, proposes to improve the present by a straight channel cut from the north end of Cedar Point to end of the existing channel in front of city.

history of this project for making a straight channel and de-stimate of cost, see Annual Report of the Chief of Engineers for iges 2303 and 2304, and pages 2335 to 2341.

l description of the operations carried on in earlier years for the ement of this harbor will be found in Annual Reports of 1880 1.

e close of the last fiscal year work was in progress under a con-ith Messrs. L. P. & J. A. Smith, of Cleveland, Ohio, for dredg- straight channel. Work under the contract was completed 17, 1891.

The amount of material removed after June 30 was 148,638 cub yards, and the total amount under the contract was 212,962 cubic yard measured in scows.

Other works of improvement in this harbor have been carried simultaneously with Straight Channel, having office and other conti gent expenses without a definite allotment or set of accounts for ea work, so that the officer recently assigned to charge of the work fin it difficult to determine the exact amount which should be charged cost of the Straight Channel alone. As nearly as can be determin the amount expended on Straight Channel in last fiscal year $27,786.22; the amount reported as expended on same to June 1892, $41,199.07; total, $69,185.29.

The cost of Straight Channel originally estimated was for dredg 628.000 cubic yards, scow measurement, at 14 cents per cubic y $87,920; contingent expenses, $8,792; total, $96,712.

The prices by contract have been 17 and 22 cents per cubic yard stead of 14 cents, as estimated.

At the close of last fiscal year, Messrs. Carkin, Stickney & C of East Saginaw, Mich., were dredging in the old channel. Work u this agreement was completed July 23. The amount dredged in J 1891, was 5,872 cubic yards, making a total of 9,500 cubic yards u the agreement. The cost was 25 cents per cubic yard.

The dredging was reported as giving a channel depth of 16½ throughout the dock channel and 15 feet in old channel.

The bar outside of Cedar Point is the worst obstruction encount in entering the harbor.

The water over the bar is only 12 to 14 feet deep and the chann quite narrow, the least being but about 50 feet.

The following is a statement of the amount and date of all appro tions for this improvement.

May 20, 1826 (survey)	$400	June 18, 1878	$2
June 11, 1844	15,000	March 3, 1879	
August 30, 1852	15,000	June 14, 1880	1
June 28, 1864 (allotment)	10,000	March 3, 1881	1
June 23, 1866	38,580	August 2, 1882	1
July 11, 1870	10,000	July 5, 1884	2
June 10, 1872	13,000	August 5, 1886	
March 3, 1873	25,000	August 11, 1888	4
June 23, 1874	25,000	September 19, 1890	4
March 3, 1875	25,000		
August 14, 1876	25,000	Total	36

Total expenditures to June 30, 1892, $365, 391.46.

Sandusky City Harbor is in the collection district of Sandusky, Ohio. Ther light-house on Cedar Point with a fixed white light of the fifth order, and three l lights within the bay. Fort Wayne, below Detroit, is the nearest work of defen

Money statement.

July 1, 1891, balance unexpended	$40,3
June 30, 1892, amount expended during fiscal year	38,2
July 1, 1892, balance unexpended	2,0
Amount appropriated by act approved July 13, 1892	41,7
Amount available for fiscal year ending June 30, 1893	43,8

COMMERCIAL STATISTICS.

ollowing statistics for the year 1891, relative to the commerce of the harbor lusky City, Ohio, were compiled from information furnished by the collector oms and others.

s—	Tons.
mber	150,000
	120,300
'otal	270,300
nts, coal	164,789

Shipping.	No.	Tonnage.
ntering	3,664	758,691
leparting	3,699	764,819
tal	....	1,523,510

ggregate tonnage given in last annual report was 1,051,108; increase, 472,402.
; of the largest vessel entering harbor, 15¼ feet.
h of water prevents largest vessels from loading to full depth.
w lines of transportation have been established during the year.

M M 5.

IMPROVEMENT OF SANDUSKY RIVER, OHIO.

Sandusky River rises in Richland County, Ohio, and after a very tous course empties into Sandusky Bay about 14½ miles from Cedar where the bay empties into Lake Erie.

mont, the head of navigation, is 17 miles from the mouth of the It is a city of about 9,000 inhabitants, and the market place of e and productive surrounding country.

history of the work carried on in earlier years for the improve- of this river will be found in annual report for 1881.

present project, adopted in 1880, provides for dredging a channel et wide and 9 feet deep through the various bars between the city mont and the depth of 9 feet in Sandusky Bay.

the beginning of the fiscal year a contract had been made with s. Carkin, Stickney & Cram, of East Saginaw, Mich., for dredging extent of available funds under the appropriation of September 90.

rk under the contract was commenced September 1 and completed mber 15, 1891.

amount of material dredged and removed was 5,808 cubic yards, red in scows. The price paid was 25 cents per cubic yard.

channel was reported to be in fairly good condition, with a least of 7 feet in September, 1891.

estimated cost of the project for 9 feet depth was $44,000, but the ate was doubtless intended to cover the first cost only of obtain- channel if the work were done in one or two seasons. In a river is there is a large amount of silt and other drift, which will fill redged cuts unless the conditions of the channel be changed by ction works.

In the ten years since the commencement of work on the project for 9 feet depth the drift has probably obliterated nearly all the dredging which has been done, and the expense would therefore not be materially reduced by the work already done.

It is the opinion of the officer now in charge of this improvement that dredging will afford no really permanent improvement. It would follow that unless the commerce be such that the benefits of a deeper channel are sufficient to justify a constant expense for dredging, or a very considerable outlay for contraction works, the improvement of the river will not pay as a business proposition.

The estimate here submitted for amount required to complete the present project is nearly the original estimate reduced by amount already appropriated, there being no present means of making the amount more definite, and no apparent necessity for so doing.

The following is a statement of the amount and date of all appropriations for this improvement.

March 2, 1867	[illegible]	August 2, 1882	$4,0
June 10, 1872		September 19, 1890	1,5
June 14, 1880			
March 3, 1881		Total	53,0

Fremont, the head of navigation [illegible] collection district of Sandusky, Ohio. The nearest light-house is at Cedar [illegible] entrance to Sandusky Bay. Fort Wayne, near Detroit, Mich., [illegible] the nearest work of defense.

No definite statistics have been received for Sandusky River. Vessels for the river are included in [illegible]istics for Sandusky Harbor.

Money statement.

July 1, 1891, balance unexpended	$1,500
June 30, 1892, amount expended during fiscal year	1,500
Amount appropriated by act approved July 13, 1892	5,000
Amount (estimated) required for completion of existing project	16,000
Amount that can be profitably expended in fiscal year ending June 30, 1894	16,000
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

M M 6.

IMPROVEMENT OF HURON HARBOR, OHIO.

The Huron River rises in the northern part of Ohio, and after a very circuitous course empties into Lake Erie about 10 miles east of Sandusky city.

The project for the improvement of this harbor, adopted in 1[illegible] when the mouth of the river was closed by a sand bar, and which p[roj]ect has been amended from time to time, as the demands of the c[om]merce called for an increased depth of channel, consists of para[llel] piers, 140 feet apart, extending to the depth of 16 feet in the lake.

For a history of the earlier operations carried on in past years [on] the improvement of this harbor, see Annual Reports of 1880 and 1[illegible]

The project approved in 1890 consists in extending piers to the [con]tour of 16 feet depth in the lake and dredging channel to same de[pth].

This project was in compliance with the requirements of the a[ct] ɔer 19, 1890, appropriating $16,000 for "improving harbor at Ohio; continuing improvement in amended project to give 16 feet ; low water."

ɜ end of the last fiscal year work was in progress under a con- th Mr. John Stang, of Lorain, Ohio, for extending west pier a of 120 feet. This work was completed September 23, 1892. In to the construction, minor repairs have been made to super- e of old piers.

roject of 1890 is about one-half completed. The old piers are, , in a very bad condition from decay and injury by storms, and their superstructure should be renewed.

ɔ end of June, 1891, the channel between piers was reported at ge depth exceeding 16 feet, but on the bar about 150 feet out- ends of piers the depth ranged from 14.5 to 15 feet.

ɔllowing is a statement of the amount and date of all appro- ɜ for this improvement:

26	$5,000.00	June 23, 1874	$1,500.00
28	4,413.35	March 3, 1875	1,000.00
1829	5,935.00	June 18, 1878	1,000.00
830	1,880.36	June 14, 1880	3,000.00
831	3,480.00	March 3, 1881	3,000.00
32	1,500.00	August 2, 1882	2,500.00
334	6,700.00	July 5, 1884	7,500.00
36	4,300.00	August 5, 1886	3,000.00
837	2,565.00	August 11, 1888	6,000.00
38	5,000.00	September 19, 1890	16,000.00
344	5,000.00		
, 1852	10,000.00	Total	139,273.71
366	39,000.00		

amount expended upon Huron Harbor to June 30, 1891, was	$128,469.43
ires in last fiscal year	10,804.28
amount to complete project of 1890	13,600.00
cost of repairing old piers	12,000.00

uld be remarked that in harbors like this the woodwork of constantly decaying and receiving more or less injury from ıses.

ır at end of piers forms to a greater or less extent during each nd spring, and as a result a part of each appropriation is neces- pended for maintenance of piers and channel and the remainder s carrying out the project of improvement.

umber of vessels which entered and cleared during the last ɜ considerably less than in the preceding year, but the aggre- nage in freights was considerably more than the registered ton- the previous year. This indicates that a larger class of vessels used at this port.

Harbor is in the collection district of Sandusky, Ohio. Fort Wayne, Mich., ıiles distant, is the nearest work of defense. There is a fixed white light th order on the outer end of the west pier.

lines of transportation have been established during the year.

Money statement.

91, balance unexpended	$10,804.28
392, amount expended during fiscal year	10,804.28
ppropriated by act approved July 13, 1892	15,000.00
that can be profitably expended in fiscal year ending June 30, 1894	10,600.00

ed in compliance with requirements of sections 2 of river and r acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The following statistics for the year 1891, relative to the commerce of Huron Harbor, Ohio, were compiled from information furnished by the collector of customs and others:

Vessels entering		137
Vessels departing		157
Freight receipts	tons..	17,000
Freight shipments	do...	134,000
Total	do...	151,000

The aggregate tonnage of vessels was stated in last Annual Report as 73,464.

MM 7.

IMPROVEMENT OF VERM[illegible]ON HARBOR, OHIO.

The Vermillion River rises in the no[illegible]thern part of Ohio and empties into Lake Erie about 20 miles to th[illegible]tward of Sandusky City.

The project of improvement, wh[illegible]s adopted in 1836, when there was a depth of less than 2 feet of [illegible]over bar at entrance, and which project has been amended from ti[illegible]o time as the requirements of commerce demanded deeper water, [illegible]ists of parallel piers, 125 feet apart, running out to a depth of 12 [illegible] in the lake.

A history of the earlier operation[illegible]rried on in the past years for the improvement of this harbor will be found in Annual Reports of 1880 and 1881.

The act of September 19, 1890, appropriated $2,000 for preservation of piers. The amount of repairs being small, the most economical and advantageous method of doing the work was by hired labor. Other and more extensive works being in progress, it was not convenient to make the repairs in last fiscal year, as was contemplated.

The repairs will be completed as far as available funds may permit during the season of 1892.

The commerce of this harbor is not sufficiently extensive or general at present to justify any large expenditure further than may be required for preservation of piers heretofore constructed, save possibly a small amount of dredging to remove small obstructions.

It is therefore proposed to apply such funds as may be appropriated to the purpose indicated.

The following is a statement of the amount and date of all appropriations for this improvement:

July 2, 1836	$10,000.00	June 18, 1878	$4,000.00
March 3, 1837	20,000.00	June 14, 1880	2,000.00
July 7, 1838	23,626.57	March 3, 1881	2,000.00
June 28, 1864 (allotment)	5,758.97	August 2, 1882	3,000.00
June 23, 1866	15,315.74	August 5, 1886	3,000.00
June 10, 1872	5,000.00	August 11, 1888	1,000.00
March 3, 1873	12,000.00	September 19, 1890	2,000.00
June 23, 1874	3,000.00		
March 3, 1875	10,000.00	Total	126,701.28
August 14, 1876	5,000.00		

Vermillion Harbor is in the collection district of Sandusky, Ohio. There is a light of the fifth order on the west pier. Fort Wayne, Mich., 80 miles distant, is nearest work of defense.

Money statement.

y 1, 1891, balance unexpended	$2,000.00
y 1, 1892, balance unexpended	2,000.00
ount appropriated by act approved July 13, 1892	2,000.00
ount available for fiscal year ending June 30, 1893	4,000.00
mount (estimated) required for completion of existing project	6,000.00
mount that can be profitably expended in fiscal year ending June 30, 1894	6,000.00

ubmitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

he following statistics for the year 1891, relative to the commerce of Vermillion rbor, Ohio, were compiled from information furnished by the collector of customs d others:

sels entering	34
sels departing	33
	Tons.
ceipts: Lumber, pound poles, and fishing tackle	2,000
ipments: Timber, fish, and fishing tackle	1,000

The draft of the largest vessel entering the harbor is 15¼ feet, As the depth of ater in the harbor is only 10 to 12 feet, the largest vessels can not load to full depth.
The chief industry of the port is fishing.
No record is kept of the amount brought in.

M M 8.

IMPROVEMENT OF BLACK RIVER HARBOR, OHIO.

Black River, Ohio, is formed by two branches nearly equal in size, hich, rising in Lorain County, Ohio, and following northward, unite out 8 miles from the town of Lorain, where the river empties into ake Erie.

A history of the operations carried on during the past years, whereby e depth at the entrance to this harbor has been increased from about feet to at least 16 feet, will be found in Annual Reports of 1880 and 81.

The project of improvement submitted in 1828, and amended from ne to time as the demands of commerce called for an increased depth channel, provides for parallel piers 200 feet apart, running out from e shore on each side of the mouth of the river to a depth of 16 feet the lake.

At the beginning of the fiscal year work was in progress under a ntract with Mr. John Stang, of Lorain, Ohio, for extending the east er a distance of 102 feet.

The date of expiration of the contract was originally August 1, 1891. wing to failure to receive materials for the construction, the conractor was granted an extension to August 30, and subsequently a cond, extending the time for completion of contract to September 30, 891. Work under the contract was completed September 12, 1891.

In addition to work of pier extension some minor repairs were made the superstructure of old piers. The superstructure of old piers is bad condition from decay and injury by storms and ice.

In the last annual report the officer then in charge of the improveent recommended that provision be made for 17 feet depth of water t an estimated cost of $40,000 in addition to the project previously dopted. The estimate is here repeated with the remark that the officer ow in charge of the work has had no means of judging of the necesty for the work or the accuracy of the estimate.

At the close of the last fiscal year the channel was reported to be feet deep. No examinations of the channel have been made since th date.

The following is a statement of the amount and date of all appr priations for this improvement:

May 23, 1828	$7,500.00	March 3, 1873	$20,000
April 23, 1830	8,559.77	June 23, 1874	20,000
March 2, 1831	9,275.00	March 3, 1875	10,000
July 3, 1832	8,000.00	August 14, 1876	6,000
March 2, 1833	2,400.00	June 18, 1878	1,000
June 28, 1834	5,000.00	June 14, 1880	1,000
March 3, 1835	4,400.00	March 3, 1881	7,000
July 2, 1836	6,660.00	August 2, 1882	7,000
March 3, 1837	6,410.00	July 5, 1884	10,000
July 7, 1838	5,000.00	August 5, 1886	10,000
August 30, 1852	5,000.00	August 11, 1888	10,000
June 28, 1864 (allotment)	20,000.00	September 19, 1890	12,000
June 23, 1866	10,000.00		
June 10, 1872	20,000.00	Total	232,20

Black River is in the collection district of Cuyahoga, Ohio. There is a fixed w light of the fourth order at the outer end of the west pier. The nearest work o fense is Fort Wayne, Mich., 80 miles dista .

The number of vessels reported as ent ng and leaving the harbor in the 1891 is less than statistics for previous . The later figures were furnishe the collector of customs and are presum be approximately correct.

On the other hand the tonnage in frei reported is greater than in the pre ing year.

Money statement.

July 1, 1891, balance unexpended	$9,27
June 30, 1892, amount expended during fiscal year	9,27
Amount appropriated by act approved July 13, 1892	20,00
Amount that can be profitably expended in fiscal year ending June 30, 1894	38,00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The following statistics for the year 1891, relative to the commerce of Black R Harbor, Ohio, were compiled from information furnished by the collector of cust and others:

Articles.	Tons.	Articles.	To
Imports.		*Exports.*	
Ore	270,240	Coal	450,
Lumber	9,143	Lumber	
Railroad ties	3,774	Miscellaneous	
Telegraph poles	5,000		
Stone	46	Total	450
Total	288,203		

Shipping.	No.	Tonna
Vessels entering	288	Not kn
Vessels departing	305	Do.
Vessels built	1	

Total tonnage for 1891 (estimated), 800,000.

The draft of the largest vessel entering the harbor was 21 feet.

The depth of water in the harbor prevents the largest vessels from loading t depth.

No new lines of transportation established.

M M 9.

IMPROVEMENT OF CLEVELAND HARBOR, OHIO.

Cleveland, Ohio, is situated at the mouth of the Cuyahoga River. The river rises in the northern part of Ohio and after a very circuitous course empties into Lake Erie.

The original project of improvement, adopted in 1825, when there was a depth of only 3 feet in the narrow and crooked channel at the entrance, and which project has been amended from time to time as the demands of commerce called for an increased depth of water, provides for parallel piers 200 feet apart, running out to a depth of 16 feet in the lake. This project is completed.

In 1875, in accordance with an act of Congress, a plan was submitted for a harbor of refuge at this place.

The amended plan for this outer harbor consists of two breakwaters. The shore arm of the west breakwater starts from a point about 700 feet west of the extremity of the old bed of the Cuyahoga River and runs out into the lake in a direction nearly due north a distance of 3,130 feet.

The lake arm, which is about parallel with the main shore, is 4,030 feet long, and at a point 200 feet from its eastern extremity a spur 100 feet long runs out at right angles so as to break the force of the heavy seas rolling along the breakwater during westerly and northwesterly gales. All this portion was completed in December, 1883.

The proposed east breakwater, under the latest plan, begins at a point on the prolongation of the lake arm of the west breakwater and 500 feet from it, extends eastward on this line about 3,500 feet, then inclines toward the shore, and extends 2,000 feet in a depth of 26 feet of water, and having between its eastern end and the curve of 14 feet depth of water an entrance 2,300 feet wide.

For a history of this change in plan for harbor of refuge, see Annual Reports of 1884, 1885, 1886, and 1888.

At the beginning of the fiscal year work was in progress, extending the east breakwater, under a contract with Messrs. L. P. & J. A. Smith, of Cleveland, Ohio.

The contract was completed November 23, 1891. By this work the east breakwater was extended eastward a distance of 452⅓ linear feet, making the total length completed of breakwater 9,308⅓ feet. The amount remaining to complete the breakwater, as planned, is 3,350 linear feet.

Work under contract with Messrs. Carkin, Stickney & Cram was continued from July 1 to July 15, when it was completed to extent of available funds.

The amount of material removed in July was 4,786 cubic yards, making a total under the contract of 18,286 cubic yards, measured in scows.

In the spring of 1892, the breakwaters were found to be considerably injured by ice and winter storms.

Repairs, which could be undertaken, were necessarily limited by funds available for the purpose, which amounted to but $1,500. These repairs were commenced in June, but were delayed owing to the difficulty of procuring certain pieces of oak lumber which were necessary for the purpose.

The repairs will be completed early in July.

In April, 1892, soundings were taken to ascertain the condition of the channel from the railroad bridge to the opening in breakwater. The soundings show that the channel depths in the river have been fully maintained to a point about 400 feet inside the ends of piers, wh a shoaling is perceived. From the end of the piers outward a distar of 400 feet the channel has an average of about 2 feet less depth th in July, 1891, referred to the mean lake level.

The actual present depth is, however, nearly the same as last ye as the mean surface level of the lake in June, 1892, was 1.73 feet higl than in June, 1891. The least depth in the channel on the bar in Ap 1892, was 15.2 feet, referred to mean lake level.

At a point 50 feet below the bridge the channel is 165 feet wide; greatest depth exceeds 20 feet and the average is about 18 feet.

The piers are not parallel, but diverge so that they are 250 feet ap at the outer ends. The result of the divergence is plainly shown in shoaling of the river.

It is apparent that no very deep channel can be relied upon with a considerable annual expenditure for dredging.

The mud and drift brought down by the river during freshets is forming a bar across the entrance to the anchorage basin behind west breakwater. It is also reported that the anchorage basin itse gradually becoming filled from various causes, such as sewerage, ill dumping, drift, etc. How far the statements are correct can onl determined by careful examination, and it is therefore proposed to m a good hydrographic survey of the harbor in the summer of 1892. area of the outer harbor, which was planned as a harbor of refug now more than ample for all the present demands upon it, and t seems to be more need of greater depth in the west basin than c creasing the area for anchorage on the east side.

All the business of the harbor is done in the river. About one of the lake front on the west side of the river is fully protected seas by the breakwaters, and harbor lines were established some ago, but no part of it has thus far been utilized for business purp

The following is a statement of the amount and date of all a priations for this improvement:

March 3, 1825 (survey)	$5,000.00	March 3, 1875	$
March 2, 1827	10,000.00	August 14, 1876	
March 3, 1829	12,179.00	August 14, 1876 (repair of pier)	
April 23, 1830	1,786.56	June 18, 1878	1
March 2, 1831	3,670.00	March 3, 1879	1
July 3, 1832	6,600.00	June 14, 1880	1
June 28, 1834	13,315.00	March 3, 1881	2
July 2, 1836	15,006.59	August 2, 1882	1
March 3, 1837	10,000.00	July 5, 1884	1
July 7, 1838	51,856.00	August 5, 1886	
June 11, 1844	25,000.00	August 11, 1888	1
August 30, 1852	30,000.00	September 19, 1890	
March 3, 1853	145.69		
June 28, 1864 (allotment)	20,000.00	Total appropriated since adoption of present project	†1.
June 23, 1866	59,806.00		
July 25, 1868 (allotment)	17,000.00		
April 10, 1869 (allotment)	13,380.00		
July 11, 1870	20,000.00		
March 3, 1871 (allotment for repairs	*636.77		
March 3, 1873	1,000.00		
June 23, 1874	30,500.00		
Total previous to adoption of project for harbor of refuge	346,881.61		

Amount expended to June 30, 1892 .... $1,167

* Difference between $1,000 and the amount which reverted to the Treasur

† About $50,000 of this amount has been expended in maintenance of the ol and channel.

Cleveland harbor is in the collection district of Cuyahoga, Ohio. There is a fixed white light of the third order on the shore and a beacon on the outer end of each pier, and a beacon with flash light and fog-whistle on the independent crib, just inside the east end of the lake arm of the breakwater. The nearest work of defense is Fort Wayne, Mich., 110 miles distant.

Money statement.

July 1, 1891, balance unexpended	$56,350.15
June 30, 1892, amount expended during fiscal year	54,718.40
July 1, 1892, balance unexpended	1,631.75
July 1, 1892, outstanding liabilities	233.87
July 1, 1892, balance available	1,397.88
Amount appropriated by act approved July 13, 1892	100,000.00
Amount available for fiscal year ending June 30, 1893	101,397.88
Amount (estimated) required for completion of existing project	344,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	344,250.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The following statistics for the year 1891, relative to the commerce of Cleveland harbor, Ohio, were compiled from information furnished by the collector of customs and others:

Articles.	Tons.	Articles.	Tons.
Imports.		*Exports.*	
Ore	1,875,144	Coal and coke	1,398,895
Lumber	1,107,038	Iron and steel	99,428
Flour and grain	123,988	Oil and grease	29,658
Stone	118,701	Stone	18,731
Fish	84,721	Lumber	16,540
Iron	49,331	Flour and grain	2,763
Ice	18,250	Brick	3,424
Salt	8,595	Plaster, cement, and lime	954
Plaster and cement	2,844	Miscellaneous	46,478
Coal	2,967		
Miscellaneous	9,770	Total	1,616,871
Total	2,895,894		

Shipping.	No.	Tonnage.
Vessels entering	3,039	(*)
Vessels departing	3,151	(*)
Vessels built	17	12,792.08

* Not known.

Total tonnage for 1891 (estimated), 5,000,000, varying little from amount given in last annual report.

The draft of the largest vessel entering the harbor was 21 feet.

The depth of water in the harbor prevents the largest vessels from loading to full depth.

The following lines of transportation were established during the year:

Lakewood Transportation Company of Rockport, Ohio.

Cleveland and Lakeside Steam Navigation Company of Cleveland, Ohio.

Hawgood & Avery Transit Company of Mantua, Ohio.

M M 10.

IMPROVEMENT OF FAIRPORT HARBOR, OHIO.

Grand River rises in the northeastern part of Ohio, and after a very circuitous course empties into Lake Erie at a point about midway between the eastern and western extremities.

A full description of the earlier operations carried on for the improvement of this harbor during past years will be found in Annual Reports of 1880 and 1881.

The project of improvement adopted in 1825, when the mouth of the river was closed by a sand bar so hard and dry in summer that teams could drive across, and which project has been amended from time to time since that date, as the demands of commerce called for an increased depth in the channel, provides for parallel piers, 200 feet apart, running out from each side [illegible]e to a depth of 16 feet in the lake.

Revised project of 1890 pro[illegible]tension of piers to depth of 18 feet in the lake, and dredging [illegible]8 feet depth in channel.

At the close of the last fiscal [illegible]ontract was outstanding with the American Transportation C[illegible]f Painesville, Ohio, for dredging in the channel of the river a[illegible] bar at its mouth.

Work was continued un[illegible]ract until July 30, when the time expired by limitation, a[illegible]act was annulled in accordance with its terms.

The amount dredged in th[illegible]ly was 9,291 cubic yards. The total amount dredged unde[illegible]t was 51,292 cubic yards, and at the time of its annulment there remained about 13,500 cubic yards to complete it.

Proposals for dredging were invited by circular letter, and the proposals were opened September 5. The lowest bid was from J. R. Irwin, of Painesville, Ohio, and a contract was entered into with him, dated September 21, 1891, to do the dredging at 17½ cents per cubic yard.

Work under the contract was commenced October 5 and completed November 23, the total amount dredged under the contract being 42,062 cubic yards.

The reason for the large excess in amount done over that required to complete the former contract was that the forfeitures of amounts due under the first contract increased the amount of available funds which could be expended under the second.

By this dredging the channel was given a depth of 17 feet between the piers and through the bars in the lake near end of piers.

In the spring of 1892 the bars had again formed so that the channel depth did not exceed 14 feet. The necessity for immediate relief by dredging through the bars was urgently represented, and the amount of dredging required being too small to attract any competition in doing the work by contract, an agreement was made with the American Transportation Company, which owns the only dredging plant at Fairport Harbor, to furnish an outfit of dredge, scows, and tug, with their crews, and to do the work at the rate of $75 per day. The commencement of work as well as its completion was greatly delayed by the windy weather which was phenomenally bad. Dredging was commenced April 21 and completed on the 4th of June, the number of days in which the dredge could work on the bar during that time being but ten and a half.

The channel was opened through the bar to a depth of 17 feet. No examination has been made between the piers to ascertain the condi-of the channel at close of fiscal year, but no complaint has been ved.

e work of pier extension was continued from July 1 to August 31, it was completed. The entire amount done under the contract isted in extending the east pier a distance of 120 feet and the west 80 feet. General repairs were also made to old piers.

e commerce of this harbor is rapidly increasing, and it is probable additional facilities of increased depth in channel will be required e near future.

ppropriations have been made for Grand River and Fairport Harfrom 1825 to 1890, inclusive, as follows:

h 3, 1825	$1,000.00	June 18, 1878	$5,000.00
20, 1826	5,620.00	June 14, 1880	3,000.00
19, 1828	9,135.11	March 3, 1881	10,000.00
23, 1830	5,563.18	August 2, 1882	10,000.00
h 2, 1831	5,680.00	July 5, 1884	10,000.00
3, 1832	2,600.00	August 5, 1886	18,750.00
28, 1834	10,000.00	August 11, 1888	10,000.00
2, 1836	6,000.00	September 19, 1890	30,000.00
7, 1838	10,000.00		
11, 1844	10,000.00	Total	320,873.53
st 30, 1852	10,000.00		
28, 1864	24,453.24	Amount expended to June 30, 1891	299,469.82
23, 1866	24,072.00		
h 2, 1867	60,000.00	Amount expended in last fiscal year	20,033.26
23, 1874	20,000.00		
h 3, 1875	15,000.00		
st 14, 1876	5,000.00	Total to June 30, 1892	319,503.08

irport Harbor is in the collection district of Cuyahoga, Ohio. There is a fixed e light of the third order on the shore and a beacon on the east pier.

Money statement.

1, 1891, balance unexpended	$21,403.71
30, 1892, amount expended during fiscal year	20,033.26
1, 1892, balance unexpended	1,370.45
unt appropriated by act approved July 13, 1892	35,000.00
unt available for fiscal year ending June 30, 1893	36,370.45
ount (estimated) required for completion of existing project	79,400.00
ount that can be profitably expended in fiscal year ending June 30, 1894	79,400.00

bmitted in compliance with requirements of sections 2 of river and arbor acts of 1866 and 1867.

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ract of proposals for dredging at Fairport Harbor, Ohio, received and opened by Maj. Cooper Overman, Corps of Engineers, at Cleveland, Ohio, at 5 o'clock p. m., September 5, 1891, in accordance with circular letter dated August 22, 1891.

[Net amount available, $7,500.]

Name and address of bidders.	Price per cubic yard, measured in scows (30,000 cubic yards, more or less).	Total.
	Cents.	
Irwin, Painesville, Ohio	17½	*$5,250
Rooney, Toledo, Ohio	25	7,500
Stang, Lorain, Ohio	23	6,900

* Lowest bid received.

commended that contract be awarded to J. R. Irwin, Painesville, Ohio, at the of 17½ cents per cubic yard, scow measurement.

ABSTRACT OF CONTRACT FOR IMPROVING HARBOR AT FAIR ING THE FISCAL YEAR ENDING JUNE

(1) Contract with J. R. Irwin, of Painesville, Ohio, da dredging 42,000 cubic yards, more or less, of material fro bor; also Grand River, Ohio.

Rate paid, 17½ cents per cubic yard, scow measurement
Contract expires December 10, 1891.
Contract completed and closed.

COMMERCIAL STATISTICS.

The following statistics for the year 1891, relative to Harbor, Ohio, were compiled from information furnished and others.

Articles.	Tons.	A
Imports.		*E*
Ore	698,831	Coal
Flour and grain	53,947	Sugar
Stone	6,700	Canned goods
Lumber	4,882	Miscellaneous
Miscellaneous	1,054	
Total	764,514	Total

Vessels arriving
Vessels departing

Total tonnage for 1891 (estimated), 1,300,000, varying li last annual report.

The draft of the largest vessel entering the harbor was
The depth of water in the harbor prevents the largest depth.

The following lines of transportation were established
The Mentor Steamship Company,
The Mitchell Steamship Company.

M M 11.

IMPROVEMENT OF ASHTABULA HAR

The original project for the improvement of th in 1826, at which time there was a depth of o the bar. This project has been modified from ti meet the demands of commerce and increased dr ing the lake. As at present being carried out, running out into the lake to 16 feet depth an through bar and between piers to secure 17 feet

The last project, adopted in July, 1890, provid piers to 22 feet natural depth in lake and excavat piers to 20 feet at mean low water.

Before operations were commenced rock was feet below water surface, extending across the c wide reef, which required blasting and dredgi order to secure the present depth of 16 feet.

At the close of the last fiscal year, a contract Messrs. Carkin, Stickney and Cram, of East Sagi shale rock and loose material which form the bottom of the nd extend into the lake.

authority of the Chief of Engineers, the contract was extended y 30 to August 30, and subsequently to September 30, 1891. is continued under the contract until September 26, when it pleted.

nount of rock and shale measured in scows and removed sub-to June 30, was 22,271 cubic yards, and the total under the was 28,956 cubic yards.

spring of 1892 it was ascertained that the channel through had become filled. The necessity for dredging the channel tely was urgently represented. The amount required was too attract any competition if advertised, and a dredge, scows, and therefore hired by the day to do the necessary work. The lge available at the harbor was owned by the Pennsylvania Company. It was hired with the scows at $50 per day, in-crew, and the same parties furnished a tug at the rate of $30

eather was exceedingly bad for work upon the bar. Dredging menced April 7, and on the 6th of June it was suspended. hat time the dredge could work on the bar but 45¾ hours. nount of material removed was 1,895 cubic yards. As a result l about 100 feet wide was dredged to a depth of 18 feet through

nual formation of a bar at the mouth of the river must be ex-t least until after the piers have been extended into deeper the lake. How far any such trouble may be experienced after one can be determined by experience only, but it is not prob-; the formation will be as rapid as before, because the action res on the bottom will be less, and the drift from the river will rger area of deep water into which it may fall.

ula is one of the largest shipping points for ore on Lake Erie, necessity for deeper water in the channel is urgent. The Lake d the Pennsylvania Railroad companies are expending large in improving their facilities for receiving and shipping iron the present channel is insufficient for the demands upon it.

la Harbor is in the collection district of Cuyahoga, Ohio. There is a fixed t of the fifth order, varied by flashes, on the west pier.

ter, New York, is the nearest work of defense.

priations for improving this harbor from 1826 to 1890 have le, as follows:

26	$12,000.00	June 23, 1874	$35,000.00
28	2,403.50	March 3, 1875	25,000.00
829	6,940.25	August 14, 1876	5,000.00
831	7,015.00	June 18, 1878	12,000.00
2	3,800.00	March 3, 1879	9,000.00
833	3,400.00	June 14, 1880	20,000.00
34	5,000.00	March 3, 1881	20,000.00
335	7,591.00	August 2, 1882	20,000.00
337	8,000.00	July 5, 1884	22,500.00
8	8,000.00	August 5, 1886	30,000.00
344	5,000.00	August 11, 1888	25,000.00
1852	10,000.00	September 19, 1890	40,000.00
853	42.64		
366	24,708.82	Total	467,401.21
367	54,000.00	Total expended to June 30, 1892, including liabilities	458,734.46
371	15,000.00		
872	15,000.00		
373	16,000.00		

Money statement.

July 1, 1891, balance unexpended	$39,0[illegible]
June 30, 1892, amount expended during fiscal year	30,2[illegible]
July 1, 1892, balance unexpended	8,8[illegible]
July 1, 1892, outstanding liabilities	2[illegible]
July 1, 1892, balance available	8,6[illegible]
Amount appropriated by act approved July 13, 1892	70,0[illegible]
Amount available for fiscal year ending June 30, 1893	78,6[illegible]
Amount (estimated) required for completion of existing project	244,3[illegible]
Amount that can be profitably expended in fiscal year ending June 30, 1894	150,00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The following statistics for the year 1891, relative to the commerce of Ashtal Harbor, Ohio, were compiled from information furnished by the collecter of cust and others:

	To
Imports:	
Ore	1,526
Lumber	4
Pig iron	
Ice	
Miscellaneous	
Total	1,53
Exports: Coal	50

Shipping.	No.	Tonn
Vessels arrived	1,046	Not kn
Vessels departed	1,008	Do.
Vessels built	1	

Total tonnage for 1891 (estimated), 2,500,000, varying little from amount giv last annual report.

No new lines of transportation have been established during the year.

The draft of the largest vessel entering the harbor is 21 feet.

The depth of water in the harbor prevents the largest vessels from loading to depth.

M M 12.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDAN ING NAVIGATION.

In the spring of 1892 information was received that two small wre which had been abandoned in the harbor of Port Clinton, Ohio, obstructions to navigation at that place. One of the wrecks wa hull of the sailboat *Rescue* and the other of the steam tug *Wilcox*.

An examination of the situation was made by Lieut. Judson, from his report the officer in charge of the improvement of that ha considered that the obstructions were such as are covered by se 4 of the river and harbor act of June 14, 1880. An estimate of $10 submitted for removal of the wrecks. This was approved and the ment made by the Secretary of War May 17, 1892.

Although the obstructions are small it was not convenient to u take their removal previous to June 30. The work will be done a first convenient opportunity in the summer of 1892.

M M 13.

[Printed in House Ex. Doc. No. 61, Fifty-second Congress, first session.]

LIMINARY EXAMINATION OF GRAND RIVER, OHIO, BETWEEN RICHMOND AND THE MOUTH.

UNITED STATES ENGINEER OFFICE,
Cleveland, Ohio, November 20, 1890.

ENERAL: In compliance with circular letter from the office of the ef of Engineers, U. S. Army, dated September 20, 1890, I have the or to submit the following report of "preliminary examination" for rey of "Grand River, Ohio, between Richmond and the mouth," as vided for in section 17 of the river and harbor act approved Septem- 19, 1890.

t is assumed that the object of the survey or examination required is h view to deepening the existing channel of the river so that large- d vessels can get to Richmond docks to discharge their cargo.

rand River rises in the northeastern part of the State of Ohio, and ing first north, then west, and then north, after a very circuitous rse empties into Lake Erie at a point about midway between its east- and western extremities. Fairport Harbor is at the mouth of Grand er. Richmond is located on the west bank of the stream about 1¼ es from the present mouth of the river, and before the improvement Fairport Harbor was the port of entry for the neighboring country.

t Richmond, and from thence down to the piers, the river is about 320 wide and of varying depth. An irregular channel, of least width 00 feet and least depth of 9 feet, averaging about 12 feet, now ex- , but with comparatively small amount of dredging can be made 160 wide and 18 feet deep.

he docks of the railroad company and ore storage companies extend the right bank of the river from point opposite Richmond to United tes piers at Fairport, about 1 mile in length.

t Richmond there has been built a dock 1,000 feet long, on which re is being erected a grain elevator capable of storing 1,000,000 bush- also two immense storage warehouses for storing general merchan- .

airport Harbor is now the third harbor on the list of Lake Erie har- s in order of amount of ore received and coal shipped. During season of navigation now drawing to a close (1890), Fairport Harbor have received over 1,000,000 tons of ore as against 829,000 tons in , and against only 112,000 tons in 1885, and the amount of this merce bids fair to increase still more as other railroad companies preparing to build to said harbor. With present dock facilities 00 tons of ore can be handled daily, and there is storage capacity 1,000,000. The use of steam shovels for loading from dock to cars s good dispatch to the ore.

ew improvements in the way of new docks and new hoisting machinery, and other general improvements, are contemplated before next season.

Fairport Harbor, therefore, amply repays for all moneys expended for its improvement, and deserves liberal appropriations for its speedy improvement.

Owing to the increased size of vessels now in use on the lakes in transporting ore and coal, and on account of the very large increase, in recent years, in the commerce seeking Fairport Harbor, Ohio, it is necessary and proper that all projects for the improvement of the channel should contemplate not less than 18 feet from lake to inner end of railroad docks on Grand River.

On the above basis the following rough estimate of cost to improve Grand River, Ohio, from Richmond to the mouth, to give channel 18 feet deep, is submitted:

Channel 150 feet wide, 7,000 fee[illegible] and [illegible]vated to 18 feet depth—average cut of 3 feet—gives 115,5[illegible] [illegible]lace measure, or, say, 125,000 cubic yards, scow measure, at [illegible] [illegible]bic yard, is	$22,500
Contingent expenses, say	2,500
Total	25,000

I am of the opinion that G[illegible] is worthy of improvement, and that the demands of comm[illegible]t and prospective, call for the improvement of the channel a[illegible]ity mentioned.

Fairport Harbor is in the coll[illegible]rict of Cuyahoga, Ohio. There is a fixed white light of the th[illegible] on the shore and a beacon on the east pier.

There were no revenue collecti[illegible]ing the eleven months ending May 31, 1890. During same peri[illegible] imports, consisting of iron ore and lumber, amounted in value to $4,[illegible],000; and the exports, consisting of coal, amounted in value to $192,000.

Five hundred and seventy-two vessels entered (aggregate tonnage not stated), and 460 vessels cleared, whose aggregate tonnage was 96,000 tons.

The largest cargo of vessels entering or clearing was 2,476 tons, and the deepest draft was 16½ feet.

The above statistics, obtained from the deputy collector at Fairport Harbor, were all that could be obtained, the collector of customs at Cleveland being unable to furnish items and figures desired.

In further compliance with terms of circular letter from the office of the Chief of Engineers, U. S. Army, dated September 29, 1888, I have to respectfully submit estimate of cost of survey, as follows:

FIELD WORK.

Services of an assistant engineer, say twenty-five days, at $160 per month	$133.33
Services of leadsman and rodman, say twenty-five days, at $90 per month	75.00
Services of two laborers, as axmen and boatmen, say twenty-five days, at $2 per day each	100.00
Hire of two boats, say twenty days, at $1 per day each	40.00
	348.33

OFFICE WORK.

Services of assistant engineer, making estimates, profiles, maps, plotting, etc., say thirty days, at $160 per month	$160.00
Total	508.33

survey should be made as soon as possible if it is to be made inter.

Very respectfully, your obedient servant,

L. COOPER OVERMAN,
Major of Engineers.

g. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

rough Col. Henry L. Abbot, Corps of Engineers, Division Engi- Northeast Division.)

[First indorsement.]

NORTHEAST DIVISION, ENGINEER OFFICE,
New York, November 22, 1890.

pectfully forwarded to the Chief of Engineers, U. S. Army.
ncur with Major Overman's opinion that, for the reason stated, id River, between Richmond and the mouth," is worthy of im- nent.

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.,
Engineer Northeast Division.

Y OF GRAND RIVER, OHIO, BETWEEN RICHMOND AND THE MOUTH.

UNITED STATES ENGINEER OFFICE,
Cleveland, Ohio, November 10, 1891.

ERAL: In compliance with letter from the office of the Chief of eers, U. S. Army, dated November 25, 1890, I have the honor to t the following report of a survey of "Grand River, Ohio, between ond and the mouth," as provided for in section 17 of the river and r act approved September 19, 1890.

as assumed that the object of the survey or examination required ith view to deepening the existing channel of the river so that sized vessels can get to Richmond docks to discharge their cargo.

nd River rises in the northeastern part of the State of Ohio, and, g first north, then west, and then north, after a very circuitous empties into Lake Erie at a point about midway between its n and western extremities. Fairport Harbor is at the mouth of l River. Richmond is located on the west bank of the stream, 1⅝ miles from the present mouth of the river, and, before the im- ment of Fairport Harbor, was the port of entry for the neighboring ry.

Richmond and from thence down to the piers the river is about et wide and of varying depth. An irregular channel, of least of 90 feet and least depth of 9 feet, averaging about 14 feet, now , but with comparatively small amount of dredging can be made et wide and 18 feet deep.

docks of the railroad company and ore-storage companies extend right bank of the river from point opposite Richmond to United piers at Fairport, about 1 mile in length.

Richmond there has been built a dock 1,035 feet long, on which has been erected a grain elevator capable of storing 1,000,000 ls, also two immense storage warehouses for storing general mer- ise.

rport Harbor is now the third harbor on the list of Lake Erie har-season.

Fairport Harbor, which includes Grand River as fa
therefore amply repays for all moneys expended for it
and deserves liberal appropriations for its speedy impr

Owing to the increased size of vessels now in use
transporting ore and coal, and on account of the very l
recent years in the commerce seeking Fairport Harbor
essary and proper that all projects for the improvemen
for harbors and rivers should contemplate not less th
lake to inner end of railroad docks on Grand River.

On the above basis the following approximate estima
prove "Grand River, Ohio, from Richmond to the mout
to give channel 18 feet deep is submitted:

Channel 160 feet wide, 7,310 feet long, and excavated to 18 feet d
age cut of 4.016 feet, gives 160,000 cubic yards, place measu
196,000 cubic yards, scow measure, dredging at 18 cents per cubic
Contingent expenses, say ....

Total ....

I am of the opinion that Grand River, from Richmon
is worthy of improvement, and that the demands of co
and prospective, call for the improvement of the chann
mentioned. A chart (tracing) of locality is transmitt
separate package.*

Fairport Harbor is in the collection district of C
There is a fixed white light of the third order on the sh
on the east pier.

During the eleven months ending May 31, 1891, the
enue collected was $1.50.

The imports, consisting of iron ore and lumber, s
amounted in value to $4,542,493, and the exports, con
amounted in value to $125,350.

Five hundred and ninety-three vessels entered with

[First indorsement.]

NORTHEAST DIVISION, ENGINEER OFFICE,
New York, November 14, 1891.

Respectfully forwarded to the Chief of Engineers, U. S. Army.
here can be no doubt that Grand River below Richmond is worthy mprovement. Whether this shall be done by the United States or the local interests is a matter for Congress to determine.

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.,
Engineer Northeast Division.

M M 14.

[Printed in House Ex. Doc. No. 42, Fifty-second Congress, first session.]

PRELIMINARY EXAMINATION OF CONNEAUT HARBOR, OHIO.

UNITED STATES ENGINEER OFFICE,
Cleveland, Ohio, November 3, 1890.

ENERAL: In compliance with circular letter from the office of the ief of Engineers, dated September 20, 1890, I have the honor to sub- the following report of "preliminary examination" for survey of meaut Harbor, Ohio, as provided in section 17 of the river and har- act approved September 19, 1890.

onneaut Harbor, Ohio, is situated at the mouth of Conneaut Creek, ut 30 miles west of Erie, Pa., and 13 miles east of Ashtabula, Ohio. he creek empties into Lake Erie near the boundary line between the tes of Pennsylvania and Ohio, and although a narrow stream pre- ts a depth of 15 feet after passing inside the piers. The attention of General Government was first called to this locality for a harbor in 9, when there was a depth of only 2 feet at the entrance to the har- . Since that date the appropriations have amounted to $112,629.39, last appropriation being that of June 14, 1880, for $6,000. The work the improvement of this harbor has been continued during fifty-one rs, with many interruptions and suspensions for want of funds.

he best channel depth ever obtained at the entrance was only 11 , the more usual depth being from 8 to 9 feet. The project for rovement was designed to give a depth of 12 feet, but the plan was er carried to completion for want of sufficient appropriations. The ropriation of 1880 of $6,000 was expended in making the most press- repairs, and it was estimated by the then engineer in charge that at st $35,000 should be expended in renewals and repairs, and an ual expenditure of $1,000 to maintain piers. No appropriation has n made since 1880, and no work done since 1881.

he commerce of the port has always been very small. We may refore conclude that the hopes entertained for this harbor when its rovement was undertaken have never been realized.

eports that surveys were being made for extending a line of railroad Conneaut Harbor for a lake terminus have been circulated a number times, but nothing definite has yet been done.

At present the harbor is virtually destroyed; the piers are nearly troyed, breaches having been made in both, so that the stream now s an outlet through the east pier, causing a bar, dry at low water, r the entrance at end of piers. Very extensive repairs and renewals necessary, together with a large expenditure for dredging.

A rough estimate as to what the proposed improvement would would be as follows:

For a channel entrance 160 feet wide, 18 feet deep:
Dredging from 18 feet depth in lake to inside, say 150,000 cubic yards of material, at about 18 cents per cubic yard ....
Repairs and renewals of piers and revetment, estimated in 1880 at $35,000, which now would cost not less than ....
Additional renewals, repairs, and enlargement of harbor necessitated by present demands of lake commerce, say ....
Contingent expenses on above estimate, say 15 per cent ....

Total ....

With a line of railroad from the coal regions of Pennsylvania t neaut Harbor the commerce would doubtless increase rapidly a harbor be frequented by vessels of the larger class now navigat lakes, and render the reconstruction of the harbor necessary. line of railroad constructed, I am of the opinion that the desi provement to restore the harbor and to deepen and widen entr same is a worthy one, but without such a road built or assur outlay for the improvement of the harbor is injudicious.

Conneaut is in the collection district of Cuyahoga, Ohio. Th fixed white light of the sixth order upon the bank of lake nea of creek, the light beacon having been removed from end of pie count of the dilapidated condition of the piers. Fort Porter, N miles distant, is the nearest work of defense.

The amount of revenue collected during the eleven months May 31, 1885, was $15.95. During the same period the value imports was $80, and of the exports $125.

Ten vessels, with an aggregate tonnage of 360 tons, enter twelve vessels, with an aggregate tonnage of 395 tons, cleared.

The above is the latest report received. The office of deputy c for the port was abolished in 1885.

In further compliance with terms of circular letter from the the Chief of Engineers, U. S. Army, dated September 29, 1888, to respectfully submit estimate of cost of survey, as follows:

FIELD WORK.

Services of an assistant engineer, say 25 days, at $160 per month ....
Services of leadsman and rodman, say 25 days, at $90 per month ....
Services of two laborers, as boatmen and axmen, say 25 days, at $2 per day each ....
Hire of two boats, at $1 each per day, say 20 days ....

OFFICE WORK.

Services of assistant engineer, 30 days, making estimates, profiles, maps plotting, etc., at $160 per month ....

Total ....

This survey should be made as soon as possible if it is to be m winter.

Very respectfully, your obedient servant,

L. COOPER OVERMAN
Major of Engi

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Henry L. Abbot, Corps of Engineers, Divis gineer, Northeast Division.)

[Fourth indorsement.]

U. S. ENGINEER OFFICE,
Cleveland, Ohio, November 24, 1890.

spectfully returned to the Chief of Engineers, U. S. Army, through H. L. Abbot, Division Engineer.

thin the past few days I have received a communication from Mr. Dick, president of the Pittsburgh, Butler and Shenango Railroad any, stating that the company which he represents expects to ex- its lines to Conneaut Harbor, Ohio, for a lake terminus; that they ying track at the rate of a mile per day; that they expect to make nection with the "Nickel Plate Railroad," at a point 10 miles Conneaut Harbor, by January 1, 1891; that they expect to com- to Conneaut Harbor not later than June 1, 1891; and intend work- ; their terminal at Conneaut Harbor this winter.

view of the above I am of the opinion that Conneaut Harbor, Ohio, rthy of further improvement, as the prospective demands of com- justify such expenditure.

L. COOPER OVERMAN,
Major of Engineers.

[Fifth indorsement.]

NORTHEAST DIVISION, ENGINEER OFFICE,
New York, November 26, 1890.

pectfully returned to the Chief of Engineers. The facts stated in urth indorsement show that "the construction of a railroad to com- cate with the iron and coal regions" may now be expected at an day, and I accordingly concur with Major Overman in thinking this harbor is "worthy of improvement."

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A,
Engineer Northeast Division.

SURVEY OF CONNEAUT HARBOR, OHIO.

UNITED STATES ENGINEER OFFICE,
Cleveland, Ohio, November 10, 1891.

NERAL: I have the honor to transmit herewith, in separate pack- a chart* (tracing) of Conneaut Harbor, Ohio, and to submit the ring report of a survey of said harbor in accordance with letter . office of the Chief of Engineers, U. S. Army, November 29,

nneaut Harbor, Ohio, is situated at the mouth of a creek of the name, about 30 miles west of Erie, Pa., and 13 miles east of Ash- a, Ohio, near the boundary line between the States of Pennsylvania Ohio.

nneaut Creek, although a narrow stream, drains a large watershed presents a depth of 15 feet and over after coming inside the shore Considerable current is usually found and the volume of dis- ge is equal or greater than that of most streams of similar width lepth. The banks are firm and the valley near the harbor would l excellent room for docks for storage of ore and coal.

e attention of the General Government was first called to this ty for construction of a harbor in 1829, when there was a depth of 2 feet across the bar at mouth of the stream. Since that date ap-

* Not printed.

propriations amounting to a total of $112,629.39 have been expen the harbor, a large part being for repairs to maintain the stru during fifty years.

The last appropriation was that provided by the act of June and was $6,000 "for repairs." The appropriations were irregu intermittent, with many suspensions, so that the plans for the in ment of the harbor, as projected, were never carried to completion best channel depth ever obtained was 11 feet at entrance, th depth being 8 feet.

The commerce seeking the harbor has always been small, and to conclude that the hopes entertained for this harbor when its in ment was undertaken were never realized, mainly for want of communication direct from the harbor to the coal regions a furnaces south of the harbor.

The failure to attract an adequate commerce to the harbor l gress to omit from the regular appropriation bills during the years any allotment for Conneaut Harbor, Ohio, and since 1881 has been done towards keeping the harbor in repair. It is now destroyed, and the channel entrance closed by a sand bar. T have rotted down and been destroyed by the storms so as to b cally useless. The stream, following its natural bent, has broke sage through the east pier, flowing to the eastward, instead of northward through channel provided by the piers. A large d sand, etc., from the lake storms has choked the channel betw piers.

At present there is neither town nor harbor, nor any comme some small fishing vessels which frequent the old harbor to d small quantities of fish for local consumption. Very extensive and renewals, together with a large expenditure for dredging, v necessary to restore the harbor as it was and give the 12-foot depth heretofore sought.

From a consideration of the data obtained it is considered th be as economical to ignore the old piers and build new, as to reb old piers on old lines; such a change would also enable us to m and better location of the piers, and this is very necessary if C Harbor is to be improved to accommodate the class of vessels wh are employed in the commerce of the lakes.

The additional or extra dredging rendered necessary by relo the piers would not be much, as the widening and deepenin present channel would necessitate the removal of at least one tirely, and considerable of the structure of the other pier, to st the channel; and the portion of the pier which is left would re be strengthened and sustained by piling to prevent underminin depth of channel is dredged to 18 feet, as the piers were fou only 12 feet channel depth.

SCHEME A (SEE TRACING).

To widen and deepen the existing old channel at Conneaut to secure 17 feet depth and 160 feet width between piers, extend 17 feet natural depth in lake to inside the shore end of the old at present located, would incur the following expenditure, appro estimated:

To repair and partly rebuild the present west pier (the best), say ....

To construct a new east pier to replace old pier, to be same length as exist ing west pier, say 1,200 linear feet, at $70 per linear foot................

construct the additional length of piers to 17 feet natural depth in lake, by an extension of 800 feet for each pier, or for both 1,600 linear feet, at per linear foot	$120,000
he piers to be 200 feet apart, with full channel width of 160 feet, and et channel depth. Dredging required for 160 feet width from 17 feet ural depth in lake to inside, say 2,100 feet, will require the removal of—	
100,000 cubic yards of soft material, at 18 cents	18,000
35,000 cubic yards of stones and gravel, at 30 cents	10,500
20,000 cubic yards of bowlders, etc., at 50 cents	10,000
etment inside of shore line for 500 linear feet on the west side and 700 inear feet on the east side, a total of 1,200 linear feet, at $10 per foot	12,000
	290,500
tingent expenses, at least 15 per cent	43,575
Total	334,075

SCHEME B (SEE TRACING).

To relocate the channel and construct new piers will incur the fol- ing expenditure, approximately estimated:

construct two new piers of the same length as the old piers, say 1,200 feet ich, or 2,400 linear feet of piers, at $75 per linear foot	$180,000
construct the additional length of piers to 17 feet natural depth in lake, by an extension of 800 feet for each pier, or for both 1,600 linear feet, at 5 per linear foot	120,000
redging new channel from 17 feet natural depth in lake to inside, for tom depth of 160 feet, length say of 2,100 feet, will require the removal of—	
120,000 cubic yards of soft material, at 18 cents	21,600
50,000 cubic yards of stones and gravel, at 30 cents	15,000
30,000 cubic yards of bowlders, etc., at 50 cents	15,000
retment inside of shore line, 500 linear feet on the west side and 700 inear feet on the east side, a total of 1,200 linear feet, at $10 per foot	12,000
	363,600
ntingent expenses, at least 15 per cent	54,540
Total	418,140

It will be seen from the above that the difference in cost, per the ap- oximate estimates, between the two plans for improvement is small ien compared with the total cost of either plan, and too small not to ke it advisable to adopt the plan which provides for the relocation the channel and construction of two new piers throughout.

A line of railroad to Conneaut Harbor for a lake terminus is being nstructed, and the grading, it is reported, will be finished by the end this year to within 2 miles of the harbor.

With a line of railroad from the coal regions of Pennsylvania to Con- aut Harbor, the commerce of this harbor will rapidly increase and rbor be frequented by vessels of the larger class by which lake com- erce is now transported. This will render the reconstruction of this rbor necessary, and on plan in accordance with present requirements.

With a line of railroad assured, I am of the opinion that the reloca- n of the harbor and the widening and deepening of the channel is a rthy improvement, and the prospective demands of commerce call r the improvement.

Conneaut is in the collection district of Cuyahoga, Ohio. There is a ed white light of the sixth order upon the bank of lake near mouth creek, the light-beacon having been removed from end of pier on ac- unt of the dilapidated condition of the piers.

Fort Porter, New York, 100 miles distant, is the nearest work of de- nse.

The amount of revenue collected during the eleven months ending May 31, 1885, was $15.95. During the same period the value of the imports was $80 and the exports $125.

Ten vessels, with an aggregate tonnage of 360 tons, entered; and twelve vessels, with an aggregate tonnage of 395 tons, cleared.

The above is the latest report received. The office of deputy collector for the port was abolished in 1885.

Very respectfully, your obedient servant,

L. COOPER OVERMAN,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Henry L. Abbot, Corps of Engineers, Division Engineer, Northeast Division.)

[First indorsement.]

NORTHEAST DIVISION ENGINEER OFFICE,
New York, November 14, 1891.

Respectfully forwarded to the Chief of Engineers, U. S. Army.

In view of the favorable location of Conneaut Harbor for the iron and coal trade, and of the construction of a railroad, now well advanced, to develop its natural advantages, I consider the harbor to be worthy of improvement.

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.,
Engineer Northeast Division.

APPENDIX N N.

IMPROVEMENT OF ERIE HARBOR, PENNSYLVANIA, AND OF DUNKIRK, BUFFALO, WILSON, OLCOTT, AND OAK ORCHARD HARBORS, AND OF TONAWANDA HARBOR AND NIAGARA RIVER, NEW YORK.

REPORT OF MAJOR E. H. RUFFNER, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Erie Harbor, Pennsylvania.
2. Preservation and protection of Presque Isle Peninsula, Erie Harbor, Pennsylvania.
3. Dunkirk Harbor, New York.
4. Buffalo Harbor, New York.
5. Tonawanda Harbor and Niagara River, New York.
6. Wilson Harbor, New York.
7. Olcott Harbor, New York.
8. Oak Orchard Harbor, New York.

EXAMINATION AND SURVEY.

9. Port Day, above Niagara Falls, New York.

UNITED STATES ENGINEER OFFICE,
Buffalo, N. Y., July 7, 1892.

GENERAL: There are forwarded herewith the annual reports for the year ending June 30, 1892, for the harbors of Erie, Pa.; Dunkirk, Buffalo, Wilson, Olcott, and Oak Orchard, N. Y.; and for Tonawanda Harbor and Niagara River, New York.

* * * * * * *

Very respectfully, your obedient servant,

E. H. RUFFNER,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. Army.

and only 6 feet in depth), provided for closing all of th
the harbor by means of a breakwater, in which should
ing 200 feet wide, and for extending to deep water
parallel piers, one on each side of the opening. Thi
stantially in force at the present time, excepting that t
feet apart.

Present works.—The present works consist of (1) a b
north and south from the main shore to the south side
to the harbor; (2) a pier on the south side of the e
nearly east and west in position; (3) a pier on the n
channel parallel with and 350 feet distant from the p
tioned, and (4) a catch-sand jetty, built in 1883, about
of the north pier, for the purpose of arresting the mo
into the channel. The construction of this jetty is s
not serve the purpose for which it was built, and it
repairs since its construction. These works are known
breakwater, (2) the south pier, (3) the north pier, and (4
jetty.

The piers and breakwater consist of timber crib-w
stone and covered with pine-plank deck.

The catch-sand jetty consists of a single row of pi
together and bound together with oak walings.

OPERATIONS DURING THE FISCAL YEA

Repairs to piers and breakwater.—Between stations 1
north pier six courses of superstructure on channel fa
removed and new deck built; 60 decayed deck plank
new; 600 linear feet of waling repaired and oak fende
150 feet of the pier to provide a landing for harbor tugs
pier minor repairs were made to the deck, and to the
at the junction with the south breakwater. Repairs
July 13 and completed on August 10, 1891.

Dredging in channels.—No dredging was done in the channels were made monthly and the water gauge tested frequently and maintained in good order.

Extension of the north pier.—The extension of this pier eastward into Lake Erie 450 feet, more or less, under contract of J. B. Donnelly, Oswego, N. Y., was begun in June, 1891. The contractor carried on his work energetically and completed his contract on October 2, 1891. The total length of the extension was 452.15 feet. The cost of the extension was $32,025.77, or $70.83 per lineal foot of completed pier.

Surveillance of the peninsula.—The watchman was on duty during the entire year. He enforced the rules in regard to the building of fires and cutting of trees or any growth on the peninsula, so far as possible over so large an area (about 4 square miles). No depredation was committed.

Fires occurred on the peninsula as follows: Two small fires on the bay shore on August 30, 1891, extinguished before any damage was done; a fire in marsh grass on the bay shore of the "neck," on October 3, 1891, burned over 20 acres of marsh, but was extinguished before any damage was done to large growth; a fire in large hemlock on the bay shore at "Big Bend," on April 24, 1892, burned trees over an area of 100 feet square, before the fire could be extinguished. In addition to his duties on the peninsula, the watchman maintained a careful watch over the public property stored in the boathouse and warehouse, and acted as engineer of the steam launch.

CONDITION OF THE WORKS.

South breakwater.—This structure is old and much decayed. Its total length is 2,024 feet; height above mean lake level, 1½ feet; width, 8 to 12 feet. No repairs were made during the year. At the close of the year the structure was intact and no repairs urgently needed.

South pier.—Length of this pier is 1,220 feet. The pier is in fair condition, but the timbers of the superstructure are becoming soft and show decay. At the junction of the pier and south breakwater some of the stone filling has been washed out and should be replaced. To do this will cost about $50.

North pier.—This pier is 2,437 feet long, having been extended 452 feet during the year. The westerly 993 feet of the pier is old, but with repairs to the deck, costing about $250, it can be put in fair condition. The remainder of the pier, 1,444 feet long, is in good condition, requiring only minor repairs, which will cost about $200.

Catch-sand jetty.—About 450 feet of the jetty remain intact but it is not considered worth repairing.

The channel.—The total length of the channel, from the 18-foot contour at low water in the lake to the same contour in the harbor, about 7,100 feet, is made up as follows:

	Feet.
From 18-foot contour at low water in the lake to the east or outer end of the north pier, outer channel	1,250
Between piers	2,450
From west or inner end of piers to 18-foot contour at low water in harbor, inner channel	3,400

The width of the channel when completely clear is 300 feet. A length of channel of 2,000 feet, lying between the piers, is kept thoroughly scoured out by the strong currents which run in and out and thus maintain the good condition at all times. The outer and inner channels require repeated dredging in order to maintain them at the required depth. No dredging was done in the inner channel throughout the year. At the close of the year it was in good condition, the depth of water being 18½ to 20 feet at mean lake level, or not less than 17 feet at low water, for a width of 275 feet. A point of the bar above the north pier which encroaches upon the north half of the outer channel along the pier extension, built during the first half of the year, was removed by dredging in June, 1892. At the close of the year the outer channel was also in good condition, being 18½ to 20 feet deep at mean lake level, or not less than 17 feet at low water, for its entire width of 300 feet.

DOCK LINES.

A brief description of the manner of locating docks at Erie Harbor is given in the Annual Report of the Chief of Engineers for 1891, page 2874. No new docks were built during the year, but the increasing demand for dock room will probably lead to dock extensions in the near future. This fact emphasizes the advisability of establishing a dock line along the city front.

PROPOSED OPERATIONS.

Repairs to piers and breakwaters.—No repairs are necessary on the south breakwater at the close of the year. The repairs required on the south pier, consisting of the replacement of about 20 cubic yards of stone filling and strengthening of the pier at the junction with the south breakwater, will be made during July, 1892. Repairs needed in the easterly half of the north pier, consisting of the closing of a hole in the crib-work with sheet piling, the replacement of about 25 cubic yards of stone filling, and the renewal of 50 decayed deck plank will be made during July, 1892. The superstructure of the westerly 993 feet of the north pier is fast becoming weak. Its entire renewal will be necessary in the near future. It can be placed in fair condition for a year or two by patching the deck and fender piles and walings. It is proposed to make these repairs during July, 1892. The total cost of the above repairs is estimated at $500.

The cost of rebuilding the superstructure over the westerly 993 feet of the pier, renewing fender piling, oak walings, and mooring piles is estimated at $20,000.

Dredging.—Sand bars are liable to form suddenly across the harbor entrance during storms from the northeast. Should there be any serious filling in of the outer channel due to these storms the dredging necessary to clear the channel will be done promptly.

Extension of the north pier.—The existing project provides for the extension of this pier to a depth of 16 feet in the lake. To complete the project would require a further extension of 300 feet, and in order to check the rapid encroachment of the bar above the pier upon the channel this extension should be made as soon as possible and as funds become available. The cost of the extension would be 300 feet of pier, at $80 per foot, $24,000.

REMARKS.

The bar formation above the north pier continues to grow and encroach upon the pier. At the close of the year the shore line of the bar was at station 12 + 10, 997 feet from the end of the pier, showing no advance lakeward; but the bar had risen above water, forming a continuous shore line northward to the easterly point of the peninsula and adding another permanently closed pond to the peninsula formation other bar formation, about 600 feet outward from the present shore is developing. In consequence, the gradual shoaling eastward ward the end of the pier will continue and eventually necessitate ther extension of this pier. The extension of the south pier, as pro-ded for in the existing project, is not deemed necessary or advisable der existing conditions. To complete the project would require an tension of 1,000 feet, at a cost of $65,000.

Proposed operations may be confined, therefore, to the extension of e north pier, repairs to piers and breakwater, and dredging in the annels.

The amounts needed for repairs and dredging can not be definitely ated, as damages by storms are liable to occur at any time. Provi-on should, however, be made for emergencies. I would therefore esti-ate the needed and possible expenditures for the coming year as llows:

xtension of north pier	$24,000
ebuilding of superstructures	20,000
epairs to piers and breakwaters	5,000
redging in channels	5,000
Total	54,000

Money statement.

ly 1, 1891, balance unexpended	$70,106.13
ceived from sales of material	4,716.89
	74,823.02
e 30, 1892, amount expended during fiscal year	37,131.23
ly 1, 1892, balance unexpended	37,691.79
ly 1, 1892, outstanding liabilities	504.00
July 1, 1892, balance available (includes $20,000 reserved for Presque Isle)	37,187.79
Amount appropriated by act approved July 13, 1892	40,000.00
Amount available for fiscal year ending June 30, 1893	77,187.79
Amount that can be profitably expended in fiscal year ending June 30, 1894 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	54,000.00

COMMERCIAL STATISTICS.

Arrivals and departures of vessels for the year ending December 31, 1891.

Vessels.	Arrivals from—				Departures to—			
	Home ports.		Foreign ports.		Home ports.		Foreign ports.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
Steam	908	1,022,507	41	3,176	915	1,033,930	40	3,917
Sail	249	138,897	16	2,515	253	137,000	15	1,624

Greatest draft of vessels, 16½ feet.
Decrease of tonnage, 1891 under 1890, 74,108.

Amount of revenue collected, fiscal year ending June 30, 1891	$21,250.22
Value of foreign imports	67,095.92
Value of foreign exports	2,239.50
Enrolled tonnage, port of Erie, 1891	25,444.60
Enrolled tonnage, port of Erie, 1892	24,214.99
Decrease, 1892	1,229.6

IMPORTS BY LAKE.

[Tons of 2,000 pounds.]

Articles.	Year ending December 31—					
	1886.	1887.	1888.	1889.	1890.	1891.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Merchandise	17,770	13,488	15,782	36,657	42,857	[illegible]
Limestone	3,360			6,000	24,414	[illegible]
Stone				17,640		[illegible]
Plaster				2,433	9,295	[illegible]
Lath	428	338	460	540		[illegible]
Shingles			100		110	
Produce					5	[illegible]
Stave bolts					2,488	[illegible]
Ice					4,700	
Copper					3,523	
Phosphates					500	
Barley	1,689	1,970	2,383	2,138	2,644	[illegible]
Corn	41,670	10,000	46,083	98,230	200,721	[illegible]
Oats			1,090	8,823	80	[illegible]
Wheat	34,360	45,062	9,530	33,815	45,354	[illegible]
Rye				2,815	6,888	[illegible]
Flax seed	13,925	3,104	2,836	250	1,500	[illegible]
Flour	133,310	91,935	96,935	152,225	143,428	[illegible]
Lumber	14,466	6,900	16,809	22,500	20,379	[illegible]
Pig iron	1,734	8,521	12,477	2,464	11,507	[illegible]
Iron ore	102,208	235,658	269,250	417,270	554,403	[illegible]
Total	364,920	416,976	473,735	804,800	1,033,796	[illegible]

EXPORTS BY LAKE.

[Tons of 2,000 pounds.]

Articles.	Year ending December 31—					
	1886.	1887.	1888.	1889.	1890.	1891.
Coal:	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Anthracite	107,406	157,083	279,400	258,534	332,666	470,716
Bituminous	127,849	73,762	125,848	151,869	234,266	176,704
Pig and manufacturing iron	4,900	397	1,262		4,017	
Merchandise	78,490	93,228	119,206	88,600	127,074	109,030
Tar and oil					1	2
Stone					1,836	
Timber					400	
Total	318,645	324,470	525,716	499,003	700,260	[illegible]

N N 2.

PRESERVATION AND PROTECTION OF PRESQUE ISLE PENINSULA, ERIE HARBOR, PENNSYLVANIA.

This peninsula forms the harbor of Erie, which is a land-locked bay about 5 miles long, having a maximum width of $1\frac{1}{2}$ miles. The peninsula is a low sand formation about 6 miles long, varying in width from 300 feet at the "neck," which is nearly 2 miles long, and joins the body of the peninsula to the mainland at its western end, to $1\frac{1}{4}$ miles at its widest part. The preservation of the peninsula is of vital importance to Erie Harbor, and it is for the purpose of preserving the harbor that the protection of the weak parts of the peninsula formation has been deemed necessary. The weak portion is the long narrow neck at the western end. The object for which all the works of protection have been constructed is the prevention of a breach through this narrow neck. This danger exists during severe storms from the westward.

At the present time no works exist excepting a few dilapidated pile no longer of service, and the main line of piles, mattresses, and ballast on mattresses, of the shore protection partially con- ed in 1889. No severe storms occurred during the year excepting ; the winter, when the shores were well protected by ice. The " remains intact, and at its normal width and height above water A slight accumulation of sand along the protection work con- ed in 1889 is noticeable.

ng the lake front, extending a mile or more west from the flash iouse the gradual wearing away of the bank continues, but as ninsula is here one-half mile or more wide, the safety of the har- not threatened at this point. There was no work done on any of otection works during the year. A report of the Board of Engi- on the construction of shore protection for the peninsula at Erie r, Pennsylvania, was published in the Annual Report of the Chief gineers, for 1890, page 2800. In accordance with the recommen- i of the Board and the approval of the Chief of Engineers, no diture will be made at present to protect the "neck" of the penin- n its lake side, and $20,000 of the funds available for the improve- of Erie Harbor are reserved to close any breach which may occur neck of the peninsula.

mercial statistics.—The commercial statistics are the same as those tted for Erie Harbor.

N N 3.

IMPROVEMENT OF DUNKIRK HARBOR, NEW YORK.

ct.—The object of this improvement is to form an artificial harbor indentation of the shore line of Lake Erie, in front of the city of rk, N. Y.

ject.—The original project was adopted in 1827, and with its sub- it modifications provided for the construction of a pier running om the west shore of the indentation, and a detached breakwater el with the pier and about 2,000 feet distant from the city front. ening between the two structures provided a harbor entrance, gh which a channel leading to the docks was to be deepened to . By 1832, the sum of $28,439.84 had been expended on the al plan, and a breakwater was then 2,564 feet long, and the pier feet long. Subsequently various improvements and repairs were In 1848 the breakwater was demolished.

870 the question of the improvement of this harbor was referred oard of Engineers. The Board recommended a plan which pro- for a detached breakwater 2,860 feet long, one part of which, feet long, was to be nearly parallel with the shore, the other part nearly parallel with the axis of the channel entrance, 560 feet and terminating at the position of the dumb beacon. This break- with the pier already built, was to form the harbor, and the old el was to be enlarged to 170 feet wide and 13 feet deep. This proj- in force at the present time.

ent works.—The present works consist of an unfinished detached water 1,341 feet in length, a part of the 2,300-foot section provided ject; a pier 1,410 feet long, exclusive of the light-house crib, and nel 100 feet wide and 12 to 14 feet deep. The breakwater and nsist of timber work, the cribs being filled with stone and decked

ations during the fiscal year.—At the beginning of the year a ct was in force with Gustavus C. Grimard, Buffalo, N. Y., for rebuilding 150 feet of superstructure at the west end of the breakwater, building and placing one crib and 170 feet of new superstructure at the east end of the west pier, westward from the beacon, and tearing down and rebuilding an additional 50 feet of superstructure where most needed.

The contractor began operations on July 27, 1891, and by the time his contract expired on December 1, 1891, had not fully completed the construction of the 170 feet of superstructure at the east end of the west pier. In order to complete this portion of the work, and render it secure for the winter, an extension of time of contract to January 1, 1892, was granted. Under this extension the contractor was able to complete the section by December 20. No work was done on the breakwater or other parts of the pier, and on January 1, 1892, the contract was abandoned. Owing to extreme low water prevalent during the season of 1891, there was but 10 feet of water on the inner and outer bars in the channel. Vessels experienced much trouble in getting around in consequence. In order to relieve navigation as much as possible the dredge *Hingston & Woods, No. 6*, was employed to dredge out the bars to a depth of 13 feet. Dredging operations were begun on October 2 and completed on October 10. The total quantity of material dredged was 2,900 cubic yards, at a cost of $665, or about 23 cents per cubic yard, scow measurement.

CONDITION OF THE WORKS.

Breakwater.—The superstructure for a distance of 200 feet at the west end requires extensive repairs, 100 feet thereof must be entirely rebuilt. The remainder of the structure, 1,141 feet in length, remains intact, though much decayed, and requires minor repairs to the slope.

West pier.—The 420 linear feet at the west or shore end are buried in the sand and need no longer be kept in repair. The next, following, 724 feet of pier, is in a wrecked condition and requires new superstructure. The next, following, 90 feet, are nearly new, but the crib wall on the lake side for a length of 30 feet is gone and stone filling washed out to a depth of 5 feet under water. The remainder of the pier to the beacon, viz, 170 feet, is new and in good condition.

The channels.—The channel to be maintained is about 2,800 feet long, extending from the 14-foot curve in the lake to the city docks, 170 feet wide and 13 feet deep. At the close of the year the channel was 100 to 150 feet wide and not less than 12 feet deep. Filling in takes place rapidly on account of the littoral currents carrying the sand across the channel to the outer bar. Against this the existing works afford no protection.

PROPOSED OPERATIONS.

The rebuilding and repair of superstructure on the breakwater and pier should be made as rapidly as funds become available. The cost of this work is estimated as follows:

Rebuilding 100 feet of superstructure in breakwater	$4,000
Rebuilding 724 feet of superstructure in piers	28,960
Repairs to breakwater	
Repairs to piers	
Total	33,960

The estimate for repairing existing structures is less than one-third of former estimates and is based on the opinion that the structures will endure with minor annual repairs, for some years in fair condition.

ork to be done to complete the existing project is estimated to bout $170,000. The estimate is given in detail in the Annual of the Chief of Engineers for 1891, page 2880. It is important e existing structures should be put in at least a fair condition the work to be done to complete the project is begun. Of the vork to be done, the construction of the arm of the breakwater, t in length along the eastern edge of the channel would no doubt ie first importance, as it would afford needed protection to the l.

proposed application of the appropriation asked for, for the fiscal nding June 30, 1894, is the continuation of needed renewal and of existing works, dredging in channel, and continuation of the g project.

Money statement.

891, balance unexpended	$20,926.33
1892, amount expended during fiscal year	6,861.93
892, balance unexpended	14,061.40
892, outstanding liabilities	7.00
892, balance available	14,054.40
appropriated by act approved July 13, 1892	20,000.00
available for fiscal year ending June 30, 1893	34,054.40
t (estimated) required for completion of existing project	128,116.11
t that can be profitably expended in fiscal year ending June 30, 1894	34,000.00

tted in compliance with requirements of sections 2 of river and or acts of 1866 and 1867.

COMMERCIAL STATISTICS.

and departures of vessels, compiled by the Collector of Customs, Dunkirk, N. Y.

Class.	Arrivals from—				Departures to			
	Home ports.		Foreign ports.		Home ports.		Foreign ports.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
	25	5,039	3	980	26	5,156	2	961
ssels	17	5,233	3	1,024	18	5,398	2	654
l	42	10,272	6	2,024	44	10,554	4	1,615

se of tonnage over season of 1890, 1,969 tons.
it of revenue collected during the year ending December 31, 1891, $1,683.87.
st draft of vessels, 12½ feet.
of imports same year, $24,287.97.
v lines of transportation established.

N N 4.

IMPROVEMENT OF BUFFALO HARBOR, NEW YORK.

t.—The object of the improvements is to protect the entrance to Harbor, protect the shore south of Buffalo Creek, and to form r harbor of refuge where vessels may lie in safety.

ct.—From 1819 to 1874 various projects, with their modifications, bmitted, and such as bear the approval of the War Department provide for the following works, to wit: North pier, south pier, masonry sea wall, sand catch or pile pier, and breakwater and shore arm.

The north and south piers are at the entrance to Buffalo Creek. The sea wall beginning at the south pier extends southward along the lake shore. The sand catch extends from the shore into the lake at a point about 8,000 feet southward of the south pier. The breakwater, commencing about on the line of the south pier extended, lies on a line parallel with the shore about one-half of a mile from it, and when completed will extend from the line of the south pier southward for a distance of 7,600 feet. The shore arm of the breakwater is intended to cover the opening between the south end of the main breakwater and the shore, leaving a passageway for vessels.

All of the above-mentioned works have been constructed, except 800 feet of the main breakwater, and the shore arm, and 220 feet of the sand catch.

The breakwater, as origina consisted of a substructure composed of separate timber crib th stone, and a continuous superstructure of timber crib work ith stone. The present project contemplates the reconstruction ayed or wrecked superstructure, substituting solid concrete in pla timber crib work. In the prosecution of the work of reconstr f the breakwater a considerable plant has been accumula on ng of steamboat, scows, steam derricks, engines, concret etc.

For the accommodation and large quantities of material, authority has been gran building of a dock with storage ground on the lake fro south pier.

Operations during the fiscal year. t the beginning of the year work was in progress, setting concrete blocks and getting machinery ready for mixing and carrying concrete. On July 4 a heavy gale washed 362 blocks, each weighing about 7 tons, from the breakwater. With the help of a diver the blocks were all recovered, the last having been raised August 23. The laying of the concrete began August 4, and was practically finished October 12. An experimental top parapet 300 feet long, 5 feet high, was begun October 17 and finished on the 19th. All top dressing was finished November 8. Prior reports describe machinery and method of construction, and it remains to note that a great volume of concrete was quickly and successfully laid, the cable road being a perfect success, and previous experience having led to skill and promptness in the details of construction. The length of the concrete superstructure built during the season is 1,967.9 feet. The volume of the concrete is 25,969.28 yards, the cost $213,165.69. This makes the cost per running foot $108.32, and per cubic yard $8.21. In 1889 this cost was $110.19 per foot, and $9.19 per cubic yard.

Experience and improved arrangement of the machinery, and especially the moving of cars by cable instead of by hand, account for the less cost.

The work on the extension of the breakwater was well started at the end of last year; the first crib was sunk July 17; the last crib, September 23; and the superstructure finished November 9. The length of the extension is 452.6 feet; the total cost, including the inspector, is $60,189.91, or $132.99 per running foot.

CONDITION OF THE WORKS.

Breakwater.—The concrete superstructure is ir
ing no settling or disintegration. The wooder

th of about 2,900 feet is in good condition, and will hold its own several years to come with minor repairs each year. The total th of the breakwater is now 6,803.9.

uth pier.—Has settled in some places, where too close dredging by city about 8 years ago had undermined it. These places were reed in 1887, but have settled again.

orth pier.—The Delaware, Lackawanna and Western Railroad Comy occupies this pier yet, notwithstanding the fact that the license such occupation was revoked by the Secretary of War on February 891. It is understood that the Department of Justice will take the ssary steps to protect the interests of the Government in this mat-

oathouse.—Is in fair condition.

o operations are proposed with funds on hand, they not allowing of ciently advantageous application. The next appropriation will be l in continuing the breakwater and in building more or less of the e arm.

Money statement.

1, 1891, balance unexpended	$269, 317. 42
nt received for cost of repair of damage to work	173. 95
yment	16. 70
Total	269, 508. 07
30, 1892, amount expended during fiscal year	230, 604. 08
1, 1892, balance unexpended	38, 903. 99
1, 1892, outstanding liabilities	15. 00
1, 1892, balance available	38, 888. 99
unt appropriated by act approved July 13, 1892	300, 000. 00
unt available for fiscal year ending June 30, 1893	338, 888. 99
ount (estimated) required for completion of existing project	146, 223. 17
ount that can be profitably expended in fiscal year ending June 30, 1894	146, 223. 17
mitted in compliance with requirements of sections 2 of river and arbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

Arrivals and departures of vessels for the year ending December 31, 1891.

Vessels.	Arrivals from—				Departures to—			
	Home ports.		Foreign ports.		Home ports.		Foreign ports.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
ners	2, 968	3, 604, 326	361	81, 538	2, 982	3, 588, 326	350	67, 788
s	......	....	558	76, 571	......	....	561	76, 973
g vessels	1, 387	691, 808	173	41, 885	1, 380	663, 635	155	36, 750
Total	4, 355	4, 296, 134	1, 092	199, 994	4, 362	4, 251, 961	1, 066	181, 520

ount of revenue collected during the year ending December 31, 1891, $827,595.76.
lue of imports same year, $4,859,602.
lue of exports same year, $539,588.
rease of tonnage in 1891, tons, 11,566.95.
sels enrolled at this port, 1891, 325.
atest draft of vessels, 16 feet.
w lines of transportation established, none.

Receipts by lake for the years ending December 31, 1886, 1887, 1888, 1889, 1890, and 18[illegible]

Articles.	1886.	1887.	1888.	1889.	1890.	18[illegible]
Grain.						
Wheat........bushels..	41,430,440	48,111,180	27,548,110	26,051,600	24,868,630	[illegible]
Corn ....do...	29,155,370	30,199,490	36,422,270	47,127,150	44,136,060	[illegible]
Oats...............do...	1,014,670	4,656,280	7,897,310	14,309,800	13,860,780	[illegible]
Barley ....do...	787,730	1,459,420	842,090	1,474,570	5,165,700	[illegible]
Rye ....do...	126,630	304,540	513,720	1,906,760	1,281,630	[illegible]
Flour (as grain) ..do...	22,910,950	20,006,800	26,224,650	27,403,550	....	[illegible]
Totals	95,425,790	104,737,710	99,448,150	118,273,430	....	[illegible]
Flour..........barrels..	4,582,190	4,001,360	5,244,930	5,480,710	6,245,580	[illegible]
Lumber.						
Headings......barrels..	75,000	....	....	....	....	......
Hoops ....number..	424,000	47,200	....	....	548,000	......
Lumber...........feet..	279,493,000	264[illegible]00	279,493,000	242,525,000	287,334,000	[illegible]
Lath ....pieces..	12,166,500	12[illegible]00	9,686,000	10,033,500	34,250,000	[illegible]
Railroad ties.number..	54,780	[illegible]80	196,600	442,570	197,110	[illegible]
Staves.............do...	1,289,500	1,980,350	945,000	200,000	970,000	[illegible]
Stave bolts ......cords..	9,710	6,450	9,100	3,120	6,560	
Shingles ......number..	58,582,000	36,705,000	58,582,000	36,331,500	73,500,000	[illegible]
Posts..............do...	255,000	7,000	4,000	15,000	48,000	[illegible]
Logs...............feet..	13,650,000	31,560,000	* 28,750,000	24,450,000	29,400,000	[illegible]
Other articles.						
Copper ......packages..	835	....	....	....	....	......
Copper ....tons..	24,968	87,611	28,164	28,853	40,436	
Copper, cakes and bars.	35,663	6,000	....	....	....	
Flaxseed ....bushel..	3,056,010	2,342,660	753,890	4,420,670	2,681,880	[illegible]
Feed ....sacks..	386,570	404,790	774,280	810,720	1,024,700	[illegible]
Iron ore..........tons..	28,430	30,760	248,850	298,000	551,940	[illegible]
Iron, pig ....do...	15,510	119,780	23,220	36,400	35,910	
Lead ....pigs..	106,770	195,590	116,820	265,130	424,550	[illegible]
Lard ....packages..	193,810	103,750	132,040	217,520	385,770	[illegible]
Oil cake...........do...	230,230	106,520	184,730	301,340	255,550	[illegible]
Pork ....barrels..	31,550	26,960	30,860	41,180	55,900	
Seed ....bags..	71,690	22,700	19,300	72,080	50,250	
Malt ....bushels..	....	....	....	234,640	482,710	[illegible]
Wool ....bales..	....	....	....	....	36,900	[illegible]

Principal exports by lake, 1886 to 1889.

Articles.	1886.	1887.	1888.	18[illegible]
Coal ....tons..	1,562,050	1,904,060	2,546,405	2,[illegible]
Cement and plaster.......................barrels..	378,940	413,890	370,790	[illegible]
Salt ....do...	126,040	109,120	143,460	[illegible]
Salt ....tons..	2,635	8,942	4,115	
Railroad iron..................................do...	45,894	40,528	14,914	

Principal exports by lake, 1890 and 1891.

Articles.	1890.	1[illegible]
	Tons.	*T[illegible]*
Coal	2,157,810	2.[illegible]
Cement and plaster..	105,794	
Salt	21,115	
Salt	2,637	
Railroad iron...	34,643	
Total..	2,321,643	2.[illegible]

N N 5.

?T OF TONAWANDA HARBOR AND NIAGARA RIVER, NEW YORK.

o provide a navigable channel from the entrance to the er at Lake Erie to the north end of Tonawanda Harbor.

Co remove obstructions so as to make a channel 400 feet feet deep, which includes work at the following places: reef known as Horseshoe Reef at the entrance of Niagara

shoal place at the head of Strawberry Island.

shoal places abreast of the lower end of Rattlesnake Island.

l width of the river between Tonawanda Island or Whites the main land along the entire front of Tonawanda.

ct was approved in 1888.

n to the above considerable work to be done in the channel r water works pier and a lately discovered shoal in the Reef Channel.

s during the fiscal year.—On May 30, 1891, bids were opened g rock, sand, gravel, and clay near Strawberry Island. t was awarded to Hingston & Woods, at $3.74 per cubic k excavation, measured in place, and 74 cents per cubic l, gravel, and clay dredging, measured in place. This coneen carried out, and the contractors removed 9,086 cubic k and 4,324 cubic yards of sand, gravel, and clay. The hannel through the shoal 200 feet wide and 16 feet deep at level. The total number of cubic yards removed near Island is 28,764.

eshoe Reef shoal was removed by the hire of dredge and r day and 1,650 cubic yards were removed, and much adhed or rolled into deep water.

0, 1892, bids were opened for removing obstructions in the rer and dredging Tonawanda Harbor. The contract was Hingston & Woods, dredging clay at 21 cents per cubic und, gravel, etc., 25 cents per cubic yard.

Money statement.

alance unexpended		$69,535.25
amount expended during fiscal year		40,392.86
alance unexpended		29,142.39
utstanding liabilities	$1,910.00	
mount covered by uncompleted contracts	25,000.00	
		26,910.00
alance available		2,232.39
priated by act approved July 13, 1892		75,000.00
able for fiscal year ending June 30, 1893		77,232.39
timated) required for completion of existing project		1,008,690.16
t can be profitably expended in fiscal year ending June		200,000.00

n compliance with requirements of sections 2 of river and ts of 1866 and 1867.

COMMERCIAL STATISTICS.

Arrivals and departures of vessels from Tonawanda Harbor, New York, season of 1

Vessels.	Arrivals from—				Departures to—			
	Home ports.		Foreign ports.		Home ports.		Foreign po	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*	*No.*	*To*
Steamers	297	144,625	78	24,452	308	150,108	71	[illegible]
Sailing vessels	694	283,567	57	21,161	703	287,047	45	[illegible]
Total	991	428,192	135	45,613	1,011	437,155	116	[illegible]

The decrease of tonnage in 1890 was 176,227.
Revenue collected December 39, 1891, was $72,948.22.
Value of imports, same year, $300,182.
Greatest draft of vessels, 13 feet.
No new lines of transportation established.
Principal imports and exports, lumber.

N N 6.

IMPROVEMENT OF WILSON HARBOR, NEW YORK.

Object.—To obtain a 12-foot channel from Twelve Mile Creek to I Ontario.

Project.—The first project for this harbor was submitted in 1 No action was taken on it. The second project, submitted in 1873, to extend piers to the 12-foot curve in Lake Ontario, to dredge a cl nel, 12 feet deep, between the piers, and 100 feet wide from the sl end of the piers to the deep water in the creek.

Present works.—The present works are the east and the west pi and a shore protection. The piers are the prolongation of piers b by private parties in 1846, and extend to the 12-foot curve in L Ontario. The shore protection joining the shore end of the east was built in 1888, and is 360 feet long. The channel has an avail depth of 9.5 feet at mean lake level for a width of 100 feet from west pier. During the fiscal year ending June 30, 1892, the lake of the west pier has been repaired at a cost of $75.

CONDITION OF THE WORKS.

West Pier.—The pier needs repairs, as follows: Starting from th land end, the first 200 feet is entirely rotten, and should be entirely built from the cribs; the next 150 feet is in good condition; the next feet is much decayed at many parts, and in two places is much sunk of line, dipping both to the east and to the west.

This last length should be rebuilt, at least from low water, an may possibly be necessary to rebuild a part of the cribs, in orde level them off. The remainder of the pier is in good condition, ex the extreme end, which was considerably damaged during the past years. The end crib with superstructure should be rebuilt.

East Pier.—This pier requires about 75 new planks to replace those ayed in its flooring in various places throughout its length. A porn of the west side should be rebuilt from the water line upward for ength of 50 feet, the present timbers being much rotted. It would well also to sheath the end of this pier with plate iron.

Shore protection is in good condition.

The channel.—This is now in fairly good condition. It is available, mean lake level, for vessels drawing 8.5 feet. The amount of rock veloped in the course of the dredging, as required to be removed in ler to obtain a full depth of water, was much greater than originally pposed. The latest examinations give the quantity to be taken out, order to obtain a depth of 12 feet, as 4,200 cubic yards in place. The ount of dredging yet to be done is about 700 cubic yards in place. this rock should be removed at any future time, it would be well to mp it along the lake sides of the piers.

Estimated cost of the work.—In order to complete the present project e following work is necessary—the removal of 4,900 cubic yards [in ace] of material from the channel. This will cost—

place:

4,200 cubic yards rock excavation, at $3 per cubic yard	$12,600
700 cubic yards dredging, at 30 cents per cubic yard	210
Total	12,810
Contingencies, 10 per cent	1,281
Total	14,091

The necessary repairs to the piers are estimated to cost $13,364.20.

The total cost of the work that should be done to carry out the proj; is:

ening the channel	$14,091.00
pairs of piers	13,364.20
Total	27,455.20

This work can all be done in one season; if only one of the items be ken up, it should be the repairs of the piers. There being no funds hand, nothing is proposed to be done.

Money statement.

ly 1, 1891, balance unexpended	$100.25
ne 30, 1892, amounted expended during fiscal year	78.76
ly 1, 1892, balance unexpended	21.49
mount (estimated) required for completion of existing project	27,455.20
mount that can be profitably expended in fiscal year ending June 30, 1894	27,455.20

ubmitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Arrivals and departures of vessels for the year ending December 31, 1891.

Vessels.	Arrivals from—				Departures to—			
	Home ports.		Foreign ports.		Home ports.		Foreign ports.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
Steamers	.....	.....	39	9,282	.....	.....	39	[illegible]
Sailing vessels	1	280	3	213	2	319	5	[illegible]
Barges	.....	.....	.....	.....	.....	.....	.....	
Total	1	280	42	9,495	2	319	44	[illegible]
Total, 1890	5	562	46	12,067	5	562	43	12,[illegible]

Amount of revenue collected during the year ending December 31, 1891, $103.9[illegible]
Value of imports same year, $2,419.
Value of exports same year, $678.
Decrease of tonnage same year, 5,527.
Vessels enrolled at this port, none.
New lines of transportation established, none.
Principal imports, lumber, shingles, and posts; principal exports, fruit.

N N 7.

IMPROVEMENT OF OLCOTT HARBOR, NEW YORK.

Object.—To obtain a protected channel 13.5 feet deep at mean lake level from Lake Ontario to the bridge crossing Eighteen Mile Creek at Main street.

Project.—The first project for this work was submitted in 1846, but it was not executed. The present project was adopted in June 18, 1891, and is substantially the project of 1866, with some enlargements. It provides for two piers extending into the lake with a channel between them. The piers are nearly parallel to each other, about 200 feet apart. The east pier is 850 feet long, and the west pier 873 feet. Between the piers the channel is about 180 feet wide, the limiting lines being 10 feet from the piers, and from the shore ends of the piers it decreases to 98 feet in width at the Main Street Bridge. The channel depth is 13.5 feet, measured from mean lake level.

Present works.—East and west piers, and the channel between them.

Operations during the fiscal year.—In the river and harbor act of 1890 the amount of $30,000 was appropriated for this harbor. Contracts were made with Ira Farnsworth for the repairing of the piers, and with Hingston and Woods for channel excavation. Both contracts have been carried out. The piers have been placed in a good condition at an expense of $8,991.87, and the channel has been excavated to the required depth at an expense of $15,213.48. Ten thousand two hundred and eighty-seven cubic yards of rock, at the rate of $1.24 per cubic yard, and 10,140 cubic yards of sand, gravel, and clay, at the rate 24 cents, have been removed.

Condition of works.—Both piers are in good condition, and the channel has the full depth between the limits as given.

sed operations.—The project for this harbor is completed, and aining funds will be used for maintenance.

Money statement.

91, balance unexpended	$30,296.94
1892, amount expended during fiscal year	24,800.71
92, balance unexpended	5,496.23
92, outstanding liabilities	17.00
92, balance available	5,479.23

COMMERCIAL STATISTICS.

rrivals and departures of vessels for the year ending December 31, 1891.

Vessels.	Arrivals from—				Departures to—			
	Home ports.		Foreign ports.		Home ports.		Foreign ports.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
	2	32	4	651	3	51	4	651
ssels	1	76	18	764	1	76	16	622
1	1	108	23	1,415	4	127	20	1,273
			1	12			1	12

t of revenue collected during the year ending December 31, 1891, $371.21.
of imports same year, $4,229.85.
of exports same year, $1,820.15.
se of tonnage same year, 2,911.
s enrolled at this port, none.
st draft of vessels, 10 feet.
nes of transportation established, none.
pal imports, lumber; and principal exports, fruit.

N N 8.

IMPROVEMENT OF OAK ORCHARD HARBOR, NEW YORK.

t.—To furnish a protected channel 200 feet wide and 12 feet om deep water in Lake Ontario to deep water in Oak Orchard

ct.—The original plan for this improvement, adopted in 1836, ed in contracting the mouth of the creek to 200 feet by two break-running from the shore, one on each side, and a channel between rallel piers from the 12-foot curve in the creek to the same curve ake. This project, except as to the breakwaters, is still in force.
nt works.—The present works are the east and west piers and a rotection. The piers extend to the 12-foot curve in the lake.

ction, beginning at the shore end of the east pier, w
d is 91 feet long. The channel has a depth of 13.5 f
rel for the whole width between the piers, excepting
eet al... each pier.

Operations during the fiscal year.—In the river and harbor act
1890 the amount of $5,000 was appropriated for this harbor. Contr
as made with Hingston & Woods to widen the channel at the r
$1.40 per cubic yard for rock excavation and 34 cents per cubic ya
r mud, sand, and gravel measured in place. Three thousand thr
ndred and eighty-eight cubic yards of rock and 350 cubic yards
mud, sand, and gravel have been removed, giving a channel of 13.5 f
depth below mean lake level.

Condition of the works.—The east pier and the shore protection a
in good condition and need but slight repairs—a few planks for dec
ing. The west pier has settled for a length of 130 feet about 2¼ f
on the harbor side, where t... ...rsects the shore line; also on t
outer end toward the lake. Both settlements were caused by ve
rough weather in the fall of 1891 dur ng the low stage of water, 2.2 f
below mean lake level, under... those places. The channel is
good condition.

Proposed operations.—If t... hand allow it, the settled porti
of the pier will be repaired. ...ect of this harbor has been co
pleted, but a certain amount o... y should be appropriated to ke
it in repair.

Money s... ement.

July 1, 1891, balance unexpended	$5,485
June 30, 1892, amount expended during fiscal year	4,963
July 1, 1892, balance unexpended	522
July 1, 1892, outstanding liabilities	8
July 1, 1892, balance available	513

COMMERCIAL STATISTICS.

Arrivals and departures of vessels for the year ending December 31, 1891.

Vessels.	Arrivals from—				Departures to—			
	Home ports.		Foreign ports.		Home ports.		Foreign p	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*	*No.*	*To*
Steamers	6	131	......	......	6	131	......	......
Sailing vessels	1	76	4	692	4	586	1	
Total	7	207	4	692	7	717	1	
In 1890	......	......	5	250	......	......	5	

Amount of revenue collected during the year ending December 31, 1891, $196.8
Value of imports, same year, $2,282.
Increase of tonnage same year, 1,298.
Greatest draft of vessels, 10 feet.
New lines of transportation established, none.
Principal imports and exports, lumber, shingles, and posts.

N N 9.

[Printed in House Ex. Doc. No. 67, Fifty-second Congress, first session.]

PRELIMINARY EXAMINATION OF PORT DAY, ABOVE NIAGARA FALLS, NEW YORK.

UNITED STATES ENGINEER OFFICE,
Buffalo, N. Y., February 28, 1891.

GENERAL: In accordance with the provision of the river and harbor act of September 19, 1890, directing an examination of Port Day, above Niagara Falls, and Department letter of September 20, 1890, assigning the examination to my charge, I have the honor to submit the following report of preliminary examination:

Port Day is the name given to the head, or entrance from Niagara River, of what is known at Niagara Falls as the Hydraulic Canal, and about 2,000 feet above the head of Goat Island.

In November, 1880, an examination of this locality was made under the direction of Maj. Walter McFarland, and his report may be found in the annual report of the Chief of Engineers, U. S. Army, for fiscal year ending June 30, 1881, page 2454. From this report it will be learned that at the time of the first examination the improvement contemplated was to provide a safe water communication between Niagara Falls and Tonawanda, on the Niagara River, 10 miles above, where connection could be had with the Erie Canal. The improvement suggested in the report was the making of a good and secure channel through which canal boats drawing 5 feet of water could pass to Port Day, by making a cut close to the American shore through the rocky ledge forming the Schlosser Rapids, the estimated cost of which was $17,000.

After some correspondence with the authorities of Niagara Falls, my inquiries concerning the nature and extent of improvement contemplated and the demands of commerce for such improvement were referred to the Cataract Construction Company, who are engaged in the construction of the tunnel and works of the Niagara Falls Power Company. Upon meeting the resident engineer of the company, Mr. Albert H. Porter, at Niagara Falls, I was shown the plans of the company, and was informed that the improvement of river desired was to furnish a channel for the navigation of lake vessels to convey raw material to, and the manufactured products from, the extensive factories and works, in addition to those now existing, which it was expected would in the near future be established at Niagara Falls upon the completion of the development of the enormous water power now under way.

The plans upon which work is in progress are estimated to develop 120,000 horse power, which is said to be equal to the water power of

Lawrence, Holyoke, Turners Falls, Manchester, Bellows Falls, Lewi ton, Cohoes, Oswego, Patterson, Augusta, Ga., Minneapolis, Rochest and Lockport combined. With this immense power developed, with uncertainty concerning its continuance, and in a central and otherw favorable locality, it would seem that a very large commerce must soon built up which would justify very considerable improveme in the way of providing for cheap water transportation. This la prospective commerce, however, though it may be considered well sured, is in the future more or less distant.

At this present the commerce of Niagara Falls may be estimated the following statement of annual output of manufacturing establ ments as furnished by the Business Men's Association of Niagara F

Articles.	Quantity.	Va
Flour ... barrels..	942,000	$4,
Paper and pulp ... tons..	9,156	
Barrels ...	603,600	
Blank books ...	...	
Beer ... barrels..	40,000	
Other industries ...	...	
Total ...	...	6,

Twenty-seven thousand cars of mill freight are now handled year.

From the above it will be seen that this locality is already a m facturing center of no small importance, and with the greatly incr future importance which seems to be well assured to it, it appea me to be a locality worthy of improvement with regard to its communications.

Work now in progress on the upper part of the Niagara Rive furnish a channel 16 feet in depth as far as Tonawanda, and from awanda to a point near the head of Conners Island, about 2¼ miles Port Day, there is shown on the lake survey chart a channel w least depth of 11 feet, and for most of the distance a least depth feet. This channel is on the east side of Grand Island. A channel exists on the west side of this island, but to reach Port from the latter channel would necessitate the crossing of the rive point not more than 2½ miles above the falls, which is entirely too ardous for the ordinary and constant use of a commercial highwa

An examination of the accompanying map, showing the soun recently made by the Cataract Construction Company from Port up to a point above Conners Island, indicates that a navigable ch could be made on a line just inside of Grass and Conners island comparatively small cost. Unfortunately, in the company's su borings were not made far enough out in the stream to show the n of the bottom in the deeper water, but such borings as were made cate that there is considerable gravel, and the bottom contours ju side of the two islands would seem to show that the gravel is of depth that a good channel could be made without much rock ex tion, except on the crossing of Schlosser Rapids. The current and below these rapids is not of very great velocity, the water s having a gentle slope, while in crossing the rapids it falls about

An embankment extending from Port Day to the foot of Grass I and from the head of the island to the head of the rapid, about feet altogether, would give an additional depth of 1 foot below th nake a safe entrance to Port Day. In my opinion it would be e to make a survey at this locality to ascertain more definitely r surfaces, and the nature of the bottom that would have to be d to provide a channel with a depth, say, of 13 or 14 feet. The hould cover the distance from Port Day to deep water just nners Island, and a few points on the river above. The esti- st of such a survey is $500. I am indebted to the courtesy of ert Porter, engineer of the construction company, for a map* ings in the vicinity of Port Day, a copy of which is appended, with a map* of the Niagara River from Tonawanda to Niagara larged from the lake survey chart.

ery respectfully, your obedient servant,

AMOS STICKNEY,
Major of Engineers.

Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

gh Col. Henry L. Abbot, Corps of Engineers, Division Engi- rtheast Division.)

[Third indorsement.]

NORTHEAST DIVISION, ENGINEER OFFICE,
New York, March 10, 1891.

tfully returned to the Chief of Engineers, U. S. Army. It is on that Port Day above Niagara Falls is worthy of improve-

HENRY L. ABBOT,
onel of Engineers, Brevet Brigadier-General, U. S. Army,
Engineer Northeast Division.

RVEY OF PORT DAY, ABOVE NIAGARA FALLS, NEW YORK.

UNITED STATES ENGINEER OFFICE,
Buffalo, N. Y., December 31, 1891.

RAL: I have the honor to submit the following report on the f Port Day above Niagara Falls, N. Y., and upon plans with s of cost for navigable channels to that point.

report of February 28, 1891, upon the preliminary examina- his locality, it was stated that the improvement desired was to a navigable channel for lake vessels. In order to obtain the y data for planning such a channel, and for making estimates t was necessary to make a survey that would not only cover ediate vicinity of Port Day, but several points on the river ie lake survey charts showed shoal places as far up as Tona- Authority having been received for such a survey, a party was the field under the charge of Mr. Ernest Siegesmund, assist- neer. The principal part of the survey was made in July and 1891, and was supplemented by a few days' work in December, supply some information which the plotting of the notes showed eded. The results of the survey are presented in the charts

* Omitted.

anying this report. The soundings in the charts are ... possible to a stage of river corresponding to a stage ... feet below the mean level at Buffalo. This stage very nea... corresponds to the lowest stage of the river at Port Day during the past five years. Any lower stage would be of exceedingly rare occurrence. In the adopted project for the improvement of the Niagara River from Lake Erie to Tonawanda the channel is 400 feet wide and 18 feet deep at mean lake level, which is intended to accommodate the largest class of lake vessels.

To continue the channel for vessels of this class from Tonawanda to Port Day, maintaining the 18-foot depth, but with decreased widths, would cost an exceedingly large sum of money, far beyond any amount the expenditure of which would be justified by the possible demands of commerce in the near future. To make such a channel at the least cost, work would be required ov... stretch of river and beyond the limits of this survey, as it ... at the least expensive method would be to reduce the ex... sing the water surface inside of a long embankment, exten... he river as might be necessary. This is made evident by ... of the amount of excavation necessary for a channel ... nbankment from Port Day to Conners Island, and in ope... which shows that 1,966,499 cubic yards of solid rock wo... excavated, which, estimated at $4 per yard, would cost $... inquiry then presents itself as to whether any channel c... thin a reasonable cost of sufficient size to accommo... of a smaller class. An examination of the charts s... v... channel exceeding the depth of 12 feet at mean lake level, ... ow-water stage, a large amount of rock excavation would be necessary between Tonawanda and the head of Conners Island, in addition to the excavation that will be necessary for any channel below Conners Island. For that depth (12 feet at mean lake level) there is a natural channel, of ample width, for the whole distance from Tonawanda to near Conners Island, except the crossing of a reef about 9,000 feet above Cayuga Island, where the channel would have to be excavated for a distance of about 1,500 feet. As a channel of this depth would permit the passage of a smaller class of lake vessels, an estimate of the cost is presented, which is $1,341,029.80. This is still a very large sum, but a channel with less depth than 12 feet at mean lake level for lake vessels is hardly worth considering.

The proximity of the Erie Canal, connection with which can be made from the Niagara River at Tonawanda, makes it proper, however, to consider smaller channels such as would serve for the passage of canal boats. Estimates are therefore added for a channel of 7 feet depth at low water, which is the depth on the lock sills of the Erie Canal, and for 6 feet depth at low water, which is 8 feet at mean lake level, and which would have a depth of 7 feet for the greater part of the season of navigation. An examination of the charts shows comparatively deep water in the river within about 1,000 feet of Port Day, but it can not be utilized for a channel for navigation, as it is within 1 mile of the falls; and even if it were possible to make a safe channel by inclosing it with a dike, there would still be required a large amount of excavation to make harbor room inside of Grass Island. I therefore deem imperative to locate the channel inside of the line connecting Co... and Grass islands, where, inside of a dike, vessels would be e... safe, and the approach to which from the river above would l... In all of the plans presented the width of the channel provide... as follows: In open river, 300 feet; from Conners Is...

200 feet; from head of Grass Island to Port Day, a gradual ment from 200 feet to 400 feet, to allow for harbor room and space. In all of the plans provision is made for a loose stone kment extending from Conners Island to Port Day. This em- ent would be made entirely from the rock excavated from the l, suitable portions of which could be selected and laid so as to facing on the slopes. The embankment would serve three pur- First, it would be a guard to prevent vessels being drawn to- the falls; second, it would raise the water surface in the channel, ore than pay for itself in reducing the amount of excavation; t would be a guide for vessels navigating the channel. At the the survey the fall of water surface from the head of Conners to Port Day was 1.795 feet. It is estimated that with the in- embankment this fall would not exceed two-tenths of a foot, as ape of water would be only that which leaked through the stone kment and the amount used by mills. The variation in the water f the river depends, of course, upon the variation of the level of rie at the head of the river, except in the case of minor oscilla- ue to wind, which are of short duration.

xamination of the records kept in this office of the readings of rie water gauge shows the following stages of the water during iods of navigation from May 1 to December 1 for five years, from 1891, inclusive:

Year.	1 to 2 feet above zero.	Zero to 1 foot above.	Zero to 1 foot below.	1 to 2 feet below zero.
	Days.	*Days.*	*Days.*	*Days.*
....	19	148	44	3
....	0	71	135	8
....	1	33	123	57
....	14	114	86	0
....	1	2	144	67
l	35	368	532	135

zero of the gauge is at the mean lake level.

level of the lake is below a stage of minus 2 feet so seldom as not orth considering. From the above table it will be seen that the one thousand and seventy days of navigation of the past five he lake surface was more than 1 foot below zero 12.62 per cent total number of days; below zero, 62.34 per cent; at or above 7.66 per cent; more than 1 foot above zero, 3.27 per cent. In a l 12 feet deep at mean lake level, or 10 feet at a stage of minus 2 ere would be 10 feet least depth practically at all times. Eleven pth or more for 87.38 per cent of the time; 12 feet depth or more 6 per cent; 13 feet depth or more for 3.27 per cent. The ex- scillation of the lake surface at Buffalo during the past five years .99 feet, being from 3.2 feet below to 7.79 feet above zero. The ex- scillation of the Niagara River surface at Port Day during the x years, was 6 feet, being from 2 feet below mean surface to 4 feet mean. The highest and lowest stages were caused by storms.

following is a summary of the estimates of cost of navigable ls of various depths from Tonawanda to Port Day:

eet depth at mean lake level (if excavated in open river above s Island)	$8,694,824.60
eet depth at mean lake level	1,341,029.80
et depth at mean lake level	380,377.80
et depth at mean lake level	257,829.00

With regard to the commercial need for a navigable channel to Day, I have to add to what was stated in my preliminary report th commerce of Niagara Falls has increased about 20 per cent in the year. I am informed that it is the intention of the company contr the Hydraulic Canal to double the capacity of the canal, whicl furnishes the power for most of the manufacturing establishme Niagara Falls. The Cataract Construction Company, engaged development of an enormous water power, have vigorously push work on one of their tunnels during the past year, and it is now n completion. This one tunnel, it is estimated, will furnish one hu thousand horse power, and negotiations are now pending for th use of sixty thousand horse power by various manufacturing int Work on another tunnel of equal or greater capacity will, it is stood, be commenced in a short time.

The completion of the development of this enormous power, un control of a company whose stockholders represent an immense of capital, can not fail to build up a manufacturing center whi consume large amounts of raw material, such as grain, lumber, o that will be largely obtained from the Northwest, whence tran tion by vessels on the lakes will be the cheapest method of these articles to the mills, and after being manufactured into the products of the mills their return to the westward by the lak transportation eastward by the Erie Canal will be the cheapest getting them to their markets.

As stated in my preliminary report, this very large prospecti merce, though seemingly well assured, is in the future; but already a considerable commerce, and the assurance of great inc an early day is very strong.

The only navigation of the river below Tonawanda at present steamboat of light draft (5 feet) running between Buffalo and ing at the foot of Sugar street, Niagara Falls, opposite Conners The principal business of the steamer is to carry excursionists.

If it should be decided to enter upon the work of improve this part of the river I would recommend that a beginning sh made by providing for a navigable channel of the lesser depth could be increased as the increase of commerce should dema channel 8 feet deep at mean stage is estimated to cost $ According to the experience of the past five years, such a would provide a least depth of 6 feet at all times during the se navigation, a least depth of 7 feet for 87.38 per cent of the ti a least depth of 8 feet 37.66 per cent of the time. No work w required above Conners Island. A water route would be op Tonawanda and Buffalo, and by connection with the Erie Canal ern points, which would be navigable for the largest class of that can use the canal. A channel with a least depth of 12 feet stage, extending as far down the river as Conners Island, c made at an estimated cost of $149,749.60. Attention is invited accompanying letters of Messrs. Albert H. Porter, John J. Ma and Lautz & Long.

I am indebted to Mr. Albert H. Porter, resident engineer, a George B. Burbank, consulting engineer of the Cataract Const Company, for information and courtesies extended.

The report of Mr. Ernest Siegesmund, assistant engineer, is ap

Accompanying this report are the charts * (five sheets) show sults of the survey, with channels laid out upon them; also a

* Omitted.

* of the town of Niagara, N. Y., showing the hydraulic canal, of tunnel, and proposed canal of the Niagara Falls Power Company, the shore line of the river up to and including Cayuga Island, with oad connections.

Very respectfully, your obedient servant,

AMOS STICKNEY,
Major of Engineers.

rig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

REPORT OF MR. ERNEST SIEGESMUND, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Buffalo, N. Y., December 19, 1891.

JOR: According to your order dated July 23, 1891, to survey the Niagara River e Port Day to determine a plan for making a safe navigable channel for large ls from Tonawanda to Port Day, I made preparations at once and started from lo July 24, in the morning, with a steam launch, a rowboat, one recorder, and aborers. Neither the captain of the steam launch nor I had ever been at Port but as we had to go there with the launch, I laid out a course northerly of Island, near the mouth of Chippewa Creek to Port Day, according to the lake y of 1875. This course proved the correctness of the map in this vicinity ughly. We arrived safely, to the great astonishment of many persons watch- ur crossing of the river.

t Day is the name of the inlet of the hydraulic canal, half a mile above the s, in the village of Niagara Falls, furnishing water power for several flour , barrel factories, paper mills, etc. This canal was planned and commenced by stus Porter in 1847. But this was not the first attempt to utilize the water r of the Niagara River. It was made in 1767 by a British officer, De Peyster, erected a sawmill near the foot of the present mill stream. In 1800, Mr. Sted- erected mills a little below this point.

1886, the Cataract Construction Company was incorporated and commenced l operations October, 1890, to develop 120,000-horse power for manufacturing oses. This company must be called the instigator of the present movement to ove the Niagara River above Port Day. It is not only the owner of the power, lso of many acres of land along this power, and it has the intention to erect ries as well as sell privileges. It is desirable for these factories to have the material of the West brought directly to their doors. To do this the Niagara r needs deepening.

e report of the preliminary examination was made February 28, 1891. It recom- led a survey of the river as "worthy of improvement." This recommendation approved; $500 allowed, and the survey ordered March 11, 1891. The survey nenced July 24, and was finished August 15, 1891. After plotting the field notes is survey, it was found necessary to cover about 4,000 feet westerly from sheet , near Gratwick's dock, with soundings in order to get the extent of the ledge ing across the river at this point. These soundings were taken December 10 to 891, and at once plotted. I started at Port Day and surveyed the shore line to e Conners Island, a distance of about 2¼ miles. Triangulations were made to y Island, Buckhorn Island, and Grand Island, but I found that the limits of your t were somewhat too far extended to be covered with the amount of money on l, and with your consent I narrowed it down; that is, I covered all the essential ts on the American side and left out the Canada side, Navy Island, Buckhorn id, and Grand Island.

e survey has been divided in three parts:

.1 from Port Day to above Conners Island.

.2 above, in front, and below Cayuga Island.

.3 below Gratwick's dock.

ese points were selected, as an examination of the lake survey map of 1875 ed shoal places in these localities.

the running of the shore line with the transit, as shown on Sheet No. 2, s commenced.

..undings were taken in the following manner: All the lines from the shore

---

* Omitted.

observations had been taken by the Cataract Construction Com
these gauges were read mornings and evenings during the su
since 1886 show that the mean stage of the water at Port Day
this gauge of 575.246. The lowest water during this period oc
gauge reading 573.2. All soundings are reduced to this gauge
low mean water level. The highest water occurred January 1
ing 579.2.

The average gauge reading during the survey at Port Day w
mean stage; at Cayuga Island, −0.2 foot below mean stage; at G
foot below mean stage; difference between highest and lowes
period 0.4 foot. Two extra gauges were set above and below S
a line of levels run from the Port Day gauge to these gauges, to
ing opposite Conners Island, at the foot of Sugar street, and to
Island, giving a rise of water surface of 1.795 feet between Por
of Conners Island.

Borings were made around the islands and along the shore,
tion of mud and sand had taken place.

On all important points current measurements were made w
kindly loaned by Albert H. Porter, resident engineer of the Ca
Company, at Niagara Falls.

The bottom of the first section is all bare rock; only around t
the main shore is a small accumulation of mud, sand, etc.
steamboat landing at the foot of Sugar street went through 4 f

The second section at Cayuga Island is also rock bottom, he
thin covering of sand or mud in the indentations of the rock su
mulation along the island. Piles driven for a dock went throug

The third section at Gratwick's dock is rock in the center of t
main shore and Grand Island is some sand and mud. After plot
you determined to submit four projects for the improvement by

1. A channel, with embankment for vessels of all sizes now nav
   feet deep at low water. The estimate is based on rock ex
   river for the whole length.
2. A channel with embankment 10 feet deep at low-water mark.
3. A channel with embankment 7 feet deep at low-water mark.
4. A channel with embankment 6 feet deep at low-water mark.

This low-water mark is 2 feet below mean stage of the rive
respectively call for 18 feet, 12 feet, 9 feet, and 8 feet at the mea
The first project would give a continuous channel of 18 feet dep
Port Day, as the project for improving the Niagara River from
wanda, giving an 18 foot channel, is already approved and unde

ıw water. The embankment will be 6 feet wide on top with slopes 1:1½, ›bove mean, the highest water known according to gauge readings at ıce 1886. The center line of this embankment is intended to be 50 feet therly line of the channel, and is 9,000 feet long.

ıkment will inclose the area from Conners Island to Grass Island and to his will raise the water at Port Day about 1.59 feet, allowing 0.2 fall for ugh the embankment.

3 shows no excavation is needed near Cayuga Island for a 6-foot, 7-foot, annel; the 16-foot channel requires excavation for a length of about

4 shows no excavation is necessary for a 6-foot, 7-foot, or 10-foot chan- ,600 feet in length must be excavated for 16-foot channel.

5 shows no excavation necessary for a 6-foot or 7-foot channel; for a 10- a cutting through a ledge across the river for a length of about 1,500 ›sary; for 16-foot channel a length of about 10,000 feet must be exca-

ESTIMATED COST.

Project No. 1.

›l 16 feet deep at low water or 18 feet at mean-water level, 300 feet wide ›er and 200 feet wide below Conners Island, with embankment to Port

›avation, 1,966,499 cubic yards in place, at $4 per cubic ...	$7,865,996.00
ment: Placing 83,300 cubic yards of loose rock in line of kment, at 25 cents per cubic yard ...	20,825.00
vith selected stones laid by hand, 23,420 square yards, at ts per square yard ...	17,565.00
	7,904,386.00
›ncies, 10 per cent ...	790,438.60
›tal ...	8,694,824.60

Project No. 2.

›l 10 feet deep at low water or 12 feet at mean water level, 300 feet wide ›er and 200 feet wide below Conners Island, with embankment to Port

cavation, 295,182 cubic yards in place, at $4 per cubic ...	$1,180,728.00
ment: Placing 83,300 cubic yards of loose rock in line of kment, at 25 cents per cubic yard ...	20,825.00
vith selected stones laid by hand, 23,420 square yards, at ts per square yard ...	17,565.00
	1,219,118.00
›ncies, 10 per cent ...	121,911.80
...	1,341,029.80

Project No. 3.

›l 7 feet deep at low water or 9 feet at mean water level, 200 feet wide, nkment from Conners Island to Port Day:

›avation, 76,852 cubic yards in place, at $4 per cubic yard..	$307,408.00
ment: Placing 83,300 cubic yards of loose rock in line of kment, at 25 cents per cubic yard ...	20,825.00
vith selected stones laid by hand, 23,420 square yards, at 75 ›er square yard ...	17,565.00
	345,798.00
›ncies, 10 per cent ...	34,579.80
...	380,377.80

Project No. 4.

For a channel 6 feet deep at low water or 8 feet at mean water level, 200 feet wide, with embankment from Conners Island to Port Day:

Rock excavation, 49,000 cubic yards in place, at $4 per cubic yard....	$196,
Embankment: Placing 83,300 cubic yards of loose rock in line of embankment, at 25 cents per cubic yard..............................	20,
Facing with selected stones laid by hand, 23,420 square yards, at 75 cents per square yard...	17,
	234,
Contingencies, 10 per cent..	23,
Total...	257,

Finally, please allow me two remarks: Would it not be most economical and advantageous to the Government, if any of the projects for improvement of the Niagara River above Port Day is approved and adopted, to let the whole work in one contract and not divide it into small contracts according to the appropriations made? It requires a special plant adapted for this locality. None of the drill boats, dredges or scows at the present time on the lakes could do the work on account of lack of water.

If any one of the projects is adopted, would it not be well to connect the Buffalo gauge with the Port Day gauge by a line of levels, establish bench marks, and water gauges on all points where improvements are contemplated, in order to have more definite data than at present on hand? The mean lake level is known; the mean stage of the water at Port Day is also known. What is needed is to establish the mean stage of the water on all necessary points along the river, a distance of about 23 miles.

Annexed please find a letter from Mr. MacIntire, vice-president of the Business Men's Association at Niagara Falls, giving statistics of the place from January 1 to November 1, 1891.

A letter from A. H. Porter, resident engineer of the Cataract Construction Company, giving details of the work done during the same period.

A letter from Messrs. F. C. M. Lautz and Long, proprietors of Cayuga Island, setting forth their intentions.

Very respectfully, your obedient servant,

ERNEST SIEGESMUND,
Assistant Engineer.

Maj. AMOS STICKNEY,
Corps of Engineers, U. S. A.

LETTER OF MR. JOHN J. MACINTIRE.

NIAGARA FALLS, N. Y., *November 4, 189*

MY DEAR SIR: In reply to your inquiry of this date regarding the amount of business done by the different industries at this place, I beg to hand you the inclosed statement. The figures given are as near the actual figures as can be given without going over the records of the different firms. I take pleasure in calling your attention to the rapid increase in the volume and value of the output of our mills and factories during the past year.

The best indication of the rapid growth here is the increase in the freight traffic by the railroads here, said increase being 20 per cent during the past year.

I trust the information given will be such as you require.

Very truly yours,

JOHN J. MACINTIRE.

E. SIEGESMUND, Esq.

ınd value of output of the mills and factories at Niagara Falls, N. Y., January 1 to November 1, 1891.

Industries.	Output.	Value.	No. of employés.	Wages.
s	954,000 barrels	$5,247,000	120	$54,000
lls	12,000 tons	675,000	148	52,500
s	5,400 tons	129,600	42	17,260
orks	568,000 barrels	189,450	136	51,400
company	36,000 barrels	252,000	43	22,680
te and chain works		209,000	228	56,200
k manufactory		343,000	176	41,750
firms		293,000	178	112,160
power company		20,000	8	5,000
works		38,000	28	17,320
s	178,000 boxes	11,000	36	3,900
l		7,407,050	1,143	434,170

ight business now averages per day, 70 car loads in; 45 car loads out.
has been signed and recorded at the county clerk's office between the Soo Company of Chicago and the Niagara Falls Power Company for 3,000 wer for forty-five years at $24,000 a year. The first quarterly payment of ıal rent has to be made December 1,1892. The Soo Paper Company's mills so it is said, the largest establishment, both wood pulp and paper, in the States, perhaps the world. They will be built principally on made land, Tenth, Buffalo, the southern extension of Bademan street and the Niagara ıd will cover from 11 to 12 acres. Their output is expected to be more than ined output of the present four paper and three pulp mills.

OF MR. ALBERT H. PORTER, ENGINEER, CATARACT CONSTRUCTION COMPANY.

NIAGARA FALLS, N. Y., *November 14, 1891.*

SIR: Your letter of October 31 in reference to notes of progress on the tunnel the report of your office is received.

esent contract includes the construction of a tunnel and open cut 6,700 feet soffit of which lies at an average depth of 170 feet beneath the surface, the ing seven-tenths per cent.

ross section is to be 335.5 square feet, and of uniform area; excavation to when necessary with permanent timbering in five block timber arches with and tunnel to be lined throughout with four rows of brick.

was commenced on October 4, 1890. On November 1, 1891, 3,437 feet of had been driven, and 2,938 feet of bench had been taken out, 3,093 feet of remaining yet to be excavated.

3,437 feet of heading driven, 2,877 feet was permanently timbered, 394 feet or masonry section.

eadings and first bench are to be taken out until headings meet, when the ench is to be excavated to the required depth, and the masonry put in as as the preparation of the excavation admits.

quantities of brick and other material are already on the ground.

reater part of the tunnel thus far constructed lies in gray slate and shale, ting temporary timber support in headings for the safety of the men, and g that the permanent timbering be kept up within a short distance of the

780 feet from the east bank of the lower river a stratum of Queenston limeıs encountered which forms a substantial roof, no permanent timber being l. At this point rapid progress was made, 78 feet of heading being driven ne week of thirteen shifts.

mpany is at present excavating the first section of their canal, and filling nkments on the lands under water, forming the same. The earth is loosened ing and thrown into scale boxes, which are raised from the pits by travelicks mounted to run along the banks. These boxes are placed on trucks from the derricks and rapidly hauled to the point of fill. Excellent rock ide walls is being taken from the excavation, steam drills being used on the Both centrifugal and cylinder pumps are used in keeping excavation clear of

ours very truly,

ALBERT H. PORTER,
Engineer.

RNEST SIEGESMUND,
Assistant Engineer.

LETTER OF MESSRS. FRED. C. M. LAUTZ AND BENJAMIN G. LONG.

BUFFALO, N. Y., *July 31, 1891*

DEAR SIR: The undersigned, owners of Cayuga Island, desire to call your att
tion to the fact that we have purchased and commenced to improve the aforesa
island to the end that it may be utilized for commercial purposes. Cayuga Islan
containing 140 acres, has a river frontage of 6,800 feet which can be utilized f
dockage if a navigable channel connecting with Lake Erie is brought contiguo
to it.

You are undoubtedly aware of the fact that the river front in and about To
wanda has already been taken up with docks and mill sites, and that a move farth
down the river for commercial purposes, especially in view of the tunnel develo
ments at Niagara Falls, is inevitable.

A careful consideration will convince any one that Cayuga Island is the next m
available river frontage down the river. With the foregoing in view, a termi
railroad company has been organized, who have laid out and secured the right
way for a railroad upon and around the island to connect with the New York Cen
and Erie railroads upon the main land, so that so soon as a proper channel shal
made to or near the island mills may be erected and lumber yards established wh
will be in reach of the cheap power from the falls tunnel, and be contiguous to
and river navigation, and also have railroad facilities unsurpassed elsewher
the country.

Our object in securing this property is to so improve it that the foregoing c
mercial undertakings may be properly equipped in every way for economical busi
purposes.

Respectfully submitted,

FRED. C. M. LAU
BENJAMIN G. LON

MR. ERNEST SIEGESMUND,
U. S. Assistant Engineer.

APPENDIX O O.

IMPROVEMENT OF HARBORS ON LAKE ONTARIO EAST OF OAK ORCHARD, NEW YORK.

REPORT OF CAPTAIN DAN C. KINGMAN, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Harbor at Charlotte, New York.
2. Harbor at Pultneyville, New York.
3. Harbor at Great Sodus Bay, New York.
4. Harbor at Little Sodus Bay, New York.
5. Harbor at Oswego, New York.
6. Harbor at Sacketts Harbor, New York.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., July 9, 1892.

GENERAL: I have the honor to transmit herewith annual reports for the fiscal year ending June 30, 1892, for the following works under my charge.

* * * * * * *

I have the honor to be, very respectfully, your obedient servant,

DAN C. KINGMAN,
Captain of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

O O 1.

IMPROVEMENT OF HARBOR AT CHARLOTTE, NEW YORK.

OBJECT.

To secure a navigable channel at the mouth of the Genesee River on Lake Ontario.

Charlotte Harbor is the port of the city of Rochester, which is situated 2 miles above the head of the navigable part of the river forming the harbor.

PROJECT.

1829.—To obtain a channel 480 feet wide and 12 feet deep, formed and protected by parallel piers extending to deep water of the lake; executed in 1834.

1881.—To secure and maintain by pier extension and dredging a channel of navigable width and 15 feet depth at extreme low water. No dredging had heretofore been done, the channel having been formed and kept open with 12 feet depth by the current of the Genesee River.

PRESENT WORKS.

The piers which define and maintain the channel are formed of cribs of timber, 20 feet wide and 30 feet long, sunk, end to end, in as close contact as practicable, by filling with loose stone. The cribs forming the original work were built of round logs hewed flat, and were allowed to settle into the natural sand bottom upon which they were placed, each crib having two to four oak guide piles driven on each side of it to keep the crib in line while settling into the sand. A continuous timber superstructure was then built upon the cribs for the full width of 20 feet, and for 3 to 5 feet in height above the mean lake level. The whole was then filled with loose stone and decked with 3-inch pine plank. The cribs being below water, and not subject to decay, were built of hemlock timber, fastened together with tie-heads and drift-bolts, while the continuous superstructure was built of white pine timber and plank similarly fastened. The latter has a life of about 15 years.

(1) *West pier.*—This has a total length of 3,257 feet, in addition to a shore-return of 137 feet.

The width was originally 20 feet throughout, but the accretion against the west side of the west pier has advanced the lake shore line 1,200 feet, and the inner 900 feet was last renewed 10 feet wide.

Section A, from the shoulder-angle of the return, at the shore line of 1829, for 554 feet northward toward the lake. The cribs forming its superstructure were built in 1829–1834 of flatted logs, and are still sound. The superstructure was first rebuilt in 1853, was again rebuilt in 1864–1868, and was last rebuilt in 1869, with a width of 10 feet. It is now decayed to mean water level (2.4 feet above extreme low water) and its renewal has not since been necessary.

Section B, 564 feet northward from last section. The cribs were built in 1829–1834, and are still sound. Superstructure was first rebuilt in 1853, was again rebuilt in 1864–1868, and was last rebuilt with oak timber in 1885, part 10 feet and part 20 feet wide, by the Ontario Beach Improvement Company, forming, with Section A, the water front of the accretion since 1829, which is now owned by the New York Central and Hudson River Railroad Company, and is leased and occupied by the Ontario Beach Improvement Company as a summer resort.

The following sections extend out into the lake to 14 feet depth at extreme low water:

Section C, 1,402 feet long, 20 feet wide. The cribs were built in 1829–1834, and are still sound. The superstructure first rebuilt in 1853, was again rebuilt in 1864–1868, and was last rebuilt in 1887–'88, 20 feet wide and 4 feet above mean water.

Section D, 235 feet long, 20 feet wide. The cribs were built in 1829–1834, and are still sound. The superstructure was first rebuilt in 1853; was again rebuilt in 1864–1868, and was last rebuilt in 1891.

on E, 303 feet in length; cribs 30 feet long, 20 feet wide, built
d 10-inch by 12-inch hemlock timber, with tight floors placed
le natural sand bottom in about 12 feet of water. Superstructure
ch by 12-inch white pine, 20 feet wide, was bonded back 11 feet
e preceding section; cribs and superstructure were built in 1883.
on F, 201 feet in length (including timber horns projecting at
er end), formed of cribs 50 feet long, 20 feet wide, built of sawed
by 12-inch hemlock timber, the floor being built in center only,
itted for width of 4 feet along each side. Sunk in 13 feet depth
riprap foundation, about 4 feet in thickness and 30 feet wide,
ed upon the natural sand bottom. These cribs differed from
isly built cribs at this harbor in being 50 feet long instead of
; in having a riprap foundation; in having a partly open bot-
hich feature has given unsatisfactory results as compared with
aving tight bottoms). They also differ in having, besides the
lrift-bolt fastenings, six vertical pine posts in each crib extend-
m the grillage bottom to the top of the superstructure, and screw-
to each timber; and they have a tight deck laid longitudinally
y upon the top set of cross-ties. Cribs and superstructure were
1885.

Cast pier.—This has a total length of 2,896 feet, in addition to an
ned shore connection 402 feet in length, upon which the super-
re has not been renewed since its original construction in 1829–
nd which is now destroyed to nearly the level of the surrounding
, only its guide piles showing above low water. The width was
lly 20 feet throughout, the substructure being of separate
nd the superstructure of continuous timber work, similiar in
to the west pier structures before described.

ion A, 325 feet in length, measuring toward the lake from a large
oak pile at the south end of the work now visible; cribs 30 feet
d 20 feet wide, built 1829–1833, and still sound below mean lake
Superstructure, 20 feet wide, decayed to mean lake level, having
rst renewed in 1864–1867 and not since then. The stone filling
superstructure was taken in 1887 to refill exposed portions of
r; this portion being within the shore line.

ion B, 100 feet in length; cribs are the same as last section, and
ps sunk upon them in 1868–1870. Superstructure was first re-
in 1868–1870, received general repairs in 1880, and was last
d for 4 feet above mean lake level in 1887 by the United States
ving Service of whose station it forms the water front. The
s following are in the open lake:

ion C, 225 feet in length; cribs are the same as last section, and
ps sunk upon them in 1868–1870; superstructure was first rebuilt
–1870, received general repairs in 1880, and was last renewed in

ion D, 797 feet in length; cribs are the same as last section and
ps sunk upon them in 1868–1870; superstructure was first rebuilt
–1870; received general repairs in 1880 and was last rebuilt in
37.

ion E, 995½ feet in length; cribs are the same as last section;
uilt in 1833-1834 and had tops sunk upon them in 1868-1870. The
tructure was first rebuilt in 1868-1870; 750 feet of it was again
1881-1882, and the whole was last rebuilt in 1890.

ion F, 303 feet in length; cribs 30 feet long 20 feet wide, built of
10-inch by 12-inch hemlock timber with tight floors placed upon
tural sand bottom in about 12 feet of water. Superstructure of

[illegible] and [illegible] will a [illegible] of the [illegible] of the scouring [illegible] [illegible] the time of building the jetties in [illegible] and the increased s[illegible] [illegible] to require a greater depth in the [illegible] dredging [illegible] was then done, taking [illegible] [illegible] and from the shoal [illegible]. This [illegible] was followed in 188[illegible] [illegible] dredging of the eastern half of the channel [illegible] [illegible] feet in width and [illegible] feet in length to a [illegible] [illegible] water [illegible] cubic yards were dredg[illegible] [illegible].

In [illegible] the improvement of the channel was cont[illegible] dredging of the western half of the channel between [illegible] and two thousand one hundred and ninety-[illegible] of sand and gravel were then removed during 1891, of [illegible] yards were dredged during this fiscal year, as [illegible], scow measurement. This completes the chan[illegible] [illegible] feet long between the jetties, except a port[illegible] [illegible] at the inner end, [illegible] feet long and 70 feet [illegible] [illegible] about 30,000 cubic yards of sand.

To deepen the entrance to [illegible] feet in the lake outs[illegible] will require an average cut of [illegible] feet for a length of [illegible] [illegible] the removal of about 30,000 cubic yards of [illegible] will soon refill unless the jetties are extended to shel[illegible]

OPERATIONS.

Dredging was in progress at the beginning of the [illegible] [illegible] contract with J. & T. Cowden. The contract[illegible] work until October [illegible], 189[illegible], at which time they had [illegible] cubic yards of material under their contract, or [illegible]

k of renewing the superstructure by hired labor, on section t of the west jetty was begun on August 11, 1891, and com- ember 19, 1891. In addition to this work, the same party re- small breaks in the jetties, and also repaired injuries to them om their being run into by the barges *Wheeler* and *Hiawatha.* y also finished up certain work on section E of the east jet- ould not be completed last year. In rebuilding Section D, vas obliged to take down and put up again a corresponding the elevated walk leading to the light-house.
unts for these several objects was as follows:

o small breaks—

	$40.92
	13.87
	54.79
mage to piers by vessels	$144.90

sum was collected from the parties in fault by the United rney for the northern district of New York, without a suit, en taken up and accounted for.

ction E, east jetty—

	$217.38
	18.91
	236.29
u account of elevated walk	$170.47

ewal of superstructure on Section D, west jetty, there was for labor and new material, $2,179.43, divided as follows:

	$1,182.37
v)	804.43
	122.12
aterials	70.51
	2,179.43

as also expended for reading water gauge during the portion son when there were no employés available for this work,

ority of the Chief of Engineers $8,000 was expended from priation towards the purchase of a dredging plant. The nt expended for all purposes, including engineering and office ɩnd inspection to the work during the year was $23,291.35.

REMARKS.

made this season after the spring freshets show that no bar l beyond the end of the jetties. My assistant engineer who surveys suggests "that this bar may have been formed in om material washed from the channel between the jetties, this supply of material has been annually renewed by the ed through the jetties (which are not sand-tight) and by n into the channel from the adjacent beaches. The enormous f the shore-line (some 1,200 feet since the jetties were built) t there has been plenty of material in motion to keep up the the channel. The Ontario Beach Improvement Company has laimed this sand bar by covering it with soil and sod out to line; so that this material is now held in place. The recent ɩas increased the channel capacity between the jetties some ɩt, so that the current can now have but little tendency to scour it. If this is so, then there is reason to hope that the bar will not form again. This theory is ingenious, but it can only be demonstrated by a series of sediment observations taken during high water in the river, at the upper and lower ends of the jettied channel, and by comparative surveys of the channel during the same period. I am of the opinion that the river itself brings down a good deal of silt, and that a portion of it may now be deposited in the channel, reducing its depth so that it may ultimately require redredging.

As stated elsewhere, the channel between the jetties has a general depth of 15 feet at extreme low water; but the jetties terminate near the 13-foot contour, and therefore the full depth of the improved channel is not available. I doubt if a dredged channel would maintain itself beyond the end of the jetties. I can find no record that it has ever been tried. But I have so little confidence in it that I would recommend that the approved project of extending the jetties to the 15-foot contour be carried out as rapidly as the means provided will allow.

Name of harbor, Charlotte, N. Y.; collection district, Genesee, N. Y. (at Charlotte). A fixed red light of the fourth order on crib 300 feet inside of outer end of west pier. A range light of 3 fixed lights, 2 red and 1 white, 60 feet high, at inner end of west pier. Forts Niagara and Ontario, N. Y., are the nearest works of defense.

Money statement.

July 1, 1891, balance unexpended	$34,699.85
February 26, 1892, received from vessels for damages to piers	144.90
Total to be accounted for	34,844.75
June 30, 1892, amount expended during fiscal year	23,291.35
July 1, 1892, balance unexpended	11,553.40
Amount appropriated by act approved July 13, 1892	25,000.00
Amount available for fiscal year ending June 30, 1893	36,553.40
Amount (estimated) required for completion of existing project	109,650.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	75,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Arrivals and departures of vessels at Charlotte Harbor, New York, during fiscal year ending June 30, 1892.

ARRIVALS.

Trade engaged in.	Steamers.		Sailing vessels.		Barges.	
	Number.	Registered tonnage.	Number.	Registered tonnage.	Number.	Registered tonnage.
Home, on lake	371	48,784	65	8,698	211	71,253
Foreign, on lake	242	113,521	295	55,239	153	58,868
Total	613	162,305	360	63,937	364	130,121
American owned	377	54,906	46	4,869	285	98,161
Canadian owned	236	107,399	314	59,068	79	31,960

Sum total, 1,337 arrivals; 356,353 registered tons.

Arrivals and departures of vessels at Charlotte Harbor, etc.—Continued.

DEPARTURES.

Trade engaged in.	Steamers.		Sailing vessels.		Barges.	
	Number.	Registered tonnage.	Number.	Registered tonnage.	Number.	Registered tonnage.
...e, on lake	376	54,975	40	4,644	204	67,720
...ign, on lake	236	106,969	317	59,229	160	62,401
Total	612	161,944	357	63,873	364	130,121

...m total, 1,333 departures; 355,938 registered tons.

...reatest draft of vessels, 14 feet.
...reatest tonnage of vessels, 1,583 registered tons.
...reatest load of vessel, 2,130 net tons of coal.

...eipts and shipments by lake at Charlotte Harbor, New York, during fiscal year ending June 30, 1892.

RECEIPTS.

Trade.	Passengers.	Grain.	Merchandise.	Live animals.	Poles and ties.	Post and wood.	Lumber, etc.
	No.	*Net tons.*	*Net tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
...e, on lake	22,108	....	44	....	....	....	....
...ign, on lake	9,222	6,385	329	683	2,282	3,668	4,425
Total	31,330	6,385	373	683	2,282	3,668	4,425

SHIPMENTS.

Trade.	Passengers.	Merchandise.	Oil.	Coal.
	No.	*Net tons.*	*Tons.*	*Net tons.*
...e, on lake	22,359	59	....	186,162
...eign, on lake	8,540	375	73	275,922
Total	30,899	434	73	462,084

...avigation closed December 20, 1891.
...avigation opened March 29, 1892.
...otal revenue collected at port during the fiscal year, $98,858.50.
...or the purpose of reduction to tons weight, the following is assumed: Barrels oil, ...qual 1 ton; M lumber, 1 equal 1½ tons; crates fruit, 20 equal 1 ton; railroad ties ...d poles, 12 equal 1 ton; cords wood and posts, 1 equal 1½ tons; live animals, 4 ...ual 1 ton.

O O 2.

IMPROVEMENT OF HARBOR AT PULTNEYVILLE, NEW YORK.

OBJECT.

To furnish a protected channel of navigable width and not less than ...0 feet depth at the mouth of Salmon Creek, Wayne County, N. Y., ...hich is situated 21 miles east of the Genesee River.

PROJECT.

The present project of 1872 provides for a breakwater running 330 feet eastward from the west side of the creek, a west pier or jetty thence northward into the lake, and an east pier or jetty about 200 feet eastward from the west pier and parallel to it.

Also a dredged channel between the piers and behind the breakwater, and extending about 400 feet up the creek.

After this work was done, at a total expenditure of $71,000, it was found that the waves from the lake when driven by a gale from the northwest would strike the east pier in such a way as to be reflected upon the beach within the harbor, and that in receding they would sweep the gravel and sand from the beach into the excavated channel along the harbor side of the breakwater, where it would lodge across the mouth of the creek.

Accordingly it was further proposed in 1884, in order to make dredging of permanent value and effect, to build a sand-tight structure 500 feet in total length, parallel to the breakwater and about 100 feet from it, between it and the harbor beach, so as to arrest this movement of material.

A part of this structure has been built during this fiscal year.

PRESENT WORKS.

(1) *West breakwater.*—This has a total length of 330 feet, and is formed as follows:

Section A, from the west shore line eastward, 150 feet in length and 15 feet in width, formed by cribs of flatted round logs built at local expense before the General Government undertook the improvement of the harbor in 1867, $30,000 having been thus expended before that year.

The superstructure, 15 feet wide and 4 feet above mean lake level, was repaired by the United States in 1871, was rebuilt in 1877, and is still in place in a half-ruined condition. The gravel from the lake beach has washed over it, and has aided in closing the entrance to the creek.

Section B, from section A to the west pier which it joins, is 180 feet in length, 20 feet in width, formed of tight-bottomed cribs, each 30 feet long, 20 feet wide, and 9½ feet deep. These cribs were built by the United States in 1871 of sawed 12 by 12 inch hemlock timber and were sunk, in close contact, in a trench dredged to the depth of the proposed channel about 8 feet below extreme low-water level. The cribs were filled with loose stone gathered from the neighboring shore of the lake. The continuous superstructure which was built by the United States upon these cribs in 1871 was formed of sawed pine timber framed together, bolted with drift bolts, and ballasted with loose stone from the lake shore.

It has not since been renewed, and is decayed, though still in position. The substructure of this and the preceding section is sound up to mean level, 2.4 feet above extreme low water.

(2) *West pier.*—This has a total length of 558½ feet and is 20 feet wide. Its substructure is formed of separate cribs sunk in close contact and its superstructure is continuous, except on section D, which is separate.

Section A is 222 feet long, from the shoulder angle northward. It is formed of eight separate cribs, one irregular angle crib, measuring 12 feet on its face, and seven regular cribs, each 30 feet long and 20 feet wide, and 7 feet deep.

The cribs were built in 1874–1875 of sawed hemlock timber 12 inches square, had tight floors upon screw-bolted grillages, and were sunk, in 1874–1875, in a foundation trench dredged to 8 feet depth at extreme low water where the natural depth was 4 feet. The cribs are still sound.

The superstruction was built upon them in 1874–1875 of 12-inch square pine timber, 4 feet high, filled with loose stone and decked with 3-inch pine plank laid crosswise, with 2-inch spaces. This has not since been renewed, and is decayed, but still in position.

Section B is 93½ feet long, from last section northward. It is formed of 3 separate cribs, each 30 feet long, 20 feet wide, and about 9 feet deep. They were built in 1880 like those of the last section, with similar superstructure, and sunk in a trench dredged to 8 feet depth.

The cribs are still sound, but the superstructure needs repair.

Section C is 183 feet long, from last section northward. It is formed of six separate cribs, each 30 feet long, 20 feet wide, and about 9 feet deep. They were built in 1881 like those of the last section, except that the foundation trench was not dredged for all the cribs, its completion being prevented by encountering a mass of large bowlders embedded in clay, which the dredge could not remove.

One of the cribs rested partly upon these bowlders and partly upon the riprap, and others rested partly upon the sand among the bowlders, and about 100 feet afterwards settled irregularly.

The superstructure was built upon the cribs in the same season, 1881, and has not since been repaired, except that in 1884 it was leveled for 83 linear feet by raising the east wall 2 to 3 feet and relaying the deck. Fifty feet of this again needs similar leveling, refilling, and redecking.

Section D is 60 feet long from the last section northward, and forms the outer end of the pier.

It is formed of two cribs similar to those built in 1874–1875 and since, each 30 feet long and 20 feet wide and 12 feet deep. The cribs were built 1883, of sawed hemlock timber, 10-inches by 12-inches square (the two upper courses being of white pine), with tight floors upon screw-bolted grillages, and they were sunk upon a bed of riprap 3 feet deep and 40 feet wide, where the natural depth was about 10 feet at extreme low water.

The superstructure was built upon them 4 feet high in 1883. The cribs have not settled at all, and now stand level, 2 feet above the adjoining irregular work.

The outer end of the pier was breached at some time prior to 1890, the stone filling was washed out to 9 feet depth, from the outer half of the outer crib, and the entire end wall is now gone, the deck and superstructure remaining.

It is fully exposed, and will be destroyed unless the end is rebuilt.

(3) *East pier.*—This has a total length of 571½ feet, with a varying width of 15 to 20 feet as described below. It was all built between 1872 and 1880, and was formed of cribs, each 30 feet in length, 15 to 20 feet in width, and generally 6 to 8 feet in depth.

The cribs were built of sawed hemlock timber, 12 inches square, had tight floors upon screw-bolted grillages, and were sunk on the natural bottom in depths of 6 to 8 feet at extreme low water. The superstructure was built upon the cribs during the same year, of 12-inch square pi timber, 4 feet high, filled, as were the cribs, with loose stone, and deck with 3-inch pine plank laid crosswise with 2-inch spaces.

The different sections were built, first at one end of the jetty a then at the other end, as seemed most useful.

Section A, beginning 140 feet from the present shore line (at the e of a private wharf, since destroyed), extending 85½ feet northward in the lake, 16 feet wide. It was formed of three cribs, two 30 feet lon and one 25½ feet long. They were sunk upon the remains of a wreck private wharf, leveled to receive them. Its superstructure, also 16 f wide, was 4 feet high. Both were built in 1880 and are still in fair c dition.

Section B, 62 feet in length, 15 feet in width, built in 1877, and since renewed.

Section C, 30 feet in length, 20 feet in width, built in 1877, and since renewed.

Section D, 92 feet in length, 20 feet in width, built in 1873, and since renewed.

Section E, 180 feet in length, 120 feet in width, built in 1872, and since renewed.

Section F, 122 feet in length, 20 feet in width, built in 1873, and since renewed.

In all these sections the cribs are sound, but the superstructure n renewal, without which the whole will be wrecked.

(4) *Sheet-piling.*—Of the constructure to arrest sand drift from harbor beach to the channel into the creek, which was propose 1884, 200 linear feet, from the east side of the creek outlet eastw toward the land end of the east jetty have been built during the f year. The work was done by hired labor, at a total cost of $1,55 equal to $7.78 per linear foot complete.

The structure is sand-tight, being formed of the Wakefield pa sheet-piling. Its oak wale-pieces are below the line of no decay, they are tied back by iron rods to logs buried in the bottom, u which the accretion will probably form, so that the structure ma expected to be a permanent one. It has already produced an effe causing a scour of the shoal between it and the breakwater, but dr ging will be needed to make a navigable channel.

CHANNEL.

The channel between the jetties, behind the breakwater and 400 up the creek, had been dredged in former years to 8 to 9 feet dept extreme low water; but it has since shoaled to 7 feet between the ties and 2 feet at the creek outlet. The dredging which has been is as follows:

In 1874, 14,189 cubic yards of sand and gravel were removed at cents per cubic yard, making an effective depth of 8 feet at ext low water, 25 to 40 feet wide and 600 feet long between the jetties. 10 feet depth for 50 feet width, and 400 feet length behind the breakwater to the creek outlet, and 40 feet width for 400 feet up creek.

This dredging made known the existence, in the space between jetties, of a deposit of bowlders embedded in stiff clay and ceme gravel, which was most difficult to remove, none of which was t until the next year (1875) when a special contract was made for its oval. Under this contract, in 1875, 7,700 cubic yards of hard mate- was excavated between the jetties at 70 cents per cubic yard, and 3 yards of sand and mud was excavated from the creek channel at ents per cubic yard. This gave an entrance 130 feet wide and 9 deep at extreme low water.

ı October, 1879, the space between the jetties (then 222 feet long) 7 and 8 feet depth at extreme low water, but the cut behind the kwater and up to the creek outlet had filled with sand from the bor beach, so that there was only 2½ to 4 feet depth at extreme low er for 30 feet width. In 1880 the entrance was dredged to 8 feet th at extreme low water for 150 feet eastward from the west jetty, for 250 feet northward from its junction with the west breakwater. ind the breakwater the same depth was made for a width from the akwater of 70 feet at the shoulder angle, narrowing to 50 feet at the ek outlet, and thence for 50 feet width up the creek. In this year re was removed 20,450 cubic yards of sand, gravel, and mud at 18 its per cubic yard, and 806 cubic yards of bowlders and hard mate- l at $1 per cubic yard.

ince 1880 no more dredging has been done. Meantime the west y has been extended 336 feet further into the lake, so that the rance is better sheltered from sand drift, and 7 to 8 feet depth con- ies in it.

he space behind the breakwater has again filled with sand from the bor beach, but this movement will be arrested by the sand-tight y just completed.

he removal of 10,000 cubic yards of sand from behind the break- er and from the creek outlet will give an effective depth of 7 to 8 at extreme low water, and will make the harbor available for the ll vessels suited to the coasting trade.

OPERATIONS.

n examination by borings was made along the line of the proposed l-tight jetty in the fall of 1891, to see if it would be possible to drive s there. The results indicated that work of this kind would be rely practicable. Accordingly, material was purchased and a party sent to Pultneyville to construct about 200 feet of this work. Opera- s were begun November 19 and continued until January 9, 1892, n it was completed. The Wakefield patent sheet piling was used, the owner was paid a royalty of 20 cents a running foot of com- ed structure for the use of this patent. The piles as used here e built up of three oak planks, 12 inches wide and 2 inches thick, ed so as to form a tongued-and-grooved pile of proper length. They be driven in close contact, and form a structure that is nearly water- it.

his particular form of patent sheet piling has been elsewhere used the public works, and has been described in the Reports of the ef of Engineers. The piling is stregthened by oak wale pieces, ch are below the line of no decay, and is tied back by iron rods 12 long to logs in the bottom, the object of this being to prevent the ıg from being pushed over towards the channel by sand which will bably gather behind it.

he cost was $1,555.85, or $7.78 per running foot complete.

The items are as follows:

Labor	$73
Lumber	65
Stone (and protecting the outer end)	2
Other materials and tools	9
Use of patent right	2
Total	1,55

In addition to this, $62.63 was expended during the year for e neering and office expenses.

REMARKS.

A good deal of dredging has been done in the past before the struction of the bulkhead, but the moving sand has reduced the av able depth between the jetties to about 7 feet; and along the br water and at the mouth of the creek the channel is only three or feet deep.

This renders it impossible for vessels to approach the wharves warehouses which are within the mouth of the creek, and there the harbor is well-nigh useless. The few vessels that do come here forced to lie at the outer end of the jetty channel in an exposed p tion and transfer their cargoes to small boats. As a result comm has almost disappeared.

The superstruction of the breakwater and a greater part of th the jetties is now very much decayed. It ought to be renewed at o If this was done, and the sand-tight bulkhead completed and channel thoroughly dredged out, it would complete the prop improvement and make valuable the work already done. It wo afford a safe and good harbor for small vessels (the class that most u it) between Great Sodus Bay and Charlotte, a stretch of exp coast some 35 miles long, which now offers no shelter whatever. T is no other place in my district where a small amount of money w produce such marked benefit.

The amount now available, being less than $400, is too small to en me to undertake any of this work.

Name of harbor, Pultneyville, N. Y.; collection district, Genesee, N. Y.; ne light-house, Great Sodus, New York; nearest work of defense, Fort Ontario, N.

Money statement.

July 1, 1891, balance unexpended	$1,9
June 30, 1892, amount expended during fiscal year	1,6
July 1, 1892, balance unexpended	3
Amount appropriated by act approved July 13, 1892	1,0
Amount available for fiscal year ending June 30, 1893	1,3
Amount (estimated) required for completion of existing project	9,0
Amount that can be profitably expended in fiscal year ending June 30, 1894	9,0
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

...vals and departures of vessels at Pultneyville Harbor, New York, during fiscal year ending June 30, 1892.

ARRIVALS.

Trade engaged in.	Steamers.		Sailing vessels.	
	Number.	Registered tonnage.	Number.	Registered tonnage.
...e, on lake	4	300		
...eign, on lake			4	208
Total	4	300	4	208
...erican owned	4	300	1	76
...nadian owned			3	132

Sum total, 8 arrivals; 508 registered tonnage.

DEPARTURES.

Trade engaged in.	Steamers.		Sailing vessels.	
	Number.	Registered tonnage.	Number.	Registered tonnage.
...ome, on lake	4	300	1	76
...reign, on lake			3	132
Total	4	300	4	208

Sum total, 8 departures; 508 registered tonnage.

Greatest draft of vessels, 7 feet.
Greatest tonnage, 76 registered tons.
Greatest load, 92 net tons.

...eceipts and shipments by lake at Pultneyville Harbor, New York, during fiscal year ending June 30, 1892.

Trade.	Receipts.			Shipments.	
	Passengers.	Merchandise.	Lumber, etc.	Passengers.	Fruit.
	No.	*Net tons.*	*Tons.*	*No.*	*Tons.*
...ome on lake	1,000			1,000	
...reign on lake		6	103		56
Total	1,000	6	103	1,000	56

For the purpose of reduction to tons weight the following is assumed: Barrels oil, 7 ...qual 1 ton; M lumber, 1 equals 1¼ tons; crates fruit, 20 equal 1 ton; railroad ties and ...les, 12 equal 1 ton; cord wood and posts, 1 equals 1½ tons; live animals, 4 equal 1 ton.

OO3.

IMPROVEMENT OF HARBOR AT GREAT SODUS BAY, NEW YORK.

OBJECT.

To secure a navigable channel from Lake Ontario to Great Sodus Bay with a depth of 15 feet.

Great Sodus Bay is 5 miles long, 2 to 3 miles wide, is deep and land-locked, and is situated midway between Oswego and the Genesee River. It is the coal-shipping port on Lake Ontario for the Pennsylvania Railroad.

PROJECT.

1828.—To contract the entrance to Great Sodus Bay to 470 feet by breakwaters extending from east and west shores and to define and project a channel 470 feet wide by piers extending to deep water in Lake Ontario.

1882.—To extend the piers to the 15-foot curve in the lake and to dredge the channel between them to 1 feet depth at extreme low water.

PRESENT WORKS.

The project has been completed, ept that the east jetty lacks 800 feet of reaching the curve of 15 feet extreme low water and that the channel has not been dredged to 15 feet for its full width.

The dredging has been confined to the western half of the space between the jetties, and the channel thus made has not been permanent.

Excavation of the full width (except 50 feet next the jetties) to 15 feet at extreme low water is now in progress.

The piers and jetties which contract the entrance and define and shelter the channel were originally built in 1829–1834. They were started from the west and the east sides of the entrance, naturally about 4,000 feet wide, and were extended toward the center, where they were continued northward by parallel jetties, 470 feet apart across the 8-foot bar, from deep water in the bay to the deep water in the lake.

These piers and jetties defining and sheltering the channel were built in 1829–1834, and were composed of cribs of timber, each 18 feet wide and 30 feet long, sunk, end to end, upon the natural sand and gravel bottom in as close contact as practicable by filling them with loose stone.

The cribs were formed of round logs, hewed flat, framed together and bolted with iron drift bolts and wooden treenails. They appear to have had floors of slabs, and were allowed to settle into the natural sandy bottom for part of the season before building upon them the continuous superstructure of hewed timber. These old cribs, in part or whole, are still in place, and are sound below mean water level.

The different portions of the works may be described as follows:

(*1*) *West breakwater.*—This has a total length of 2,200 feet. It was built 18 feet wide, with a superstructure of same width, in 1829–1834.

The cribs were each 18 feet wide and 30 feet long, and starting at the beach line gradually increased in depth to 8 feet where they joined the jetty.

Section A, 1,693 feet long from west shore eastward. The

-e built in 1829–1834, and are still sound. The superstructure was lt at the same time, was never renewed, and has long since decayed. whole structure is buried and covered by the accretion of the beach d outside it, and its maintenance has been unnecessary.

Section B, 241 feet long in continuation of the last section. The cribs re built in 1829–1834, and are still sound. The superstructure was renewed, for the same reasons given above, until 1888, when the ner of the adjoining tract of land formed by accretion renewed it 14 t wide and 4 feet high.

Section C, 266 feet long in continuation of the last section to the st jetty. The cribs were built in 1829–1834, and are still sound. The perstructure was renewed by the United States in 1877–1878 207 et, 14 feet wide and 59 feet next the angle, 18 feet wide. Upon the tter stands the inner range beacon and the United States water auge.

(2) *West pier or jetty.*—This is 1,580 feet long, 18 to 20 feet wide, as llows:

Section A, from shoulder-angle at junction with breakwater, 975 feet orthward, 18 feet wide. The crib structures built in 1829–1834 were recked to an average depth of 4½ feet below mean water level be- ween 1857–1866. Had new cribs sunk on top of the wrecked ones 1866–68. Are now sound, but in bad condition, allowing free passage of nd into the channel.

The superstructure was built of timber filled with loose stone at the me date as the cribs and was continuous over them. It received neral repairs in 1845 and again in 1852, but was all decayed and de- royed prior to 1866, when its renewal was begun, and was completed 1869.

In 1877, 150 feet from the angle northward was again renewed, and 1880 the remaining 825 feet was also renewed.

Section B from the last section northward is 285 feet long and 18 feet ide. The cribs were built is 1829–1834, and otherwise have the same story as the last section, and were rebuilt as they were in 1866–1868. e superstructure was built upon them in 1866–1868 and was first re- ilt in 1889.

Section C from the last section northward is 134 feet long and 18 feet ide, the outer 40 feet being a pier head 40 feet square. This section as built in 1869, and was formed of three cribs, each 30 feet long and 18 et wide, and a pier head at the outer end 40 feet square, having an en central space 18 feet square for a light-house foundation. The ibs were built of sawed hemlock timber 12 inches square and had tight ors laid upon screw-bolted grillages. The foundation was prepared r these cribs by dredging a trench to about 12 feet depth, in which ey were sunk. The superstructure, five courses high of 12 by 12 inch ne timber, was built upon them in 1869, but had to be leveled and re- cked in 1871, the structure having settled. The superstructure was rst renewed in 1889, when the pier-head crib was cut down to line of decay and decked at that level with solid timber.

Section D extends from the last section 185 feet northward to the 15- ot curve of extreme low water. This section is 20 feet wide and was ilt complete in 1883. The cribs were each 30 feet long and 20 feet ide and 13 feet deep, and were formed of sawed 10-inch by 12-inch nber (the lower 11 feet of hemlock and the upper 2 feet of pine) and d partly open floors made of 3-inch plank laid 18 inches apart upon rew-bolted grillages. The cribs were placed upon a riprap founda- n 40 feet wide and 4 to 5 feet thick, deposited in a trench dredged

for the purpose, costing 50 cents per cubic yard for the excavatio
$1.30 per cubic yard for the riprap in place.

The superstructure was built upon the cribs the same seaso consisted of four courses of 10-inch by 12-inch pine timber (with a deck of 3-inch pine plank) filled with loose stone.

In 1891 the outer end was cut by a barge down to 6 feet below requiring the renewal of the end of the crib and superstructure.

3. *East breakwater.*—This has a total length of 1,651 feet Charles Point on the east side of the bay westward to join th jetty. The original structure, built in 1829–1843, was not repair renewed until 1874. The superstructure and cribs were then g about the level of the surface of the bar in which the cribs we bedded, which was at an average depth of 1 foot below extrem water level.

Section A, the shore arm, from Charles Point to the lake arm feet long and 14 feet wide, with 5 feet total height of cribs and structure. It was built in 1884 and sunk upon the natural bo about 2 feet depth of water. It is in good order.

Section B is 511 feet long and 14 feet wide; is part of the c structure built in 1829–1843.

It was first renewed in 1874, when four courses of continuous structure was framed together of 12-inch by 12-inch pine tim lower courses being securely bolted to the remains of the old cri top being at 4 feet above extreme low water. In 1877–1878, th plank and joints being decayed and broken but the side timber sound, the top was renewed by adding one course of 10-inch by pine timber and laying a new deck.

Section C is 415 feet long, 14 feet wide, and has a history simila last described section. Its first renewal was made in 1870–18 its next and last renewal in 1887–1888.

Section D is 172 feet long, 14 feet wide, was built in 1829–18 was first renewed in 1870, but not since then. The superstru much decayed.

Section E is 264 feet long, 14 feet wide, was built in 1829–18 was first renewed in 1876. The superstructure has not sin renewed until 1891, when the western 126 feet was renewed in form, the half toward the harbor being 4½ feet above extre water, and the lake half 7½ feet above the same plane.

Section F is 74 feet long to the east jetty, and is 18 feet wide. built in 1829–1834; was first rebuilt in 1876, and was next ren 1891, when it was built in parapet form as described in the last

(4) *East pier or jetty.*—This is 1,294 feet long from its juncti the east breakwater northward into the lake to the 10½-foot c extreme low water. It was originally built 18 feet wide in 1829– the same style of crib work as formed the west jetty, and was e 20 feet wide in 1883–1884. Its details are as follows:

Section A from angle with east breakwater 440 feet northw built in 1829–'34. It was first repaired in 1853 by renewal o structure, and this was again done in 1875–1876.

In 1891 the superstructure was again renewed, this time in form with the half next the channel 4½ feet above extreme lo and the other half 3 feet higher.

Section B is 500 feet long and 18 feet wide, and was original in 1834. The superstructure was first repaired in 1853, but stroyed between that date and 1869, when it was necessary to cribs and superstructure from an average depth of 4½ feet belo level to about 4 feet above the same plane. The superstructure st rebuilt in 1890, not in parapet form.

ion C is 154 feet long and 20 feet wide, and was built complete ; the details of its construction being the same as those of Sec- of the west jetty, which has already been described.

ion D is 200 feet long and 20 feet wide, and was built complete . It was formed of cribs each 50 feet long, 20 feet wide, and 12½ gh, built of 10 by 12 inch hemlock timber with two upper courses timber.

floors were built in the center only, and were omitted for a width t along each side. The cribs were sunk upon a riprap founda- feet wide, deposited in a trench dredged for the purpose in the bottom.

continuous superstructure of four courses of pine timber was ıpon the crib in 1885. The cribs forming this work differ from ısly built cribs at this harbor in being 50 feet long each, instead et; in having a riprap foundation; in having partly open floors; having, besides the usual drift-bolt fastenings, 6 vertical pine n each crib, extending from the grillage bottom to the top of the tructure and screw-bolted to each timber; and they have a leck, laid longitudinally, directly upon the top set of cross-ties. mpletes the description of the structures of this harbor, except the iling, which has been placed along the west jetty to arrest the f beach sand through it into the channel. Of this sheet-piling st section was driven in 1877 along the west face of the west eginning 150 feet north from the shoulder angle and extending northward. In 1887 the second section was built, beginning at th end of the first and extending 245 feet northward along the ace. At this point the substructure of cribs projected outside e of the superstructure about 3 feet, so that it was necessary to the third section of sheet-piling on the east face, where it was ed 367 feet northward along the channel face of the jetty during a tight cross bulkhead being driven between two cribs to unite o sections.

sheet-piling consists of 4-inch by 12-inch oak plank, each 20 feet riven to a depth of 14 to 15 feet below extreme low-water level, cured to the superstructure of the jetty by 1-inch lag screws h each pile and also by 6-inch by 12-inch continuous oak wale screw-bolted through the piles to the timbers of the crib work. rrest sand movement into the channel there was also built in d 1880 upon the west sand beach, where it had formed against st jetty, a system of overlapping sand-catch fences of a total of 760 feet. These fences have been effective, but they can not intained beyond high-water line, and there is generally a wide f sand between them and the water, from which the prevailing ly winds blow the sand across the jetty. This is the source from comes a considerable portion of the sand which refills the l.

CHANNEL.

—The space 470 feet wide between the jetties had a natural of 8 feet in October, 1829. This was the actual depth at that hen the water level must have been at least 1 foot, and was ly 2 feet, above extreme low water, this being the average stage level at this time of year. No plane of reference for lake water level was established until 1837, when the present accepted extre low-water level was determined at Oswego and fixed as the zero of t gauge, whose readings have since been daily observed in feet an hundredths above this zero.

The records of channel depths in the various reports are much co fused during recent years, as well as formerly, by variously stating t depth as at ordinary low-water level, or at ordinary water level, or the actual depth at a given date. In this report all such reference w be reduced to the plane of extreme low water without further comme

1836.—The first dredging was done at Great Sodus Harbor in 18 and was continued during 1837 and 1838, $45,390 being thus expend

1838.—The result was to form a channel 100 feet wide, 1,500 feet lo with 11½ feet depth, by removing about 30,000 cubic yards of gra and sand.

1844.—In August, 1844, this channel was found to have shoaled t feet depth.

1856.—The next dredging was done in 1856, when 6,233 cubic ya of sand was removed at a cost not stated.

1867.—Nothing more was done until 1867, when renewal of the j was begun and dredging was done under its shelter; 9,200 cubic ya were then dredged at 24 cents per yard.

1868-'69.—The dredging was continued in 1868 and 1869, comple a channel next the west jetty, 200 feet wide, 1,700 feet long, and 10 deep, by removing about 40,000 cubic yards additional.

1870.—In 1870 the sand had again drifted into this 200-foot cha to such an extent as to reduce it to 8 feet depth for its west half, 4 to 5 feet depth for its east half, the undredged eastern 270 fe the space between the jetties varying from 2 feet at the inner end feet at the outer end.

1873.—In 1873, 19,000 cubic yards of sand were removed at 35 c per cubic yard measured in position, again making the channel 9 deep for 150 feet next the west jetty, and this was continued in

1874 by removing 44,977 cubic yards of sand at 22½ cents, scow m urement, and again making the 200-foot channel 9 to 11 feet deep.

1881.—No further dredging was done until 1881, when the cha had again shoaled to a governing depth of 8 feet and dredging resumed.

1882.—During 1881 and 1882, 42,050 cubic yards were removed a cents per cubic yard in scows, making a channel 2,300 feet long feet wide next the west jetty, and 11½ feet deep.

1886.—In 1886 dredging was again needed and 13,224 cubic y were removed at 16 cents yer yard, making a channel 50 feet wide 12 feet deep.

1887.—In 1887 the depth was again reduced to 9 feet and a cent gal pump was employed to take the sand from the channel and de it on the other side of the west jetty. Thirteen thousand cubic y of sand were thus removed, at 12½ cents per cubic yard, making 10 deep for 50 feet width.

1889-'90.—In 1889 and 1890 a dipper dredge was again empl 40,942 cubic yards of sand, gravel, and cobblestones were remove 18 cents per cubic yard, scow measurement, and a navigable ch was again made 100 feet in width, 2,000 feet long, and 15 feet located 30 feet from the west jetty.

1892.—In 1892 this was found to have again filled so that there but 8¾ feet depth, and the new United States dredge *Frontenac* b work on May 30 to improve the channel.

llowing summary shows the total dredging which has been l the sums expended therefor. For the first item, the number yards is computed from the dimensions of the channel , and the cost given is the sum of the appropriations for 1836, d 1838, less $1,000 used for repairs, the reports stating that ns for those years were otherwise confined to dredging:

Date.	Cubic yards.	Rate per yard.	Cost.
38	33,000	$1.37	$45,390
	6,233		
	9,200	.24	2,208
	40,000	.24	9,600
	19,000	.85	6,250
	44,977	.22½	10,120
	42,000	.23	9,660
	13,224	.16	2,116
	13,000	.12½	1,626
	40,942	.18	7,370
	261,576		94,340

arison of a detailed survey made in 1870 with another survey 1892 by the same assistant engineer serves to give a definite he effect of the dredging done during the interval.

been repeatedly stated in the annual reports that the refilling redged part of the channel was caused by the movement of o the cut from the undredged part.

arison of the surveys show that between 1870 and 1892 the ed part has deepened for an average of 3 feet over an area t long and 270 feet wide. This indicates a movement of 30,000 rds of material into the cuts made at different times. The er, 142,000 cubic yards, has come through and over the west Much of this movement through the jetty was made possible by sual manner in which the renewal of the wrecked cribs below as done in 1867–'68. The original cribs had then been de- to depths varying from 2 to 10 feet below water (averaging 4½ here were sunk, on top of the old substructure, cribs whose nk extended across from side to side, placed 3 inches apart of close together. These spaces between the floor plank formed, ve the level of the sandy bottom, clear passages for sand the jetty, and through these spaces the sand has flowed when- re were waves to move it.

OPERATIONS.

ork of renewing the superstructure in the parapet form, accord- e most recent and approved plans, on section A of the east 0 feet long; section F of the east breakwater, 74 feet long, and ern 126 feet of section E of same, in all 640 feet, was begun 9, 1891, and finished November 6 of the same year. The lum- iron required for the work were purchased by public notice and roposals; the other material and labor required was secured in rket.

lition to the foregoing the same party repaired the old light- ib on the west face of the west jetty, and also placed some 80 stone in the portion of the east jetty that was rebuilt the pre- ar and which was not wholly filled with stone at that time. ty also put up a tool house for use in connection with the work at the shore end of the west jetty. Old material taken from the which was being repaired was used in its construction.

The total expenditure for the foregoing work was $6,481.78, divid follows:

Labor	$3,
Lumber	2,
Iron	
Other material and tools	
Total	6,

There was also expended for engineering and office expenses d the fiscal year, $1,243.62. Under the authority of the Chief of neers $4,000 was expended from the appropriation for this work t the purchase of a dredging plant for use in the harbors in this di

On the 29th of May, 1892, the United States dredging plant wa to Great Sodus Harbor to deepen the channel between the jetti continued to work until the end of June. It was much delayed count of breaking its spuds, which had been badly worn on other and also by breaking a casting which could not be quickly rep Notwithstanding this, however, it removed, up to June 30, 11,219 yards of material. The exact cost of the work can not be given present time. The total sum paid during the fiscal year in conn with this work was $500.66, and there was outstanding at the the year $1,235. This amount is estimated, as there are some bills for supplies which have not yet been received and examined. would make the total cost per cubic yard a little less than 15½ which compares favorably with the cost of previous work done contract. The price, 15½ cents, is really too large, because it in the cost of rope and other similar material which can be used f eral seasons.

The dredge will be forced to stop work at this place early in J account of lack of funds.

REMARKS.

It appears from the records that a large amount of dredging ha done in this channel in the past, and it also appears that this dr has always been done near the west jetty, the side from whi winds and waves bring in the sand. This has put the channel place where it could be most quickly filled.

The sand, whether blown over the jetty by the wind or w through it by the waves, would most of it come to rest within 2 of the west jetty, or, in other words, in the west half of the channe surveys confirm this and show that the eastern half of the ch where no dredging has ever been done is deeper now than it wa 40 years ago. In view of this, it seems best to me to begin dr on the east side of the channel and to gradually widen towar west. In the meantime every effort should be made to keep th from getting into the channel, both by inducing a growth of veg above the high-water line along the shore of the west of the c and by making the jetty perfectly sand-tight below water.

I think the pier should be extended to the 15-foot curve as rap the means provided will allow and that the channel should be d to its full width in the manner before stated.

The work will cost $58,000. In addition to this there should b able every year the sum of $5,000 for the maintenance of existing renewing from time to time, as required, the perishable portions of structures.

me of harbor, Great Sodus Bay, New York; collection district, Oswego, New k; nearest light-house, Big Sodus, New York, a fixed white light of the fourth er, varied by a white flash every 2 minutes, on a bluff three-fifths mile west of entrance to the bay; a fixed white light of the sixth order 180 feet inside of the er end of the west pier, and a fixed red light of the sixth order at elbow of west . Nearest work of defense, Fort Ontario, New York.

Money statement.

y 1, 1891, balance unexpended	$13,763.80
e 30, 1892, amount expended during fiscal year	12,226.06
y 1, 1892, balance unexpended	1,537.74
y 1, 1892, outstanding liabilities	1,235.00
ly 1, 1892, balance available	302.74
ount appropriated by act approved July 13, 1892	15,000.00
ount available for fiscal year ending June 30, 1893	15,302.74
Amount (estimated) required for completion of existing project	43,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	40,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

rrivals and departures of vessels at Great Sodus Harbor, New York, during fiscal year ending June 30, 1892.

ARRIVALS.

Trade engaged in.	Steamers.		Sailing vessels.		Barges.	
	No.	Registered tonnage.	No.	Registered tonnage.	No.	Registered tonnage.
me, on lake	29	4,605	17	2,947	19	7,144
reign, on lake	1	277	61	9,787	2	643
Total	30	4,882	78	12,734	21	7,787
erican owned	29	4,605	4	854	7	1,817
nadian owned	1	277	74	11,880	14	5,970

n total, 129 arrivals; 25,403 registered tonnage.

DEPARTURES.

Trade engaged in.	Steamers.		Sailing vessels.		Barges.	
	No.	Registered tonnage.	No.	Registered tonnage.	No.	Registered tonnage.
me, on lake	28	4,636	11	1,935	5	1,355
eign, on lake	4	391	66	10,600	16	6,432
Total	32	5,027	77	12,535	21	7,787

m total, 130 departures; 25,349 registered tonnage.

Greatest draft of vessels, 10½ feet.
Greatest tonnage, 541 registered tons.
Greatest load, 993 net tons of coal.

Navigation closed November 26, 1891; navigation opened A
For the purpose of reduction to tons weight the following is
7 equal 1 ton; thousand feet lumber, 1 equals 1¼ tons; crate
railroad ties and poles, 12 equal 1 ton; cordwood and posts,
animals, 4 equal 1 ton.

O O 4.

IMPROVEMENT OF HARBOR AT LITTLE SODUS B.

OBJECT.

To secure a channel from Lake Ontario into Little
igable width and of depth not less than 15 feet at ex
Little Sodus Bay is 2 miles long, three-fourths of
and land-locked, and is situated midway between
Sodus, or 13 miles west of Oswego. It is the coa
Lake Ontario for the Lehigh Valley Railroad.

PROJECT.

To contract by breakwaters the entrance to the
250 feet and maintain a channel 200 feet wide and
treme low water by parallel piers.

PRESENT WORKS.

The project has been completed, except that the cteristic of this and of all the bays on the south shore of Lake

reakwaters were built to the sides of the natural cut through (which was 1½ feet deep in 1853 and 5½ feet deep in 1866), and ence extended north to deep water in the lake by parallel jet- feet apart.

structures were formed of cribs each 20 feet wide and 30 feet nk end to end upon the natural bottom in as close contact as ble by filling them with loose stone gathered from the shores ay and lake, and by dredging gravel and dumping it into them. ribs were formed of sawed hemlock timber 12 inches square, by 12 inches, which was framed together and bolted with iron The cribs had tight plank floors and the earlier ones were al- settle into the natural gravel and sand bottom for part of the before building the continuous superstructure of 12 by 12 inch ber, also filled with loose stone. For the later cribs, a founda- prepared by dredging a trench or by depositing riprap.

ch side of the bay the junction of the breakwaters with the s effected by stake and fascine structures, intended to aid the n of drift.

ifferent portions of the work are described as follows: In every ere depth of water is mentioned in this report, the depth at low-water level, or below the zero of the Oswego gauge is

est breakwater.—The original structure was built in 1868, and eculiar one, specially designed for this place. It was of trian- oss section, with 13 feet base and 13 feet sides, built in separate , 25 feet long, of 6 by 6 inch hemlock frames, planked inside nch hemlock plank, the whole filled with loose stone and sunk e crest of the bar at depth of half a foot to 2 feet.

tal length from the west shore to the west jetty was 650 feet. akwater was built in 1868, and was destroyed the same year.

70–'71 the present rectangular crib-work structure, 469 feet long eet wide, was built 30 feet outside of and parallel with the orig- . It is still in place, though much decayed; all but 90 feet ad- the west jetty is buried beneath the accretion of the west beach, 90 feet was repaired in 1887. In 1887, there was built in front reakwater and adjoining the jetty 200 feet of stake and fascine This has gathered the gravel, and it is probable that minor re- 50 feet of the breakwater is all that will be here needed in

est pier or jetty.—This is 1,960 feet long and 20 feet wide, ex- across the bar north to deep water in the lake.

n A is 186 feet long, 20 feet wide, and was built with its super- re in 1854.

ribs forming the substructure were each 20 feet wide and 30 g, sunk end to end upon the natural gravel bottom in as close as practicable by filling them with loose stone. The cribs were of flatted logs framed together and bolted with iron bolts and tree nails.

appear to have had floors of slabs, and to have been allowed to nto the natural gravel bottom for part of the season before g upon them the continuous superstructure of hewed timber.

cribs are still in place and are sound below mean water level. perstructure was never renewed and has disappeared. The breakwater and the beach line being outside of this portion of the jet it is no longer necessary to keep it in repair.

Section B is 50 feet long and 20 feet wide, extending north in prol gation of section A. It was originally built in 1854 when the section was built, but instead of being abandoned as that has been superstructure was renewed in 1867, and has since been maintai and forms the inner end of the west jetty. The west breakwater j it 40 feet north of its south end.

Section C is 860 feet long in prolongation of the last section n is 20 feet wide, and was built with superstructure in 1867-'68. cribs forming the substructure were each 20 feet wide and 30 feet with tight floors, and were sunk upon the natural bottom, in depth creasing from 6 to 11 feet at extreme low-water level, by partly f with loose stone. After building the continuous superstructu five courses of 12 by 12 inch pine upon the cribs, the filling completed by dredging the channel to 12 feet depth close besid cribs, and dumping the sand and gravel directly into the crib from the dipper. The cribs settled into the cut so that the ch side was under water and the structure nearly rolled over.

In 1870-'71 it was necessary to remove the deck, build up the nel side vertically for 3 feet, and relay the deck. No future dre can safely be done nearer to this section than 30 feet.

In 1889 the superstructure was first renewed, built this time w by 12 inch pine timber, and with longitudinal tight deck.

Section D is 150 feet long and 20 and 30 feet wide. It was b 1870-'71 in prolongation of the preceding sections. The substructu formed of four cribs, each 20 feet wide and 30 feet long, and one feet square for a pier head. They were built of sawed 12 by 1 hemlock timber, with tight floors, and were sunk upon the natur tom at depths of 10 to 11 feet by filling with loose stone. The c uous superstructure of four courses of 12 by 12 inch pine timb built upon the cribs the same season.

The superstructure was first renewed upon it in 1889-'90, at th time when renewal was made upon sections B and C.

Section E is 242 feet long in prolongation of last section; is wide, and was built complete in 1881.

The cribs forming the substructure are each 30 feet long, 20 feet and were buit of 10 by 12 inch sawed hemlock timber, framed to and bolted with 1¼ iron drift bolts. The floors are of 3-inch he plank, laid 18 inches above the bottom, and with 3-inch spaces, screw-bolted grillage.

The cribs were filled with loose stone and sunk end to end i contact upon the natural bottom, having an average depth of 1 There was no dredging or riprap for their foundation. The conti superstructure of four courses of 10 by 12 inch pine timber wa upon the cribs the same season and filled with loose stone. Th was of 3-inch pine plank, laid crosswise and close together.

Section F is 272 feet long in prolongation of the last sections, is wide, and was built complete in 1883. The cribs were similar t of the last section, except that their floors were laid 30 inches the bottom and with 18-inch spaces. These cribs were also sun the natural bottom, having an average depth of 12 feet without ing or riprap for foundation. The bottom was leveled for the fir only by throwing in stone.

The continuous superstructure of four courses of 10 by 12 inch pi t the same season, and was of 3-inch pine plank, laid crosswise close ether.

ection G is 200 feet long in prolongation of the last section, is 20 wide and was built complete in 1885. The cribs differ materially n the former ones. Foundation was prepared for them in 1884, by ing upon the natural bottom a mass of random stone 3 feet in kness and 30 feet in width. Upon this, in 1885, were sunk the cribs, ich were each 50 feet long and 20 feet wide and 14 feet deep and were lt of 10 by 12 inch sawed hemlock timber, except the two upper courses, ich were of pine. In addition to the usual drift-bolt fastening each also had six vertical pine posts extending from the grillage bottom to top of the superstructure and screw bolted to each timber. The rs were of 3-inch hemlock plank, 36 inches above the bottom, but not clear across, an open space of 4 feet width being left along each to permit the stone filling to settle. This last feature has proved e a radical defect, resulting only in a waste of stone filing and requir- (in 1888) the repair of the outer end, from which all the stone had ped. It was necessary to build and sink within the crib four interior s to close these openings, and then to refill the outer end of the crib stone.

he superstructure of four courses of 10 by 12 inch pine, which was built n the crib the same season, 1885, has a longitudinal tight deck of 3- pine, laid directly upon the top set of cross-ties without the usual k joints. This section, upon which the light-house stands, completes west jetty.

) *East breakwater.*—This is 1,850 feet long, consisting of 1,680 feet hallow crib work, is 20 feet wide, placed upon the crown of the bar lepths varying from half a foot above extreme low-water to 2½ feet w the same plane. It extends from near the east side of the bay he east jetty, its junction with the east shore being effected by 170 of stake and fascine work.

s details are as follows:

ection A is 170 feet long and 8 feet wide and was built in 1885, from east shore to the crib-work breakwater, which it joins 50 feet west he east end.

consists of stakes and wire-bound fascines, made from the trunks branches of hard-wood brush, the whole paved with stone gathered the lake shore. It has stood without attention and is covered by accretion of sand and gravel.

ction B is 150 feet long and 20 feet wide and was built in 1878, ing the east end of the breakwater.

is formed of 5 cribs, each 30 feet long, 20 feet wide, and 3 feet deep, upon the natural bottom. The cribs were built of 10 by 12 inch lock timber, with a close floor of hemlock plank one foot above the om.

he continuous superstructure of two courses of 10 by 12 inch pine er was built over the cribs the same year and the whole filled with e stone and decked with 3-inch pine plank laid cross-wise, with 3- spaces. The deck was 4½ feet above extreme low water. It has since been renewed, except its western 50 feet, which was included e portion rebuilt in parapet form in 1891.

ction C is 750 feet long and 20 feet wide. It was originally built 875, its cribs and superstructure being of the same description as e of the last section. Its superstructure was not renewed until , when it was rebuilt in parapet form. The parapet on the lake front is 9 feet wide and 3 feet higher than the harbor front, which w rebuilt at 4½ feet above extreme low-water level for 11 feet width.

The whole was filled with loose stone and decked with 3-inch lon tudinal pine plank, laid tight.

Section D is 540 feet long, 20 feet wide, formed of cribs and sup structure like those of the last section, and was built in 1874. T superstructure was renewed in the parapet form just described duri 1889-'90.

Section E is 240 feet long, 20 feet wide, formed of cribs and sup structure like those of the last sections, and was built in 1873. T superstructure was renewed in the parapet form just described duri 1889-'90 in connection with the last section. This joins the east jett with which its superstructure is bonded.

(4) *East pier or jetty.*—This is 1,510 feet long from the west end the east breakwater across the bar to 11½ feet depth in the lake. It located parallel with the wes[?] je[?]y and 250 feet from it. The su structure cribs of the inner 512 feet were placed in a trench dredged feet wide in a gravel bar to a depth of 8 feet below extreme low wate the next 757 feet were placed in a trench dredged to 10 feet below e treme low water, and the remaining 241 feet were placed upon the n ural bottom at depths of 10 to 11 feet. The details are as follow beginning at the inner end:

Section A is 512 feet long, 20 feet wide, and was built in 1872-' The cribs forming its substructure were built of 12 by 12 inch saw hemlock timber framed and drift-bolted together. They had cl floors of hemlock plank laid 18 inches above the bottom upon the ti bers of a screw-bolted grillage.

Each crib was 30 feet long, 20 feet wide, and 9 feet deep. The s was prepared for the cribs by dredging across the gravel bar a tren 30 feet wide to 8 feet below extreme low water, where the natural dep were 2 feet at the inner end, increasing gradually to 6 feet at the ou end. The cribs were sunk in this trench by filling them with lo stone.

The continuous superstructure of 4 courses of 12 by 12 inch p timber was afterward built upon them and was also filled with lo stone and was decked with 3-inch pine plank laid cross-wise, with 3-i spaces. The superstructure was not repaired until 1887, when it renewed by building 4 courses of 10 by 12 inch pine timber, dec with 3-inch longitudinal plank laid tight.

Section B is 757 long in prolongation of the last section, 20 feet w and was built in 1881 and 1882. Each crib was 30 feet long, 20 wide, and 12 feet deep, the lower 10 courses of hemlock and the u 2 courses pine. The cribs had close floors of 3-inch hemlock plank 18 inches above the bottom upon the timbers of a screw-bolted grill

The site was prepared for the cribs by dredging a trench to 10 below extreme low water, where the natural depth was from 6 t feet.

The continuous superstructure of 4 courses of 10 by 12 inch timber was built the same season, filled with loose stone, and de with 3-inch pine plank laid cross-wise, but tight together. It has since been renewed.

Section C is 241 feet long in prolongation of the last section, feet wide, and was built complete in 1883. Each crib was 30 feet l 20 feet wide and 12 feet deep, the same as those of the last sec The foundation was not prepared for them by dredging or riprap cept that the bottom was leveled for the first crib by throwing in e natural depth when the cribs were placed was 10 to 11 feet at me low water. The superstructure was built the same year, similar at of the last section.

is completes the present east jetty, which is, however, about 500 shorter than its proposed length.

CHANNEL.

ior to beginning the construction of jetties, there was no perma- natural channel across the bar which closed the entrance to the

e general width of this bar from deep water within the bay to deep r in the lake outside was from 600 to 900 feet between 6-foot curves, t 2,000 feet between 12-foot curves and 2,600 feet between 15-foot es. These and all depths stated in this report are at extreme low- r level, which coincides with the plane of zero of the Oswego gauge h was established at extreme low-water level in 1837.

e natural depths upon the crest of the bar and in the channel s it varied from time to time.

1828 and in 1845 the crest of the bar was above water for most of listance across the bay, the channel (at the same place as the pres- ne) being stated in the annual report for 1847 "to have but 2 feet ter." If this meant the actual depth, which seems probable, its tion to extreme low-water level would give but half a foot.

1853, just before the first jetty construction, the depth was 1¼ feet v extreme lowwater, which was in 1854 increased by dredging, r the shelter of the west jetty to 6 feet. The amount of material removed to make the channel, which appears to have been about eet long and 80 feet wide, must have been about 4,000 cubic yards.

1866, when the next work of improvement was begun, a detailed ey showed this cut to be 5½ feet deep.

the west jetty was extended during 1866, 1867, and 1868, the chan- as enlarged by dredging close beside the jetty and in August, 1868, s reported to be 10 feet deep, 80 feet wide, and 800 feet long. The nt dredged is not reported, but it appears to have been about 0 cubic yards, at a cost of 24 cents per cubic yard in scows.

1869, the width had been increased to 200 feet, but in 1871 22,625 yards of gravel, sand, and mud were excavated, at 17 cents per yard, to make the depth 10 feet over this width for 1,200 feet h from bay to lake.

1872 and 1873 small amounts of dredging were done at $1 per yard, but it was limited to the excavation of a trench for crib lations and no dredging was then done in the channel.

1875, a shoal about 100 feet wide had formed across the channel nd-drift around the outer end of the west jetty, which then ex- d only to the 9-foot curve. This shoal had 8 feet depth and cubic yards were dredged from it at 25 cents per cubic yard, to a passage 80 feet wide next to the west jetty.

exceptionally high stage of water prevailed in the lake in 1876, o further dredging was done until 1879, when the deepening of hannel to 15 feet depth at extreme low water was begun. During and 1880 and 1881 there were removed 25,931 cubic yards of gravel, and mud, at 18 cents per cubic yard, scow measurement, and the was continued in 1881 at 17¾ cents per yard. At the latter rate, 2 cubic yards, scow measure, were removed up to December 1, 1881, ng 15 feet depth at extreme low water for 200 feet width and 1,700 ength.

1891, continuing until December 1, when weather per
this time 7,257 cubic yards of sand and mud and 54
hardpan were removed. The work done showed that
too tough to be dredged economically and that blasti
sary for its removal.

OPERATIONS.

The work of removing the superstructure of 800
Breakwater, being all of Section C, and the western 50 f
was begun August 10, 1891, and continued until Decemb
it was practically completed. There remains only a
smoothing up and finishing now to be done. This wo
necessary to the strength and durability of the work,
give it a neat and workmanlike appearance.

The superstructure was built in the parapet form, a
most recent and approved design. The lumber and iro
work were purchased by public notice and sealed prop
material and labor required were obtained in open ma
excellent piece of work, and is well and economically
was $7,594.85, divided as follows:

Labor	
Lumber	
Iron	
Stone	
Other material and tools	
Total	

Or at the rate of $9.49½ per foot. This sum include
unusually large amount of stone, which it was necessa
order to fill the superstructure on account of its increa

Under authority of the Chief of Engineers $5,000 wa
the appropriation for this work towards the purchas

not employed at that time. The dredge continued to work when the condition of the lake permitted until the end of November, when it returned to Oswego and was laid up for the winter.

The total material dredged and removed from the channel was as follows:

	Cubic yards.
Hardpan	541
Sand	7,257

The amount expended for this purpose was $2,622.29, the cost being reasonable considering the character of the material. In addition to the foregoing sums, $1,001.52 has been expended during the fiscal year for engineering and office expenses.

REMARKS.

The reports show a small increase in the number of vessels arriving at this harbor over that of last year; but no material increase can be looked for till the effective depth of the channel is increased.

The completion of the project requires about 665 feet of pier extension, and the dredging of 20,000 cubic yards of hard material from the channel. This will cost in all about $58,500, and in addition to this sum there should be available $6,000 every year for the repair and maintenance of the existing works. The material to be dredged through from the outer end of the jetties to the 15-foot curve in the lake appears to be all hardpan, and it is reasonable to expect that a cut dredged through it would remain open, unless filled up by sand moved out beyond the ends of the jetties from the beach.

There is no satisfactory evidence that the beach sand is moved out as far as this. Even if the sand does move out to the location of the cut in moderate quantities it might be cheaper to maintain the channel by dredging than it would be to keep the increased length of jetties in repair.

I think the experiment worth trying at this place, and I would, therefore, recommend that the jetties be not extended any farther until after the proposed dredging has been completed and the effect observed for one or two seasons.

The small amount of money now available will be applied during the present season to dredging and blasting in the channel according to the project.

Name of harbor, Little Sodus Bay, New York. Collection district, Oswego, N. Y. Nearest light-house, Fair Haven, N. Y.; a fixed white light of the fourth order near the head of the west pier, a fog bell attached; a mast range light at inner end of west pier. Nearest work of defense, Fort Ontario, N. Y.

Money statement.

July 1, 1891, balance unexpended	$17,960.52
June 30, 1892, amount expended during fiscal year	16,218.66
July 1, 1892, balance unexpended	1,741.86
Amount appropriated by act approved July 13, 1892	6,000.00
ount available for fiscal year ending June 30, 1893	7,741.86
mated) required for completion of existing project	52,500.00
an be profitably expended in fiscal year ending June 30, 1894	40,000.00

pliance with requirements of sections 2 of river and
66 and 1867.

COMMERCIAL STATISTICS.

Arrivals and departures of vessels at Little Sodus Harbor, New York, during fiscal year ending June 30, 1892.

ARRIVALS.

Trade engaged in.	Steamers.		Sailing vessels.		Barges.	
	No.	Registered tonnage.	No.	Registered tonnage.	No.	Registered tonnage.
Home, on lake	57	2,673	51	8,017	46	11,168
Foreign, on lake	27	3,832	158	33,470	62	22,590
Total	84	6,505	209	41,487	108	33,758
American owned	58	2,728	28	1,537	36	8,596
Canadian owned	26	3,777	181	39,950	72	25,162

Sum total, 401 arrivals; registered tonnage, 81,750.

DEPARTURES.

Trade engaged in.	Steamers.		Sailing vessels.		Barges.	
	No.	Registered tonnage.	No.	Registered tonnage.	No.	Registered tonnage.
Home, on lake	59	2,707	26	2,565	30	8,034
Foreign, on lake	25	3,798	182	38,770	78	25,724
Total	84	6,505	208	41,335	108	33,758

Sum total, 400 departures; registered tonnage, 81,598.

Greatest draft of vessels, 13 feet.
Greatest tonnage, 585 registered tons.
Greatest load, 1,193 net tons of coal.

Receipts and shipments by lake at Little Sodus Harbor, New York, during the fiscal year ending June 30, 1892.

Trade.	Receipts.						Shipments.		
	Passengers.	Grain.	Fish.	Railroad ties.	Posts.	Lumber, etc.	Passengers.	Merchandise.	Coal.
	No.	*Net tons.*	*Net tons.*	*Tons.*	*Tons.*	*Tons.*	*No.*	*Net tons.*	*Net tons.*
Home, on lake	512	....	....	....	....	....	492	8	7,250
Foreign, on lake	......	235	12	3,746	567	279	....	....	122,144
Total	512	235	12	3,746	567	279	492	8	129,394

Navigation closed December 14, 1891.
Navigation opened April 8, 1892.

For the purpose of reduction to tons weight the following is assumed: Barrels oil, 7 equal 1 ton; M lumber, 1 equal 1¼ tons; crates fruit, 20 equal 1 ton; railroad ties, 12 equal 1 ton; cords wood and posts, 1 equal 1½ tons; live animals, 4 equal 1 ton.

O O 5.

IMPROVEMENT OF HARBOR AT OSWEGO, NEW YORK.

OBJECT.

To provide a basin sufficient for the needs of commerce at the mouth of the Oswego River, New York, on Lake Ontario, and to secure and maintain a navigable channel into said basin and river.

PROJECT.

1827.—To inclose by breakwaters a western basin of 11 acres area outside the bulkhead line, and an eastern basin of 9 acres outside the bulkhead line, and to protect the entrance channel by piers. (Completed 1829; pier extended 1869).

1870.—To inclose by a breakwater of crib work filled with stone a western basin of 100 acres area outside the 9-foot curve and the existing western breakwater. (Completed in 1882.)

1882.—To build an eastern breakwater on the alignment of the western, sheltering an eastern basin. (Superseded by project of 1888.)

1883.—To build spurs projecting from lake face of western breakwater for the purpose of breaking the accumulated and reflex waves occasioned by that breakwater, which have rendered the entrance exceptionally difficult and dangerous during storm. (Completed in 1889.)

1888.—To remove the east breakwater. (Removed in 1889.)

1891.—To make permanent and to shelter the western entrance to the outer harbor.

PRESENT WORKS.

(1) The present works consist of the inner west breakwater, which lies wholly within the outer breakwater, by which it has been superseded.

(2) The inner east breakwater, which has been private property since 1852.

(3) The Fort Wharf, which constitutes a storage place for harbor material.

(4) The outer west breakwater, whose maintenance constitutes the principal work.

(5) The detached spurs outside the outer breakwater, two of which have been built, and of which two more are proposed to shelter the present western opening.

(6) The deepening of the entrance and river channel in the inner harbor. These works are described in detail as follows:

(1) *The inner west breakwater.*—This is 1,993 feet long, of masonry and crib work of varying widths, and was built between 1827 and 1837. The original structure was composed of cribs of timber, each 30 feet wide and 30 feet long, sunk end to end upon the natural lake bottom in as close contact as was practicable by filling with loose stone.

The cribs were formed of round logs, hewn flat, framed together and bolted with iron drift bolts and wooden treenails. They had floors of slabs, and were allowed to settle upon the natural bottom for a part of a season before building upon them the continuous superstructure of timber.

...ths in which the cribs were placed increased gradually from nothing, at the origin of the shore arm on the west side of the mouth of the river, to about 21 feet (at extreme low-water level) at the pier head next the river channel. The construction of the timber breakwater was completed in 1829.

In 1837 the construction of a masonry superstructure of cut limestone was begun at the shore end. This masonry superstructure was built upon the shore arm, and extended for 90 feet along the lake arm during 1837, and 1838, and 1839. This portion still stands, the shore arm being in a fair state of preservation. The masonry was extended 155 feet farther along the cribs of the lake arm in 1845.

This portion was not completed and has gradually been destroyed, the great cost and the unsatisfactory character of foundation afforded by the crib work apparently accounting for its not being completed and extended. This is the only masonry superstructure which has ever been constructed at Oswego Harbor.

Between 1830 and 1837 large sums were expended in attempting to form, in front of the lake arm of the breakwater, a mole of pierre perdue. A mass of loose stone from 100 to 500 pounds each was deposited in front of the crib work, extending 6 feet above water, and along the whole lake front, about 1,100 feet.

In 1834 it was given a regular profile and was paved with massive blocks of Chaumont limestone, 2 feet thick, weighing 3 tons each.

This pavement was 30 feet wide from the face of the breakwater and the foot of the slope was formed of larger blocks, each 10 feet long, 3 feet wide, and 2 feet thick. The waves moved these stones so freely and destroyed the mole so thoroughly that its maintenance was abandoned in 1837.

During low water in 1891, about 150 of these blocks were recovered and piled on the fort wharf for use in repairs of the outer breakwater.

Section A: The shore arm is 250 feet long, 30 feet wide, and has a crib-work base with cut limestone superstructure in parapet form. Built in 1828 with superstructure reconstructed of masonry in 1837–1838. In fair preservation.

Section B, from the angle eastward, 110 feet. The same description as the last except that its condition is ruinous.

Section C, located back of section B, overlapping it and extending past it a distance of 138.8 feet, including a 10-foot passage for boats cut through its east end in 1884.

This section is of crib work, 22 feet wide, built back of the ruined masonry structure in 1854. Its superstructure was rebuilt on its south or harbor face in 1887 and on its lake face in 1891.

It serves to shelter the United States reservation slip, where the United States boats, scows, and dredge are moored, and to provide a storage place for timber needed for repairs.

Section D: This is 838. 2 feet long, in prolongation of the line of the masonry portion of the lake arm eastward, and extends to the light-house pier head. It was built in 1828–'29 and its superstructure was rebuilt and repaired in 1844, 1854, 1860, 1867, 1874, and was burned in the great fire of 1881.

It was transferred to the Light-House Department in 1886 and was rebuilt by the Light-House Department in 1889, in parapet form. The superstructure is built of 12 by 12 inch pine timber, filled with loose stone, and decked with 3-inch pine plank. It is 27 feet wide, founded upon the original crib work 30 feet wide.

At the west end of this section, a small crib-work jetty has just been built in 1892, 12 feet wide and 48 feet long, to shelter the passage way or boats from the outer to the inner harbor. The jetty is formed of a iece of parapet and of old timbers from the 1884 breach in the outer reakwater, and its superstructure is of blocks of stone taken from the djoining lake bottom.

A bridge crosses the passage way high enough to permit the passage f the Life-Saving Service boat at extreme high water.

Section E is the light-house pier head of irregular form, extending 2 feet on prolongation of the line of the breakwater and 132 feet at a ight angle to it northward. Upon a mass of loose stone, inclosed by he cribs forming the pier-head substructure, stands the masonry light-ouse, which was built in 1836.

The cribs were built in 1835 and its superstructure was repaired and ebuilt repeatedly until the transfer to the Light-House Department in 886, by which department it was last repaired in 1889.

Section F is 432 feet long, in prolongation northward into the lake f the pier head, and is 30 feet wide. It was not included in the trans-er to the Light-House Department. It was built in 1869 of cribs 30 eet long and 30 feet wide, which varied in depth from 15 to 26 feet. hese were built of 12 by 12 inch sawed hemlock timber, with floors f 3-inch hemlock plank laid, with 7-inch spaces, upon the screw-bolted imbers of the grillage which formed the bottom of each crib, the oor-plank being 18 inches above the bottom.

The cribs were sunk upon the natural bottom, without dredging or iprap, in depths varying from 11 feet at the pier head to 15 feet at the uter end.

The material forming the bottom was sand and the cribs settled ery irregularly into it 4 to 10 feet, making a crooked line and requiring uch leveling.

The superstructure of 6 courses of 12 by 12 inch pine, with 3-inch ine deck-plank laid cross-wise 3 inches apart, was completed in 1870 nd has not since been renewed. It is thoroughly decayed and its enewal, in parapet form, is the next work proposed. Another section, which was a part of the inner west breakwater, but has disappeared, was designed in 1869 and then made a part of the project, but was not built until September and October, 1871. It was a crib 100 feet long, 10 feet wide, and 7 to 11 feet high, placed across the right angle at the junction of the light-house pier head with the breakwater, the inclosed triangular space being filled with about 1,000 cubic yards of loose stone.

Its purpose was to relieve the pier head and the light-house from the shock of the waves caused by west and northwest winds. It was sunk upon the existing bottom, where the depths at extreme low water were from $2\frac{1}{2}$ to $6\frac{1}{2}$ feet. The material which formed the bottom was the remains of the mole (which had long before disappeared) and the accretion of sand which had formed against the breakwater where the original depth was about 20 feet. The crib and its superstructure were completed, with its deck at $4\frac{1}{2}$ feet above extreme low water, and the space behind it was filled with stone to the same level in October, 1871. During the first northwest gale, in November, it rolled over toward the waves (apparently by the material in its front being cut out and by the reflux of waves which rolled over it into the inclosed space) and [illegible] entirely destroyed during the same winter. It now has no place [illegible] he project.

The inner east breakwater.—This is 750 feet long, 30 feet wide, and [illegible]ated on the prolongation eastward of the line of the inner west [illegible]er, from whose pier head it is distant 357 feet.

[illegible] flows between them into the lake.

From this point the breakwater extends to the east shore, ben Fort Ontario. It was built in 1828–'29 in the same manner as west breakwater. It was repaired in 1844, and in 1852 was transf to Gerrit Smith, esq., whose estate since 1852 has owned and r tained it, building under its shelter wharf property which for t years was very valuable, but which is now not so much used as form In consequence the breakwater has not been properly maintaine some years past and it is now in a damaged state.

The northwest angle was destroyed in 1891 and has not been re and the shore arm is in a ruinous state.

(3) *The fort wharf.*—This is the landing in the inner harbor fo Ontario, and forms a part of the United States Reservation pert to that fortification. It has been of value in connection with the l improvement as a storage place for timber and stone and for fr and launching cribs.

It has a water front of about 250 feet with an area of about 1(by 200 feet. The crib work forming its water front was built in when the fort was built; was repaired in 1863, when the fort was structed, and has recently been repaired above line of no decay on the harbor work.

It is now in good order.

(4) *Outer west breakwater.*—This is 6,033 feet long, inclosi acres (outside the 9-foot curve) of what was formerly the op in front of the city and of the inner harbor. It starts from t shore, nearly a mile westward from the river outlet, and exten ward upon a line generally parallel to the lake front and 1,200 fe it to a point opposite the entrance to the inner harbor.

The breakwater is formed of timber crib work filled with loos and is 35 feet wide throughout.

Its substructure is formed of cribs each 35 feet long and 35 fee a few of those last built being of double this length. Its superst is also timber and is now in parapet form. Its height on the sh is 9½ feet above extreme low-water level; on the lake arm, 13½ f

The original survey for the location of this breakwater was r September, 1869, the plan was approved by the Board of En March 30, 1870, and the work of construction was begun on 1871. It was completed in July, 1882. Its details are as foll of the cribs being built upon essentially the same plan as those shore arm next described.

The shore arm is 916½ feet long, from a ledge of rock form shore, northeastward into the lake to 18 feet depth at extre water.

Section A, from the shore 846½ feet, was built in 1871–'72 o each 35 feet long and wide, sunk in contact with each other u natural bottom, the cribs being built to fit the irregular ledges rock on which most of them were placed. The cribs were for 12 by 12 inch hemlock timber, all the sticks being of the same le 35 feet.

The timber forming the grillage bottoms were screw-bolted to Those forming the sides were driftbolted, course by course, as b the sides being held together against the outward thrust of th stone filling by the dovetailed heads of the cross-ties and by inclined halvings.

The floors were of 3-inch hemlock plank, laid 3 inches apart, 18 above the bottom, upon the timbers of the grillage, a central s feet square being left without plank.

The continuous superstructure built the same season upon these ribs was formed of 12 by 12 inch pine timber, 7 courses in height, with a horizontal deck 8 feet above extreme low water, of 3-inch pine plank laid crosswise, 3 inches apart, upon 6 by 12 inch pine joists, loose stone of random sizes being filled in to the top of the joists. The planks were fastened by 9 by ½ inch spikes, and by six longitudinal bands of 2 by ½ inch flat iron.

This deck was maintained by annual repairs of varying extent every year from the first until the rebuilding of the superstructure in 1887. It was then built in low-parapet form of the 1887 model, which differed radically from the 1884 model hereafter described.

The 1887 model is a parapet 9½ feet high above extreme low water for one-third the width, with the inner two-thirds 5½ feet high. Its timbers are held together by screw bolts and vertical oak posts instead of by tie beads. Deck joists are omitted, and the 4-inch pine deck plank are laid longitudinally and tight together upon the top set of cross-ties. It cost no more than the work which it replaced. It has neither needed nor received any repairs whatever since its completion in December, 1887.

Section B is 70 feet long, in prolongation of the last section, to the angle of the lake arm. It was built in 1871–'72, at the same time and in the same manner as the last section. Its superstructure had the same frequent repairs until 1884, when, with the following section, the superstructure was renewed in parapet form of the 1884 model. It has received some repairs during the year 1892, and the superstructure on the exposed face needs repair below water.

Section C of the lake arm is 2,910 feet long from the angle eastward. Points upon the lake arm are described by naming their distance from the angle, measuring along the axis.

It was built in 1872–'77 of cribs, each 35 feet long and wide, of depths varying from 18 to 30 feet. The cribs were sunk upon the natural bottom of the lake, and about 30 of the first ones settled more or less irregularly into the sand. The bottom upon which the rest stood was of stones and gravel, and very little settlement took place, generally about one to two feet on the lake face.

During the winter of 1872–'73 700 linear feet of cribs, from 80 feet from the angle eastward, were left without superstructure to settle until next season. During the winter the three last cribs, from station 671 to 776, each 28 feet deep, were moved off the line by the waves, the last one being thrown ashore. All the cribs left open were damaged and had to have shallow cribs sunk upon the damaged substructures. This was done in 1873, and the superstructure was built over them 8 feet high above extreme low water with a flat deck. This was annually repaired until 1883, when a more serious damage occurred, by which the superstructure was wrecked and the crib tops carried away to 12 feet depth for 105 feet.

In 1884 these crib tops were rebuilt by sinking 12-foot cribs on top of the original bases, and then the entire superstructure for 2,910 feet, including this piece, was renewed. The renewal was in parapet form upon what is described as the 1884 model. The parapet is 13 feet high ... next the lake for a width of 12 feet. It offered more resist... waves, which had formerly rolled over the lower super... replaced. In October, 1884, immediately after the ... the superstructure was shifted inward from ... feet in length from station 475 to 615. ...re was not broken apart by this movement, feet above the still-water level within the harbor. made the break were 19 feet above still-water level, t miles per hour.

The opening thus made through the breakwater an improvement in the sanitary condition of the incl the harbor, and was so convenient an entrance for that it has not been rebuilt and will be made a perm

Since the building of the 1884 parapet upon this se it has received damage at many points and has had co though much less than required by the original flat s

The part of the breakwater which is in a condition tention, and which may need radical repairs, is th breach. The actual breach was limited, as above feet, and it has not since extended. But the su strained and its joints opened for 100 feet farther on has only been maintained by closely watching it a screw bolts and steel plates to check indicated yieldi

The exposed face of all the cribs of the substruc from the angle eastward for about 700 feet (incluc breach) are more or less shaken, and show signs o instance, on January 8, 1890, five courses went out f of the crib next the angle, 5 to 10 feet below water This is at 24 to 47 feet eastward from the angle.

Through this submerged opening all the stone fi out down to 10 feet below water, and a large breach followed.

It was repaired by building within the parapet inte filling the spaces between the ties and filling these cr pended above water with concrete and lowering them concrete was formed.

In this way there were formed 3 monoliths, each 8 20 feet high, which put no strain upon the shaken lake of construction had been proven necessary by the con in the preceding season of similar interior cribs filled t, were made of creosoted Georgia pine, and these are sound. the other timbers already show some decay.

ction D is 570 feet long in prolongation of the last section eastward. s built in 1877–1879 with its cribs placed upon the natural bot- some being double the usual length, and with a continuous super- ture, which was 8 feet high with a flat deck. The superstructure ved repairs at various times, and in 1890–'91 it was renewed in pet form, in connection with the following section.

e details of this parapet differed entirely from that of 1884, which ned, and is also different from the 1887 shore-arm model. Like the r it is tied together by the tensile strength of screw bolts and oak , and its deck is of 4-inch pine plank laid tight. But none of its ers are dovetailed or cut into, all being left square and full size ghout. It is the only work ever built at Oswego in which no tim- were displaced by gales occurring during its incomplete state.

hen 600 feet had been finished the incomplete end of it was left without deck or stone filling through the winter of 1890–'91. e was an absence this winter of the usual ice covering to protect it, the gales were as severe as ordinary. But construction was re- ed in the spring of 1891, and the work was completed without hav- to replace a single stick. Its evident stability promises a freedom repairs equal to that of the shore-arm work.

ection E, is 900 feet long in continuation of the lake arm. Its cribs built in 1880 and differ from all the preceding ones in that they a foundation prepared by dredging a trench in the natural sand om 3 to 6 feet deep and 55 feet wide, and then filling it with random e. Its superstructure was renewed with that of the last section in . A part by contract and a part by hired labor.

he comparison of cost by the two systems is made in an appended rt by United States Assistant Engineer Judson, who designed this of structure under the direction of Captain Palfrey, Corps of En- ers.

ection F 490 feet long in continuation of the lake arm to the eastern e. The cribs were built in 1880–1882, and founded upon random e placed in a trench 3 to 10 feet deep and 55 feet wide. The cribs about 18 feet deep, and the original superstructure was built t courses high with a flat deck. In 1884 the parapet superstructure built upon the other, all of white pine, without the creosote in the and supports which was used in section C.

was damaged by a schooner which was wrecked against the break- r in 1885, but the shaken timbers held together until 1891, when njury was repaired in an effective manner by screw-bolting a large plate to the face, below water, and filling back of it with grout of cement.

is carries the description to the east end of the lake arm, where channel arm extends southward, inclosing the beacon crib.

ection G, the channel arm, is 246 feet long from the south side of lake arm, with which it makes about a right angle, and extends rd. It was built in 1882, its cribs being placed upon a foundation ndom stone, filling a trench dredged 4 to 10 feet in the natural sand om, where the depth of water was 20 feet and the sand 15 or more deeper.

e superstructure upon the first 62 feet next the lake arm had orig- y a flat deck, 6 feet above extreme low water, and the parapet was 1882—like that on the preceding section. The inner 184 feet has still the flat deck, but its change to parapet form is part project.

Its inner angle was cut into 12 feet below water by a barge i requiring extensive repairs.

The detached spurs.—Under the project of 1883 two or more d spurs outside of the outer breakwater were provided for. O two have been built; one, situated 250 feet west of the easter the breakwater, was built in 1885. The other, situated midwa length of breakwater, was built in 1889. The first one consi single crib 100 feet long, 40 feet wide, and 25 feet deep, with 4-in floors, 4 feet above the bottom, and with vertical sides to mea level. It is placed with its long axis at a right angle to the fac breakwater and is separated from the latter by a space of 10 fee natural bottom at the place was of sand 15 or more feet deep trench was dug for each side and each end of the crib, 10 feet d 15 feet wide at bottom, and this trench was filled with randon The riprap base thus formed extended 10 feet outside of the c line all around. It was leveled at 21 feet below extreme low and the crib sunk upon it.

The superstructure was built upon the crib 14 feet high, slopi the sides to a central top width of 12 feet. The angle at the the slope is covered and joined to the substructure by plates inch tank iron. The crib is formed of one thickness of 12 inch hemlock timber, with three top courses of oak. The sup ture is of one thickness of 12 by 12 inch pine timber; the whole bolted, and strengthened with screw-bolted posts. The de inches thick, of 6 by 12 inch pine timber laid lengthwise of c tight together. The whole is filled with loose stone. The st has not yet yielded at any point, but its foundation proved to b ficient. It was undermined by the wave action along the west fa in 1888 the west side had settled to 7 or 8 feet lower than the ea It now stands in this position. Large amounts of dredge m stone, gravel, etc., have been deposited along the west side, fi up to 10 feet depth, and the structure appears secure from furtl tlement.

The 10-foot space between the crib and the breakwater, througl violent wave action occurs, has not shown any of the scour whi looked for, and which was to be expected from its extremely e location.

The second detached spur, built in 1889, was located 2,600 fee ward of the eastern end of the breakwater, about midway of its

It also is placed with its long axis at a right angle to the brea face, from which a 10-foot space separates it.

Its length is 150 feet, with a bottom width of 40 feet, a surfac of 26½ feet, and a top width of 14 feet. The sides slope regular 5 feet above the bottom to the top of the superstructure. The of 6-inch hemlock, laid tight, 24 inches above the bottom. None timbers are framed or dovetailed, but the structure is tied toge screw bolts through vertical oak posts, and through the sides a

The crib and its superstructure were completed within the except laying the 6-inch tight deck. Its lower twelve cours calked, and the crib was ballasted with 1,200 tons of stone filli towed to position, when it was sunk by admitting water throu valves.

The valves were at once closed again, so that a gale which o immediately after sinking it, and before it could be filled witl to displace the crib, the waves keeping the superstructure filled to top, 12 feet above water level. The natural bottom at the location of stone and bowlders, so that it was only necessary to level the with 2 feet of riprap. The crib has not settled and is in good condition.

The *outer east breakwater* was located upon the prolongation eastward of the line of the outer west breakwater and 351.75 feet from it, the entrance to the harbor being between them. It was built in 1882 under the project of that date as the first section of an outer east breakwater intended to be 2,700 feet or more in length.

It consisted of a lake arm 213 feet long, with a channel arm 35 feet long. Its cribs were like those of the west breakwater, and its superstructure was built in parapet form the same season as the cribs.

Its removal was projected in 1888 and was done in 1889.

HARBOR DREDGING AND RIVER CHANNEL.

1847.—The first dredging of which there is record was done in 1847, when a gravel bar which had formed across the river channel, apparently about 1,000 feet inside the breakwater, was removed at private expense.

1855.—The next was in 1855, when the United States dredge, under direction of the engineer in charge, was engaged in deepening the entrance to the river near the head of the upper island, at the expense of the city.

1861.—This dredge was sold in 1861 for lack of funds to maintain it. No other dredging is reported up to this date and it is not likely that any had been done, as the harbor and its entrance had a general depth in excess of the draft of the lake vessels.

1866–'69.—In 1866 the inner harbor adjoining the west breakwater being too shoal to accommodate the increased draft of vessels to 12 feet, its dredging was commenced. The quantity and price of excavation is not stated, but $29,451 was thus expended to June 30, 1867, and about $12,000 was estimated as the cost of completing it. The work was continued and finished in 1868 and 1869, 12 feet depth at extreme low-water level being reported in the west inner harbor.

1881.—No further dredging was done until June, 1881, when work under contract was begun for deepening the river channel from the entrance near the light-house to the head of the island at the foot of Schuyler street for a length of 1,426 feet and a width of 125 feet. This deepened to 15 feet below extreme low-water level the west half of the river channel, outward from the south line of Schuyler street, excepting a small area next the upper island wharf, where bed rock prevented dredging below 12 feet. Twenty-three thousand one hundred and forty-two cubic yards, at 70 cents per yard in scows, were removed in 1881. The material taken out was gravel and stones, with many large pieces of bed rock, brought down by ice from the river bed in the rapids above the city, the thickness of layer worked upon by the dredge varying from 1 to 6 feet. Before beginning work many borings were made in the area to be worked upon to determine whether the channel could be made. Bed rock, with 12 feet depth, was found beneath the loose deposit, extending out 50 feet into the channel from the east and west island wharves, just north of Schuyler street. No attempt was made to remove this.

1883, 1884.—In September, 1883, dredging was resumed to deepen the east half of the channel. This was done at 30 cents per cubic yard, in

increased to 14 feet, and the inner harbor, above th
ing of 1884, was too shallow, except at a high stage

1890.—During 1890 and 1891 rock excavation to done at private cost to extend the channel above t Marine Elevator (the most northern one on the ea New York, Ontario and Western Railroad coal tr east island wharf. This at once increased the avai harbor to 16 feet, and large steamers came to use was fully complete.

1891.—In 1891 the clearing off of loose material was continued by the United States up to the no street, a farther distance of 900 feet for 240 feet dredged 100 feet next the wharves on each side. effective depth was increased 2 to 3 feet, the rock sl at the north end of the work to 7½ feet at the south sand eight hundred and forty-five cubic yards we cents in scows. In addition there were many p which the dredge could not raise, which were taken States hired labor with a derrick boat. The aggre cubic yards, costing an average of $7.58 per yard. this the ridges of gravel and stones were leveled of of railroad iron over the bottom.

1892.—In 1892 the new United States dredge *Fron* to remove a ridge of sand 20 to 50 feet wide, which outer harbor along the harbor face of the outer brea terial washed over and through it. This work beg and extended thence westward to Station 1400. T duced the original depth of about 17 feet to 10 to moval required the dredging of 10,010 cubic yards, yards of stone crib filling, which was saved. The dr in 1892, the boat passage, which was originally dr inner old breakwater to the outer harbor in 1884.

rk done by contract, has been prepared by Assistant Engineer Jud-, who was in local charge of the work, and it is transmitted here-h. The report indicates that if the whole work had been done by ed labor a very considerable saving might have been made. The t of this work, including the cost of bonding into former work, uivalent to 15 feet additional length, was $7,065.35.

Dredging near the mouth of the river by E. J. Hingston, under formal itten contract, was begun July 20, 1891, and was continued until gust 31, when, finding that he could not complete his contract by ptember 20, the date upon which it expired, he asked for and was nted an extension of time till November 1, 1891. By authority of Chief of Engineers he was not required to pay the cost of inspec-n during this period. A second extension was afterwards granted November 15, with the usual requirements that the contractor should the increased cost to the United States. The work was finally npleted November 13, 1891. The object of this work was to clear off gravel and loose rock that covered the ledge that forms the bed of river, over an area of about 24,000 square yards, from the north of Cayuga street northward to connect with dredging that had viously been done.

The actual amount of material removed by the dredge to accomplish s purpose was 16,845¼ cubic yards, at a cost, including the inspection, $4,291.97. The contract price was 23½ cents a cubic yard. In con-ction with this work a small party of laborers with a derrick scow d other suitable appliances removed from this area some 127 pieces stone that were too large for the dredge to handle. The cost of this rk was $458.04; $98 was also expended in drilling and blasting cer-in very large bowlders that could not be removed in any other way.

This makes the total cost of the work done at the mouth of the river ,848.01. The estimate was $6,000. The effect of this work is to in-ease the depth of this much used portion of the harbor nearly 2 feet. is an important, valuable, and, I think, a permanent improvement. e lake face of the old breakwater near the stone pier was repaired hired labor for a length of 136 feet, the cost being $706.82.

Advantage was taken of the low stage of the water to recover some ge blocks of stone from 2 to 4 tons in weight, which had been placed ny years ago in the lake in front of the old west breakwater. They not much needed now, on account of the shelter afforded by the w breakwater. Ninety-five of them were taken out and placed on Government wharf. They are very useful in repairing breaks in cribs below the water line.

The cost of this work was $209.25. A bad place in the outer break-ter east of the first spur crib was repaired in December. This weak ce was developed by a gale that occurred November 25, but was the ult of injuries done to the pier in 1885, when a schooner collided th it and was wrecked against it. The outer half of the timber wall a width of about 4 feet and a length of about 15 feet had been split and carried away, and the remaining half of the timber had been eatly weakened. The injury was partly above and partly below ter. It was repaired by studding the back of the break with large-aded spikes, which were allowed to project 3 or 4 inches. A steel te three-eighths inch thick and large enough to cover the entire eak was then bolted over it, and the cavity was thoroughly filled th very rich concrete of cement and sand. The cost was $269.32. e approach to the boat slip through the old west pier was deepened the United States dredge. A new and higher bridge was built over the slip, and two small cribs, made of old material, were sunk to the cut from being filled with gravel by the waves moved by the east gales, to which it is somewhat exposed. The aggregate le the two cribs is 48 feet. The superstructure is built of large The cost of this work, not including the dredging, was $679.04.

The United States dredging plant, consisting of one Osgood dredge and two dump scows of 160 cubic yards capacity each process of construction at Oswego, N. Y., at the date of my last report. It was completed in October, 1891, and sent to Littl Bay to be used in deepening the jetties channel. This plant by ity of the Chief of Engineers was paid for from the appropriat several different harbors in this district, the allotment from the priation for improving the harbor at Oswego, N. Y., being $3,0 plant is cared for at Oswego when not in use, and is accounte the Oswego returns. The plant returned from Little Sodus Ba end of November and was laid up for the winter. In the spring after some minor repairs and repainting, the dredge began the removing a ridge of sand that had formed against the new bre on the harbor side, reducing the available depth from 18 or 20 f or 12 feet, and preventing deep-draft vessels from tying up to th water, as it is intended they should. This sand had been carried breakwater by waves from the lake, before it was built up in t pet form. The total amount of sand removed was about 10,0 yards. The dredge also took up and placed upon the breakwa 385 cubic yards of stone which has been used in repair work. assisted in breaking up and destroying a wrecked and sunken was an obstruction in the harbor, and it deepened the approac boat slip as before described. The total expended for opera dredge was $1,660.29. In addition to this, $719.60 worth of st purchased for filling a portion of the parapet of the outer bre

Many minor repairs not mentioned above have also been ma piers and breakwater from time to time as they were requir aggregate cost of them all was about $700.

The cost of watching and care of all plants and material du year was $1,226.67. The engineering and office expenses amo $2,084.70.

The repair of plant and the purchase of tools and non-ex material was $931.55.

The sum total of all these amounts somewhat exceeds the penditure for the fiscal year. This is due to the difference in t of material on hand at the beginning and end of the fiscal yea

REMARKS.

The superstructure of the light-house pier extension, wh built in 1869, is very much decayed. It should be renewed as possible and in the parapet form. The parapet should also be e to the extremity of the channel arm, which extends inward eastern end of the lake arm of the breakwater. The space (3 between the ends of these two sections forms the entrance to harbor, and as the superstructure of them both is very low, i cult to see the ends of them at night, and vessels sometime them in entering and leaving the harbor. If these sections built in the parapet form, which is 12 feet high above low wa the ends toward the channel were painted some color that wou at night, the entrance would be much better and safer. This will cost about $25,000.

removal of what had been built of the east breakwater, thus loning that portion of the project which called for an eastern , leaves the whole in a rather unsatisfactory condition. The nce to the western basin, which would have been sheltered by the reakwater, is now exposed to the full force of the northeast gales, t the same time it is almost impossible for a sailing vessel unaided eam to enter the west basin at all when driven by a strong wind the northwest. I am of the opinion that the east breakwater will to be built either as originally proposed or else in some modified before the harbor will be entirely safe and satisfactory.

e present project permits the break, 140 feet long in the outer kwater near the shore arm, to be left open, and proposes the contion of two properly located spur cribs to protect the entrance. ribs adjacent to the break are considerably shaken and need extenrepairs, and the spur cribs should be built as soon as possible. The e work will cost about $75,000. In addition to the sums above mend there should be available every year about $25,000 to be used for epair and maintenance of the existing works.

hile all of the harbors on Lake Ontario under my charge show a l increase in the number of vessels arriving and departing, no rial increase need be looked for under the existing conditions.

e present fleet on the lakes seems ample for the local business, and xisting tolls on the Welland Canal, discriminating as they do against orts and harbors of the United States, will be sufficient in the e to prevent any considerable growth of commerce between our rio ports and those of the upper lakes. The continuation of the on this canal, combined with the removal of the tolls from the York State canals, has had the effect of building up the Lake ports at the expense of those of Lake Ontario, and has virtually ed Ontario from the chain of lakes. The year that sees a free opened between the lakes, either by removal of tolls from the dian canal or by the construction of a canal by the United States, show an increase of business at the Lake Ontario ports that will ish those who are unacquainted with the real value of this route unhampered by unnatural and most adverse restrictions.

e of harbor, Oswego, N. Y.; collection district, Oswego, N. Y.; nearest light-, Oswego, N. Y. A fixed white light of the third order at the eastern end of the st breakwater; a fixed red light of the fourth order on eastern end of the west breakwater, a fog bell attached. Nearest works of defense, Fort Onta-Y.

Money statement.

, 1891, balance unexpended	$29,170.51
0, 1892, amount expended during fiscal year	23,381.95
, 1892, balance unexpended	5,788.56
, 1892, outstanding liabilities	10.00
, 1892, balance available	5,778.56
t appropriated by act approved July 13, 1892	40,000.00
t available for fiscal year ending June 30, 1893	45,778.56
unt (estimated) required for completion of existing project	85,000.00
unt that can be profitably expended in fiscal year ending June 30, 1894	85,000.00
nitted in compliance with requirements of sections 2 of river and rbor acts of 1866 and 1867.	

REPORT OF MR. WILLIAM PIERSON JUDSON, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., June 1, 18

SIR: I have the honor to submit herewith a comparative statement of the a cost, by contract and by hired labor, of work done upon the Oswego outer b water during the year 1891:

The works were precisely alike, and therefore offer an opportunity for inter comparison of actual cost by the different methods.

In each case the work consisted in removing the original timber superstruct rectangular cross section 5.7 feet high above mean water level and 35 feet which was built in 1879–'80, and replacing it by timber superstructure in p form, 3.4 feet high on the harbor side and 11.4 feet high on the lake side, buil the 1890 model, which was designed specially for this work.

This renewal was required upon 1,470 feet of breakwater. Of this, 1,300 fe done by contract and 170 feet by hired labor. The latter proved to be the ch costing $146 per 100 feet less, although its smaller extent put on it an undue p tion for the cost of overseeing and derrick engine.

To make a more just statement of the cost by hired labor, if 1,300 feet had thus built, there is taken the actual cost for material, labor, tools, tug hire, et 100 feet, and to this is added the cost for the overseer, the timekeeper, and the e runner which were employed on the smaller work, and also the cost of two st men who would have been needed in addition for the larger work. All bein culated per 100 feet for the four months needed for building 1,300 feet.

This shows that for 1,300 feet the actual cost by hired labor for all ma labor, overseeing, and tug hire, etc., would be per 100 feet, $3,614. The d estimate, dated July 25, 1890, of probable cost by hired labor, per 100 feet, was The actual gross cost by contract for 1,300 feet, as stated in last Annual R averaged per 100 feet $3,937. This included cost of inspector and of certain work of bonding into the adjoining structure at the beginning.

There was, however, at the last end, to permit bonding into the future work, a amount omitted, so that the actual total was less than 1,300 feet of complete and this reduction was not allowed for in computing the above average.

The following itemized statements show the average cost per 100 feet, based the accurate average amounts of each class of the various materials actuall per 100 feet.

Office and engineering expenses are not included in the comparison, becaus would be the same in either case.

Actual cost of parapet superstructure per 100 feet, by contract.

Designation.	Amount.	Rate in place.
Pine for leveling .... feet, B. M..	4,105	$33.00
Pine timber .... do....	58,220	29.00
Pine plank .... do....	13,626	28.00
Oak timber .... do...	20,094	38.00
Driftbolts, for leveling .... pounds..	315	.05
Driftbolts .... do....	2,524	.02¼
Screw bolts .... do....	11,897	.03¼
Wood screws .... do....	200	.04
Spike .... do....	1,176	.03
Mooring cleat	....	8.00
Pitch and tallow around head of vertical bolt	....	....
Removing and replacing stone ballast .... yards..	714	60 cents.
Inspector, ($\frac{8}{13}$ month at $100 per month)	....	....
Total per 100 feet	....	....

Actual cost of parapet superstructure per 100 feet by hired labor.

Designation.	Amount.	Rate of purchase.	Itemized cost.
ne for leveling .... feet, B. M.	4,105	$18.90	$77.58
ne timber .... do....	58,220	18.90	1,100.36
ne plank .... do....	13,626	18.90	257.53
k timber .... do....	20,094	27.65	555.63
			1,991.10
rift bolts for leveling .... pounds.	315	.022	6.93
rift bolts .... do....	2,524	.022	55.53
rew bolts .... do....	11,897	.023	273.63
ood screws .... do....	200	.031	6.20
ikes .... do....	1,176	.028	28.81
			371.10
ooring cleat	....	....	5.00
tch and tallow around heads of vertical bolts	....	....	2.80
ols and repair of tools	....	....	31.36
			39.16
Total		....	2,401.36
ages of mechanics and laborers, construction and ballasting			803.24
erseer, subforeman, time-keeper, and engine runner			104.11
aning and boring timber, and transporting to and from hired machine, including four handlings (could have been cheaper done by hand on the work)			220.29
g hire, towing derrick scows			85.07
Total			1,212.71
Cost per 100 feet			3,614.07

Comparison of these results shows that if the 1,300 feet built by contract had en done by hired labor there would have been a saving to the Government of ,466.

Very respectfully, your obedient servant,

WM. PIERSON JUDSON,
Assistant Engineer.

Capt. DAN C. KINGMAN,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

rrivals and departures of vessels at Oswego Harbor, New York, for fiscal year ending June 30, 1892.

ARRIVALS.

Trade engaged in.	Steamers.		Sailing vessels.		Barges. On lake.		Barges. On river.	
	No.	Registered tonnage.	No.	Registered tonnage.	No.	Registered tonnage.	No.	Registered tonnage.
ise, on lake	463	104,914	199	26,236	106	26,169	......	....
ise, on river	64	6,240	......	....	......	....	583	79,299
n, on lake	345	60,374	715	121,608	316	92,120	......	....
Totals	872	171,528	914	147,844	422	118,289	583	79,299
merican owned	527	111,154	202	27,569	147	33,436	583	79,299
nadian owned	345	60,374	714	120,275	275	84,853	......	....

otal, 2,791 arrivals; 516,960 registered tonnage.

Arrivals and departures of vessels at Oswego Harbor, New York, etc.—Continue

DEPARTURES.

Trade engaged in.	Steamers.		Sailing vessels.		Barges.			
					On lake.		On riv	
	No.	Registered tonnage.	No.	Registered tonnage.	No.	Registered tonnage.	No.	Reg ton
Home, on lake	460	104,870	203	27,752	120	29,847	......	......
Home, on river	64	6,240	......	......	......	......	589	
Foreign, on lake	344	60,196	702	118,334	291	87,272	......	......
Totals	870	171,306	905	146,086	411	117,119	589	

Sum total, 2,775 departures; 514,420 registered tonnage.

Greatest draft of vessels, 16½ feet.
Greatest tonnage of vessel, 1,552 registered tons.
Greatest load of vessel, 1,624 net tons coal.

Receipts and shipments by lake and river at Oswego, New York, for the fiscal year June 30, 1892.

RECEIPTS.

Trade.	Passengers.	Grain.	Coal	Merchandise.	Fish.	Oil.	l
	No.	*Net tons.*	*Net tons.*	*Net tons.*	*Net tons.*	*Tons.*	
Home on lake	3,921	19,444	1,474	1,931	41	....	
Home on river	....	1,603	4,952	9,763	....	18	
Foreign on lake	247	48,425	....	1,722	13	....	
Total	4,168	69,472	6,426	13,416	54	18	

SHIPMENTS.

Trade.	Passengers.	Grain.	Coal.	Merchandise.	Oil.
	No.	*Net tons.*	*Net tons.*	*Net tons.*	*Tons.*
Home on lake	7,453	130	135,471	1,754	40
Home on river	....	34,296	3,288	8,605	......
Foreign on lake	161	....	300,211	1,763	18
Total	7,614	34,426	438,970	12,122	58

Navigation closed December 28, 1891; navigation opened April 5, 1892; t enue collected at port during fiscal year, $267,109.16.

For the purpose of reduction to tons weight the following is assumed: Ba 7 equal 1 ton; M lumber, 1 equals 1½ tons; crates fruit, 20 equal 1 ton; ties and poles, 12 equal 1 ton; cords wood and posts, 1 equals 1½ tons; live 4 equal 1 ton.

O O 6.

IMPROVEMENT OF HARBOR AT SACKETTS HARBOR, NEW YORK.

OBJECT.

To deepen the natural harbor formed by Ship House Point over an area of about 15 acres to 12 feet at extreme low water. This project was adopted in 1881. Previous to this, in 1826–'28, $6,000 had been expended for the same purpose.

PRESENT PROJECT.

To limit the excavation to an area of about 6 acres, and to define the entrance and provide a mooring place by building a crib 18 feet square upon the point of the shoal extending into the harbor from the end of Ship House Point.

Also to check shore drift by extending a jetty across the end of Ship House Point from the crib above described to the bay outside the point.

PRESENT WORKS.

A crib 18 feet square has been built, as proposed in the project; a jetty of stake and fascine work, loaded with stone, has been completed for a distance of 164 feet, and about 24,000 cubic yards of material have been dredged from the sheltered area, giving a depth of 12 feet at extreme low water.

OPERATIONS.

None, other than the collection and reporting of commercial statistics

REMARKS.

This harbor is formed by a natural spur of loose rock and gravel about 800 feet in length, extending in an easterly direction from the shore, so as to form a small sheltered bay, and the value of the harbor depends upon the preservation of this natural spur or breakwater.

During the war of 1812 the United States began the construction of a large naval vessel upon this spur. The vessel was never launched, work on it having been stopped by the treaty of peace; but the vessel was cared for for a great many years, and incidentally the site on which it stood was prevented from washing away, due to wave action. A few years ago the vessel was sold and broken up, and since then this spur has not been cared for, and consequently is slowly being destroyed by the seas.

It is not, however, exposed to very heavy waves, and can be protected by a rough wall of blocks of stone of one or more tons in weight built parallel to it and from 50 to 100 feet in advance of it, where the water is about 6 feet deep. This stone can be advantageously obtained from quarries in the neighborhood and it is estimated that it can be put in for about $3 a cubic yard.

Five thousand dollars could advantageously be applied to this purpose and would be sufficient to complete the proposed wall.

No more dredging seems to be necessary at present.

kettts Harbor, N. Y.; collection district, Cape Vincent, N. Y.; ackettts Harbor, N. Y.; a fixed white light of the fifth order, west of town; nearest works of defense, Fort Ontario, N. Y.

Money statement.

July 1, 1891, balance unexpended	$503.95
June 30, 1892, amount expended during fiscal year	54.69
July 1, 1892, balance unexpended	449.26

Amount (estimated) required for completion of existing protect	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Arrivals and departures of vessels at Sacketts Harbor, New York, during fiscal year ending June 30, 1892.

ARRIVALS.

Trade engaged in.	Steamers.		Sailing vessels.		Barges.	
	No.	Registered tonnage.	No.	Registered tonnage.	No.	Registered tonnage.
Home, on lake	84	4,617	73	3,327	7	1,284
Foreign, on lake			14	656		
Total	84	4,617	87	3,983	7	1,284
American owned	84	4,617	82	3,750	7	1,284
Canadian owned			5	233		

Sum total, 178 arrivals; registered tonnage, 9,884.

DEPARTURES.

Trade engaged in.	Steamers.		Sailing vessels.		Barges.	
	No.	Registered tonnage.	No.	Registered tonnage.	No.	Registered tonnage.
Home, on lake	80	4,317	76	3,428	6	1,124
Foreign, on lake	4	300	10	497		
Total	84	4,617	86	3,925	6	1,124

Sum total, 176 departures; registered tonnage, 9,666.

Greatest draft of vessels, 11 feet.
Greatest tonnage, 918 reg. tons.
Greatest load, 600 tons net.

Receipts and shipments by lake at Sacketts Harbor, New York, during fiscal year ending June 30, 1892.

Trade.	Receipts.						Shipments.			
	Passengers.	Grain.	Merchandise.	Hay.	Coal.	Lumber.	Passengers.	Merchandise.	Coal.	Lumber.
	No.	*Net tons.*	*Net tons.*	*Net tons.*	*Net tons.*	*Tons.*	*No.*	*Net tons.*	*Net tons.*	*Tons.*
Home on lake	2,057		1,853	613	4,060	168	2,326	361	40	16
Foreign on lake		13	2			930		77		
Total	2,057	13	1,855	613	4,060	1,098	2,326	438	40	16

Navigation closed December 7, 1891. Navigation opened April 12, 1892.

For the purpose of reduction to tons weight the following is assumed: Barrels oil, 7 equal 1 ton; M lumber, 1 equal 1½ tons; crates fruit, 20 equal 1 ton; railroad ties and poles, 12 equal 1 ton; cords, wood and posts, 1 equal 1¼ tons; live animals, 4 equal 1 ton.

APPENDIX P P.

IMPROVEMENT OF SHOALS IN ST. LAWRENCE RIVER, AND OGDENSBURG HARBOR, NEW YORK, AND OF RIVERS AND HARBORS ON LAKE CHAMPLAIN, NEW YORK AND VERMONT.

REPORT OF MAJOR M. B. ADAMS, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

Shoals between Sister Islands and Crossover Light, St. Lawrence River, New York.
Ogdensburg Harbor, New York.
Breakwater at Rouse Point, Lake Champlain, New York.
Great Chazey River, New York.
Breakwater at Gordon Landing, Lake Champlain, Vermont.
6. Plattsburg Harbor, New York.
7. Burlington Harbor, Vermont.
8. Otter Creek, Vermont.
9. Ticonderoga River, New York.
10. Narrows of Lake Champlain, New York and Vermont.

UNITED STATES ENGINEER OFFICE,
Burlington, Vt., July 9, 1892.

GENERAL: I have the honor to transmit herewith annual reports for e river and harbor works under my charge during the fiscal year ding June 30, 1892.

Very respectfully, your obedient servant,

M. B. ADAMS,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

P P 1.

IMPROVEMENT OF SHOALS BETWEEN SISTER ISLANDS AND CROSSOVER LIGHT, ST. LAWRENCE RIVER, NEW YORK.

The project for this improvement resulted from the survey and report ade in compliance with a provision in the river and harbor act of ist 11, 1888, directing a survey of the shoals between Sister Islands 'rossover Light to be made; it was submitted July 2, 1889, and in Report of the Chief of Engineers, 1889, pages 2463 and

Aggregate ....

The act of September 19, 1890, appropriated $5,00(ment. Bids were invited November 8, 1890, and op(1890, but, owing to informalities in two of the three work was readvertised, and bids were again opened the contract being then awarded to William Jame moval of the lower and upper shoals at $16 per cubi in place.

Work was to have been done during the winter of ing to ice not forming of sufficient thickness to bear machinery, etc., to be used in connection with the o in the date for the completion of the contract w granted so as to include the winter season of 1891–'

It is recommended that this improvement be defin(rence River above Ogdensburg in making further ap as bad shoals exist without the limits named in the appropriations heretofore.

It is expected that work will soon be commenced a completed on time, August 31, 1892.

Money statement.

July 1, 1891, balance unexpended..............................

July 1, 1892, balance unexpended ....
July 1, 1892, amount covered by uncompleted contracts ....

July 1, 1892, balance available..................................
Amount appropriated by act approved July 13, 1892 ....

Amount available for fiscal year ending June 30, 1893 ....

Amount (estimated) required for completion of existing proj
Amount that can be profitably expended in fiscal year ending Ju
Submitted in compliance with requirements of sections 2 of
harbor acts of 1866 and 1867.

rincipal items of merchandise carried by this tonnage were:

	1890.	1891.
	Tons.	Tons.
	21,750	44,600
ats, and corn	202,384	22,562
	112,182	135,000
freight	35,000	53,000
	....	7,000
tal	371,316	260,162

P P 2.

IMPROVEMENT OF OGDENSBURG HARBOR, NEW YORK.

en operations were commenced at this harbor the channel afforded s of 5 to 12 feet only, and now there are three channels from deep in the St. Lawrence River to the nearest docks or wharves, in water from 15 to 16 feet deep is afforded, and a channel 12 to 15 eep has been made along the city front.

project formed for the improvement by a board of engineer s in 1868 provided for dredging the channel of the Oswegatchie below the bridge, deepening the channel along the city front on . Lawrence River and across the bar northeast of the light-house, ie construction of a pile pier to prevent the water of the Oswe- ie spreading over the bar or shoal between these channels. The ier was only recommended in the event of the water of the Oswe- ie not following the line of the deepened channels after dredging ompleted. The dredging provided in the project was completed 6, and the piling proved unnecessary; consequently operations onfined to dredging the channels, which were left in good con-

harbor was surveyed in 1880 and showed considerable shoaling channels during the four years of inactivity between 1876 and and that it was due to sawdust and other waste products of saw- which had been thrown into the Oswegatchie River in violation al regulations forbidding it; that the shoaling amounted to some yards and would cost $12,000 for removal. The practice of ing these waste products into the river has now ceased.

original project was estimated to cost $175,000; $107,000 had expended in 1880, leaving $68,000 still due the improvement, to the piling not being required.

.882 the harbor was recommended to be placed in condition to the largest vessels that would be able to pass through the en- l Welland Canal, at an estimated cost of $76,000, as follows:

ar, 80,000 yards, at 30 cents per yard	$24,000
Watertown and Ogdensburg Railroad Wharves, 40,000 yards, at 40 per yard	16,000
tchie mouth, 20,000 yards, at 20 cents per yard	4,000
ront channel, 160,000 yards, at 20 cents per yard	32,000
Total, 300,000 yards	76,000

above estimate was intended to provide for a depth of 15 feet channels and 16 feet over the bar. With the completion of the last contract 237,677 cubic yards had been dredged, at a cost of $51,000, leaving 62,323 cubic yards to be dredged, and $25,000 due the improvement under the project of 1882.

In 1889 a new project was formed and approved for the improvement of this harbor, it being found that the scheme of 1882 would be insufficient for the wants of the harbor when fully carried out.

The last project provides depths of 16.5 feet in all the channels, based on 17-foot depths of dredging, at an estimated cost of $158,950, as follows:

290,000 yards, exclusive of hardpan and solid rock, at 25 cents per yard	$72,500
72,000 yards of hardpan and solid rock, mostly hardpan, at $1 per yard	72,000
	144,500
Add 10 per cent for contingencies	14,450
Total	158,950

The act of September 19, 1890, appropriated $42,000 for this improvement. Bids were duly invited and a contract has been made for the removal of 325,000 cubic yards of sand, mud, gravel, etc., at the very favorable price of 11 cents per cubic yard, which has since undergone modification by allowing 22 cents per yard for 50,000 yards of hardpan without changing the total amount to be paid under the contract.

The survey made at the harbor in November, 1890, shows a more favorable condition of things at the mouth of the Oswegatchie River than any other survey has shown. It is found that there will be no solid rock encountered within the limits of the channel, but that all the material to be removed from that locality will be hardpan, with more or less of bowlders embedded therein.

Operations under the last contract have been commenced with two dredges. One hundred and eight thousand four hundred and fifty-five yards of ordinary material and 9,286 yards of hardpan have been removed to date, and it is expected that the contract will be completed on time, November 30, 1892.

It is expected to apply additional funds as appropriated in the completion of the project of 1889, under the contract system.

The accompanying commercial statistics were obtained through the kindness of the collector of customs.

Money statement.

July 1, 1891, balance unexpended		$41,130.80
June 30, 1892, amount expended during fiscal year		13,574.57
July 1, 1892, balance unexpended		27,556.23
July 1, 1892, outstanding liabilities	$2,569.68	
July 1, 1892, amount covered by uncompleted contracts	21,777.03	
		24,346.71
July 1, 1892, balance available		3,209.52
Amount appropriated by act approved July 13, 1892		40,000.00
Amount available for fiscal year ending June 30, 1893		43,209.52
Amount (estimated) required for completion of existing project		76,950.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

harbor, Ogdensburg, N. Y.; collection district, Oswegatchie; nearest , Ogdensburg, N. Y.

e of vessels entered and cleared, foreign ports and coastwise, 1888 to 1891.

Year.	Foreign ports.				Coastwise.	
	American vessels.		Foreign vessels.			
	Entered.	Cleared.	Entered.	Cleared.	Entered.	Cleared.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
	12,068	10,503	66,759	62,918	180,214	191,790
	18,689	8,472	85,064	80,972	227,819	230,317
	12,888	10,868	75,517	66,699	278,388	287,634
	23,475	17,411	48,955	45,833	324,010	325,494

Merchandise received and shipped, foreign ports.

Articles.	1888.	1889.	1890.	1891.
	Tons.	*Tons.*	*Tons.*	*Tons.*
	76,566	75,815	117,114	127,152
c	13,092	3,676	5,278	17,521
	676	625	164	9
eous freight	15,000	25,000	15,000	11,051
	32,053	65,356	100,192	49,962
	2,685	4,750	2,725	1,224
	4,000	3,440	2,200	1,000
eous freight	29,000	59,000	31,109	1,000
	96,506	161,847	156,668	208,918

Merchandise received and shipped, coastwise.

Articles.	1888.	1889.	1890.	1891.
	Tons.	*Tons.*	*Tons.*	*Tons.*
	25,612	47,454	38,142	58,084
	145,345	181,101	227,409	221,678
	22,359	12,436	16,791	14,152
	76,991	66,230	112,181	138,638
eous freight	25,000	49,000	31,119	1,878
	2,756	2,310	700	500
eous freight	34,807	47,875	47,271	56,000
	332,870	406,406	473,613	490,930

	1888.	1889.	1890.	1891.
collected	$225,570	$219,481	$224,078	$223,454
lected	2,946	4,490	3,895	2,772
orts	1,957,440	1,628,674	1,618,616	1,729,389
orts	1,689,675	1,970,974	2,105,214	1,764,831

	1890.	1891.
chandise entered for warehouse and transshipped in bond	$174,558.00	$72,251.00
chandise entered for transshipment and exports	38,357.00	417,813.00
nties on the above	74,641.12	176,376.30

Merchandise received under consular seal from foreign ports.

Articles.	1890.		1891.	
	Packages.	Value.	Packages.	Va
Tea	129,669	$1,358,244	54,552	
Curios	203	9,288	758	
Raw silk	6,957	3,941,752	5,693	
Silk goods	81	46,646	108	
Straw braid	1,119	25,165	524	
Chinese groceries	3,027	27,202	2,028	
Firecrackers	8,659	34,426	127	
Copper matte ... pounds	2,419,112	173,428	15,287,364	
Skins			24	
Total		5,616,151		

The greatest draft of vessels at Ogdensburg Harbor is 16 feet.

P P 3.

BREAKWATER AT ROUSE POINT, LAKE CHAMPLAIN, NEW YOR

The project for this improvement was adopted in 1885 and co plates the construction of a straight breakwater of rubble and stones, extending from Stony Point in the general direction southern point of the 6-foot curve south of Windmill Point unt 18-foot curve is reached, a total distance of about 2,000 feet.

Operations have been carried on in accordance with the or plan and under contracts dated August 22, 1885, October 28, November 2, 1888, and December 6, 1890. Under the first contra linear feet of breakwater adjoining the shore were built, which w tended 550 and 140 feet, respectively, under the second and thir tracts, and was further extended 210 feet under the fourth an contract. It is found that another extension 125 feet will carry th of the structure into 18 feet of water, and it is therefore propo terminate the breakwater with another extension of 135 feet, or a beyond the 18-foot curve, but with a total length of 1,835 feet inst 2,000 feet.

The estimated cost of the breakwater was originally placed at $11 There have been four appropriations to date, amounting to $83,50 last being that of September 19, 1890; and as it is now estimate $15,000 more will be sufficient to carry the structure out to the 1 curve and to close in the outer end, the total cost will be $98,500 completed and closed at 1,835 feet in length. The good effects improvement are apparent along the town front by the compa calmness of the water at the docks there during southeasterly s which formerly caused considerable commotion.

Money statement.

July 1, 1891, balance unexpended	$7
June 30, 1892, amount expended during fiscal year	7
July 1, 1892, balance unexpended	
Amount appropriated by act approved July 13, 1892	15
Amount available for fiscal year ending June 30, 1893	15

COMMERCIAL STATISTICS.

of harbor, Rouse Point, N. Y.; collection district, Champlain; nearest light-
Windmill Point.

Vessels entered and cleared and duties collected.

Year.	Entered.		Cleared.		Duties collected.
	No.	*Tons.*	*No.*	*Tons.*	
....	1,082	108,517	1,136	100,816	$318,606.77
....	1,129	112,635	1,170	113,843	340,670.40
....	963	83,015	940	92,466	361,987.78
....	977	92,996	863	81,586	323,462.00

	1890.	1891.
llected	$361,987.78	$323,462.00
essed on merchandise entered for warehouse and transporta- other ports	89,815.25	151,225.00
tax collected	2,137.20	2,142.00
cted	8,011.95	4,803.00
eous collections	17.84	4,170.00
al collected and assessed	461,970.02	485,802.00

Number of tons shipped and arrived, Rouse Point, New York.

Articles.	1890.		1891.	
	Shipped.	Arrived.	Shipped.	Arrived.
	Tons.	*Tons.*	*Tons.*	*Tons.*
eals, plank, etc	30,000	56,000	....	218,750
nber	4,000	8,000	....	136,000
....	52,000	....	280,000	....
eous articles	3,800	44,338	11,500	60,000

est draft of vessels, 10 feet. The accompanying commercial statistics were
d through the kindness of the collector of customs.

P P 4.

IMPROVEMENT OF GREAT CHAZY RIVER, NEW YORK.

project for this improvement was adopted in 1889, after the sur-
is made in accordance with the river and harbor act of August
88.

first estimate for improvement provided for a channel with a least
of 50 feet and a least depth of 6 feet; but, owing to the cost un-
is scheme, amounting to $34,000, a second plan was considered,
provides for a least depth of 5 feet and a least width of 40 feet;
n finding that the cost under this plan would be about one-half
mer estimate, work was recommended to be done in accordance
ith, and the project was adopted.

appropriation of $10,000 by act of September 19, 1890, has been
ed (under contract dated February 16, 1891) in dredging

26,337$\frac{12}{11}$ yards of bowlders, sand, mud, and clay, in a single cut, the mouth of the river to Champlain village.

Operations were commenced June 22, 1891, and were completed ber 5, 1891, consuming the available funds.

The channel produced by the work as above is only a little more half that provided under the project for the improvement, and mu course, be very generally widened in order to complete it.

Money statement.

July 1, 1891, balance unexpended	$9,
June 30, 1892, amount expended during fiscal year	9,
Amount appropriated by act approved July 13, 1892	5,
Amount (estimated) required for completion of existing project	3,
Amount that can be profitably expended in fiscal year ending June 30, 1894	3,

Submitted in compliance with requirements sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Name, Great Chazy River, New York; collection district, Champlain; neare house, Isle La Motte; greatest draft, 6 feet.

Vessels arrived, departed, etc., 1889, 1890, and 1891.

	1889.		1890.		1
	No.	*Tons.*	*No.*	*Tons.*	*No.*
Steam vessels arrived	38	1,520	36	1,210	26
Canal boats arrived	56	5,432	44	4,562	10
Steam vessels departed	38	1,520	36	1,210	26
Canal boats departed	53	5,136	44	4,562	17
Cargoes:					
Value of arrivals		$154,500		$155,000	
Value of departures		83,500		81,000	

Number of tons arrived and shipped, 1890 and 1891.

Articles.	1890.		18
	Shipped.	Arrived.	Shipped.
	Tons.	*Tons.*	*Tons.*
Potatoes	1,000	....	1,000
Hay	6,000	....	800
Iron	100	300	....
General merchandise	611	1,652	500
Coal	....	5,000	....

P P 5.

BREAKWATER AT GORDON LANDING, LAKE CHAMPLAIN, VER

The project for this improvement was adopted in 1887 and ha object the construction of a breakwater, composed of rubble an nes, extending in a straight line from a point 250 feet south of the ck or landing, where the water is about 3 feet deep at lowest stage, a point on the 16-foot curve and a little north of the line drawn from dock to Cumberland Head.

At inception the object of the undertaking seems to have been the rding of increased shelter on the west shore of Grand Isle, Lake amplain, which incidentally has involved the protection of the dock landing which gives the improvement its name.

An appropriation of $18,750 was made for this work in the act of gust 5, 1886; $10,000 was appropriated by act of August 11, 1888, l $6,000 by act of September 19, 1890, for completion.

The original project was modified so as to make the total length of breakwater 675 instead of 800 feet.

Operations were carried on by contract. The first contract, dated gust 1, 1887, comprised the construction of 500 linear feet of breakter next the shore. Work was commenced August 11, 1887, and was apleted August 31, 1889. The second contract was dated December 1888, and comprised an extension to the above shore section, and en completed, September 30, 1889, left 675 linear feet of breakwater apleted, with the exception of the large facing stones and core of ble on 135 feet at its outer end. For completion of the improvement ording to the modified project $6,000 was asked for and appropri-ed by act of September 19, 1890, which has been consumed under con-ct dated December 26, 1890, with Edwin H. French, of Fulton, N. Y., the extension and completion of the breakwater at Gordon Landing, ermont.

Operations under the last contract were commenced July 6, 1891, and sed September 19, 1891, completing the improvement.

Money statement.

y 1, 1891, balance unexpended	$5,956.05
e 30, 1892, amount expended during fiscal year	5,956.05

COMMERCIAL STATISTICS.

ame, Gordon Landing; collection district, Vermont; nearest light-house, Cumland Head. The proprietor of the landing states that three-fourths of the busis of Grand Isle, Vt., is done there, and that 1,500 tons of freight are probably dled each season; also, that large quantities of produce and fruit, as well as stock the market, pass over the dock at the landing.

reatest draft of vessels, 8.5 feet.

P P 6.

IMPROVEMENT OF PLATTSBURG HARBOR, NEW YORK.

The original project for the improvement of this harbor was adopted obably in 1836, the date of the first appropriation, and proposed the tion of a breakwater about 1,000 feet east of the steamboat

There were 1,250 linear feet of breakwater constructed between th years 1836 and 1875, which is now being extended 300 feet farther north ward.

The modification of 1870 provided for an extension of the form structure southeastward, the dredging of some shoal areas within th breakwater, and the protection of a portion of the adjacent beach by revetment.

Operations were confined to necessary repairs and the dredging limited areas near the steamboat docks after the completion of the pro ect of 1870, until the act of September 19, 1890, made provision for northward extension to the breakwater, 300 feet, and for very gener repairs to the superstructure.

The appropriation of September, 1890, amounted to $32,500, whic has been pledged under one contract, covering the renewal of the ol timber superstructure by one composed of large facing stones, wi rubblestone cone, and an extension of 300 feet to the breakwate finished on top in the same manner as has just been described. T cross-section of this superstructure is much like that shown in Fig. of the sheet of cross-sections herewith, but the inner and outer slop were made equal and the timber of the old substructure was cut do only to low-water level, since the line of no decay is a foot or mo above low water.

Work is progressing fairly well under the above contract, the ext sion has been completed, and the work of rebuilding the old sup structure is about half done. The contract does not require comp tion until November, 1892, and it is confidently expected will be finis on time. The report of a survey at the mouth of Saranac River, Pla burg, N. Y., that appeared as House Ex. Doc. No. 72, Forty-eighth C gress, second session, comprehending the dredging of 110,000 ya there, would amount to a considerable extension of the limited ar of dredging operations, and therefore may be said to constitute a furt modification in the project for this improvement. It is thought t only small amounts of dredging will be required at this harbor for s years, unless the plan for improving the mouth of Saranac River sho be undertaken. A more recent report as to this improvement has peared as House Ex. Doc. No. 22, Fifty-first Congress, second sess

Money statement.

July 1, 1891, balance unexpended		$31, 1?
June 30, 1892, amount expended during fiscal year		15, 84
July 1, 1892, balance unexpended		15, 27
July 1, 1892, outstanding liabilities	$4, 052. 68	
July 1, 1892, amount covered by uncompleted contracts	8, 991. 32	
		13, 04
July 1, 1892, balance available		2, 23

COMMERCIAL STATISTICS.

Name of harbor, Plattsburg, N. Y.; collection district, Champlain; nearest li house, Cumberland Head; two beacon lights on the Plattsburg breakwater.

Arrivals of vessels.

	1888.		1889.		1890.		1891.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
....	838	386, 867	861	389, 150	1, 004	559, 531	998	558, 427
....	44	3, 715	41	3, 530	46	4, 278	49	4, 427
....	800	71, 938	820	73, 829	908	77, 900	936	80, 835
ıl	1, 682	462, 520	1, 722	466, 509	1, 956	641, 708	1, 983	643, 689

Departures of vessels.

....	838	386, 867	861	389, 150	1, 004	559, 531	998	558, 427
....	44	3, 715	43	3, 654	47	4, 376	49	4, 427
....	800	71, 938	820	73, 829	908	78, 180	936	80, 835
ıl	1, 682	462, 520	1, 724	466, 633	1, 956	642, 086	1, 983	643, 689

Value of goods shipped and arrived.

	1888.	1889.	1890.	1891.
....	$296, 905	$435, 000	$441, 200	$437, 316
....	60, 586	109, 000	113, 460	117, 381

Vessels enrolled at Plattsburg, N. Y., December 31, 1890 and 1891.

1890.

....	587
nage	56, 250
ge	53, 404

1891.

....	609
nage	58, 550
ge	55, 610

er of tons arrived and shipped, Plattsburg Harbor, New York, 1890 and 1891.

Articles.	1890.		1891.	
	Shipped.	Arrived.	Shipped.	Arrived.
	Tons.	*Tons.*	*Tons.*	*Tons.*
....	13, 500	....	17, 350	....
....	1, 200	....	1, 200	....
....	600	....	....	....
....	....	16, 000	....	17, 000
....	....	600	650	1, 275
ıerchandise	400	257	2, 000	1, 500
....	....	....	2, 500	....

›st draft of vessels, 10 feet.
›ove commercial statistics were kindly furnished by the collector of customs.

P P 7.

IMPROVEMENT OF BURLINGTON HARBOR, VERMONT.

first project for the improvement of this harbor was probably d in 1836. Modifications of the original project have been made

want of rectilinearity from end to end, is found in it
ment by successive extensions under different admi
distant periods of time, when the immediate and p
the harbor necessarily presented very different pha
posed to gradually withdraw the ends of the breakw
it, from water 36 and 39 feet deep into water abou
then to keep at a distance of about 1,000 feet from
structing new work, so as to reduce the cost.

The establishment of a harbor line, to limit the
and wharves out into the harbor, may become neces
jurious restrictions of the harbor capacity, especial
of the breakwater being only 1,000 feet distant. T
360 feet northward extension to the breakwater, w
structure, was the last new work at this harbor. T
tion meets all expectations thus far, and appears to
and durable breakwater; the cost is practically th
water with timber superstructure, and since no timb
water, the life of this new structure, as far as one
said to be illimitable.

In further explanation of the above form of const
to show the development of the present approved fo
the accompanying sheet of cross sections of bre
Champlain, New York and Vermont, is appended.

Regarding the respective merits of these severa
pends on the circumstances of construction, the cost
locality, depth of water, force of the wave action, a
etc.; nevertheless, the following remarks are perh
the experience had in this vicinity.

When the water is 16 feet deep or less, and if the
strong, the form as in Fig. 4 is probably as good as
water this form is too expensive, owing to its great
the amount of rubble stone foundation required. T

t no great increase of cost. It will be observed that the lower f stone are held in place by the top timbers of the cribs, and stone in the outer exposed face must be lifted bodily as well out from among the adjoining stones in order that the waves e an impression on this structure; and since none of the stones n thus displaced, though subjected to repeated storms, and known cost of construction, it is reasonable to say that it is durable and cheap.

propriation of September 19, 1890, $20,000, being for repairs, be expended as repairs become absolutely necessary, and will, , probably be sufficient for several years. Some 1,625 cubic stone for filling and riprap to the breakwater, and 55,331 feet, timber, were purchased under contract, and repairs were made inear feet of the superstructure by hired labor during the year. work is regarded as necessary at present, and no additional asked for this harbor.

ompanying commercial statistics were supplied by the collector as in response to the usual request for them.

Money statement.

1, balance unexpended	$19,531.62
92, amount expended during fiscal year	3,771.73
2, balance unexpended	15,759.89
(estimated) required for completion of existing project	129,000.00
d in compliance with requirements of sections 2 of river and acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

harbor, Burlington, Vt.; nearest light-house, Juniper Island; collection ermont.

Arrivals and departures of vessels in foreign trade.

	1888.		1889.		1890.		1891.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
	219	28,462	196	25,524	180	23,304	116	15,568
	219	28,462	196	25,524	180	33,304	106	14,324

Arrivals and departures of vessels in coastwise trade.

	1890.		1891.	
	No.	*Tons.*	*No.*	*Tons.*
	1,449	588,505	2,057	581,843
	1,440	587,705	2,072	580,826

Merchandise shipped.

Articles.	1890.		1891.	
	Tons.		*Tons.*	
	4,253	$66,040	5,228	$81,180
handise	33,000	116,000	38,000	140,000
	37,253	182,040	43,228	221,180

Merchandise received.

Articles.	1890.		1891.	
	Tons.		*Tons.*	
Lumber	33,376	$409,505	28,658	[illegible]
Lath	1,258	6,411	1,286	
Shingles	620	5,662	382	
Railroad ties	....	....	535	
Coal	95,000	380,000	109,800	[illegible]
General merchandise	75,000	600,000	78,460	[illegible]
Total	205,254	1,401,578	219,121	[illegible]

Greatest draft of vessels, 10 feet.

P P 8.

IMPROVEMENT OF OTTER CREEK, VERMONT.

The project for this improvement was adopted in 1872, and, as 1 fied in 1882 and 1884, proposes the formation of a channel from gennes, Vt., to Lake Champlain, of a navigable width and a least (of 8 feet. (See Reports of Chief of Engineers, 1872, page 273; page 712, and 1884, page 2159.)

The appropriation of September 19, 1890, has been consumed, contract dated January 12, 1891, with Willard Johnson, of Fult Y., in dredging 20,995 cubic yards from such shoals as formed the obstructions. Operations were commenced October 14, and were pleted December 4, 1891.

The improvement was originally estimated to cost $58,146. have been $41,500 appropriated to date, leaving $16,646 still d improvement under the existing project.

It is believed that $10,000 (to be applied to rock excavation) v sufficient to carry out the original scheme of improvement; bu feared that the improvement is not going to prove very perm when fully completed. It has been found necessary to repeat tions at Bull Brook Bend, after leaving that part of the stream cellent condition, and there is nothing to give assurance that accr may not occur on the shoal there again or elsewhere during the s of freshets.

The accompanying commercial statistics were kindly furnish the collector of customs, district of Vermont.

Money statement.

July 1, 1891, balance unexpended	$1,
June 30, 1892, amount expended during fiscal year	1.
Amount appropriated by act approved July 13, 1892	10,

COMMERCIAL STATISTICS.

Name, Otter Creek, Vermont; nearest light-house, Split Rock; collection d Vermont; greatest draft of vessels, 7.5 feet.

Arrivals and departures, 1887, 1890, and 1891.

Kind of craft.	1887.		1890.		1891.	
	Arrived.	Cleared.	Arrived.	Cleared.	Arrived.	Cleared.
l	112	112	33	33	40	40
					4	4
gs	168	168	30	30		
ssels	294	294	185	185	213	207

tons of merchandise, in 1879, arrived, 6,350; cleared, 500; 1890, arrived, 3,361; , 370; 1891, arrived, 4,449; cleared, 1,812.

P P 9.

IMPROVEMENT OF TICONDEROGA RIVER, NEW YORK.

project for this improvement was adopted in 1881, its object be- e formation of a channel of navigable width and a least depth of ıt low water between the falls of Ticonderoga and Lake Champlain, ınce of about 2 miles. (See Report of Chief of Engineers, 1881, '26.)

improvement was estimated to cost $42,516, of which amount 0 have been appropriated and $26,016 are still due the improve-

appropriation of September 19, 1890, has been expended, under ct dated January 12, 1891, with Willard Johnson, of Fulton, N. dredging 8,132 cubic yards from shoal places near the mouth of 'er. Operations commenced May 7 and were completed May 21,

rder to carry out the scheme of improvement the existing channel equire very general widening and deepening, and when this has ccomplished the permanency of the improvement is regarded as ıely questionable. At the rate at which work has been carried le more than keeping pace with the annual accretions has been ac- ished; we may gain a little on the channel in one part only to lose ther part, and thus alternating and remitting of efforts, with the stion of the small appropriations, no permanent gain has been d. In the prosecution of this work, if it is deemed best to pro- rith it, larger appropriations seem to be absolutely necessary for rpose of generally benefiting the channel.

Money statement.

1891, balance unexpended	$1,977.75
, 1892, amount expended during fiscal year	1,977.75
ınt (estimated) required for completion of existing project	26,016.00
ıitted in complance with requirements of sections 2 of river and bor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

tatistics for 1890 were obtainable, and those for 1881, 1886, and 1891 are ed:

ht received: 1881, 38,000 tons; 1886, 55,000 tons; 1891, 63,000 tons, and 34,000 ipped.

APPENDIX Q Q

IMPROVEMENT OF OAKLAND HARBOR, CALIFORNIA.

EPORT OF COLONEL G. H. MENDELL, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

UNITED STATES ENGINEER OFFICE,
San Francisco, Cal., July 6, 1892.

GENERAL: I have the honor to transmit herewith annual report on the work of improving harbor at Oakland, Cal., etc., for the year ding June 30, 1892.

Very respectfully, your obedient servant,

G. H. MENDELL,
Colonel, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

IMPROVEMENT OF OAKLAND HARBOR, CALIFORNIA.

Operations of the year.—At the beginning of the year five contracts ere in force, namely: 1. For delivery and placing stone upon the rth jetty. 2. For construction of piers of a highway bridge to span e tidal canal at Park street, Alameda. 3. For a steel highway bridge nd draw span at Park street, Alameda. 4. For dredging tidal basin. For dredging the eastern end of the tidal canal.

The first of these contracts, involving 13,367 tons of stone delivered nd 61 '29 square feet of dry masonry, was fulfilled on October 12, 1891, [illegible] ons of stone having been delivered and 31,528 square feet of masonry having been laid during the year.

The contract for bridge piers was fulfilled on August 20, 1891. The uantity of work done during the year was 600 cubic yards of excavation and 2,351.8 cubic yards of concrete.

The contract for the highway bridge was practically completed on December 7, 1891, several small items being placed a few days later. The amount of metal in the bridge is 195.2 tons.

Work was begun on the contract to dredge the tidal basin July 1, 1891, and the contract was fulfilled on January 13, 1892. The quantity dredged and securely placed ashore behind levees is 632,905 cubic yards. The distance over which the spoil was transported in pipes varied between 3,000 and 6,000 feet.

At the beginning of the year work had been done under the contract for excavation of the eastern end of the tidal canal to the extent of 250,820 cubic yards dredged and securely placed ashore. No work was done in continuation of this contract until January 26, 1892. The work done during the year, as measured, is 142,088 cubic yards. The agreed date for fulfillment of the contract is June 30, 1892, at which date there remained to be dredged an estimated quantity of 107,000 cubic yards.

Contracts made during the year.—A contract was made on September 28, with the San Francisco Bridge Company, for enlarging the portion of the channel in front of the city of Oakland to a width of 325 feet and depth of 18 feet or less, at low water. The work is to be begun on July 18, 1892. The estimate of work to be done is 125,000 cubic yards. The date set for completion is May 18, 1893.

Present condition of the work.—A survey just made shows that the depths in the channel have been fully maintained. They are practically identical with those found at the close of the last fiscal year. The channel from the Bay of San Francisco to the wharves of Oakland is for almost all the distance 300 feet in width, with a low-water depth of 14 feet, to which the tide adds an average additional of 4 feet, making 18 or more feet available at high tide.

In front of the wharves of Oakland the width of the channel is reduced to 225 feet.

The north jetty is practically completed, with length of 9,203 feet. The terminal mound is as yet, however, in the rough, and is to be laid up in dry masonry.

The length of the south jetty as it stands, is 11,868 feet, of which 2,465 is in an unfinished condition, and the contemplated extension is about 700 feet, making the projected length 12,680 feet.

The excavation of the tidal basin is completed. The amount of excavation made in the tidal canal is 1,002,445 cubic yards. The quantity estimated to complete the canal is 1,503,832 cubic yards.

The work yet required to carry out the project is mainly embraced in the following items, namely: Completion of the canal; bridge at High street, Alameda; extension and completion of the south jetty; dam at mouth of San Leandro Estuary, and dredging interior channels.

Future operations.—It is expected to apply the next appropriation to further excavation of the tidal canal and protection of its banks; to completion of the south jetty, and to dredging channels, both in the lower and upper parts of the harbor.

Appropriations for improving harbor at Oakland, Cal.

June 23, 1874	$100,000	August 2, 1882	$200,000
March 3, 1875	100,000	July 5, 1884	139,600
August 4, 1876	75,000	August 5, 1885	60,000
June 18, 1878	80,000	August 11, 1888	350,000
March 3, 1879	60,000	September 19, 1890	250,000
June 14, 1880	60,000		
March 3, 1881	60,000	Total	1,534,600

COMMERCIAL STATISTICS.

›llowing tables, compiled by Mr. Le Conte, show the general that passed through the jetties each year since the beginning ›ions:

Year.	Traffic by steam ferries.				Traffic by vessels.		
	No.	Trips.	Passengers.	Freight.	No.	Register.	Freight.
				Tons.		Tons.	Tons.
....	1	600	None	60,000	1,415	70,750	94,300
....	3	5,400	216,240	129,000	1,085	109,125	211,627
....	3	8,600	858,352	1,051,788	1,129	129,714	173,448
....	3	9,400	892,210	1,150,379	1,004	144,004	257,614
....	3	8,000	974,901	1,142,918	1,031	143,886	215,829
....	3	8,000	1,553,769	1,202,230	1,156	163,553	255,738
....	3	6,000	444,142	1,439,134	1,326	200,226	305,437
....	3	6,000	318,402	1,487,924	1,673	188,974	264,050
....	3	8,520	210,423	1,654,451	1,224	130,913	231,660
....	3	8,520	200,000	1,876,635	1,384	162,957	295,932
....	3	8,600	100,000	1,755,247	1,745	185,358	338,123
....	3	8,600	100,000	1,925,957	2,153	213,971	393,478
....	3	8,600	100,000	2,259,086	2,310	232,706	437,923

ear's report shows a growth in traffic in twelve months of 16⅓ equal to 378,573 tons.

›ight carried by ferry steamers, 2,259,086 tons, represents mis›s merchandise, and includes most of the rail traffic of San o.

maining traffic is carried on by vessels with registered tonnage between 200 and 1,265 tons, drawing 14 to 18 feet, and by fleet, ›ble in number, drawing 10 feet or less.

›ssification of freight carried otherwise than on ferry steamers ›ws:

	Tons.
....	207,588
....	130,677
›al productions	16,614
›aterials	41,200
ous, including supplies and productions of manufacturing indus-	41,904

Money statement.

1, balance unexpended	$247,266.79
'92, amount expended during fiscal year	164,847.49
2, balance unexpended	82,419.30
2, amount covered by uncompleted contracts	63,676.37
2, balance available	18,742.93
›propriated by act approved July 13, 1892	150,000.00
›ailable for fiscal year ending June 30, 1893	168,742.93
(estimated) required for completion of existing project	841,000.00
that can be profitably expended in fiscal year ending June 30, 1894	300,000.00

ed in compliance with requirements of sections 2 of river and ' acts of 1866 and 1867.

APPENDIX R R.

[IM]PROVEMENT OF NAPA RIVER, REDWOOD CREEK, AND SAN LUIS OBISPO, WILMINGTON, AND SAN DIEGO HARBORS, CALIFORNIA.

[RE]PORT OF LIEUTENANT-COLONEL W. H. H. BENYAURD, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

[1.] Napa River, California.
[2.] Redwood Creek, California.
[3.] San Luis Obispo Harbor, California.
4. Wilmington Harbor, California.
5. San Diego Harbor, California.

EXAMINATION.

[6.] Deep-water harbor on Pacific Coast between Points Dume and Capistrano, California.

HARBOR LINES.

[7.] Establishment of harbor lines at San Pedro, Wilmington Harbor, California.
8. Establishment of harbor lines in San Diego Harbor and adjacent waters, California.

UNITED STATES ENGINEER OFFICE,
San Francisco, Cal., July 6, 1892.

[G]ENERAL: I have the honor to transmit herewith reports upon the [wo]rks of river and harbor improvement under my charge for the fiscal [ye]ar ending June 30, 1892.

Very respectfully, your obedient servant,

W. H. H. BENYAURD,
Lieut. Col., Corps of Engineers.

[B]rig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

COMMERCIAL STATISTICS.

[Furnished by [illegible] & Co.]

Articles.		1887.	188[illegible].
Imports.			
[illegible]	feet	4,250,000	[illegible]
[illegible]	do	1,200,000	[illegible]
[illegible]	tons	1,500	[illegible]
[illegible]	do	4,500	[illegible]
[illegible]	do	4,000	[illegible]
Exports.			
[illegible]	feet	5,000,000	[illegible]
[illegible]	number	25,000,000	[illegible]
[illegible]	do	425,000	[illegible]
[illegible]	cords	8,000	[illegible]
[illegible]	do	2,500	[illegible]
[illegible]	tons	7,000	[illegible]
[illegible]	do	8,000	[illegible]
[illegible]	do	2,000	[illegible]

	Tons.
Total amount of freight via Redwood Creek, July 1, 1886, to July 1, 1887	60,[illegible]
Total amount of freight via Redwood Creek, January 1, 1888, to December 31, 1888	64,[illegible]
Increase	4,0[illegible]

R R 3.

IMPROVEMENT OF SAN LUIS OBISPO HARBOR, CALIFORNIA.

The project for this improvement is to construct a breakwater on Whaler Reef at Port Harford, extending from Point San Luis to Whaler Island and thence to a point where the outer reef rises above high water. The structure is intended to protect the anchorage and landing at Port Harford. Its total length when completed, including the island, will be about 2,300 feet.

That part of the breakwater between Point San Luis and the island, in length about 300 feet, was completed two years ago, and a commencement was made upon the extension beyond the island by depositing rock in the deeper portions of the reef. This latter work has been continued during the past year under a contract with the San Francisco Bridge Company. It was intended to commence as near the island as possible, working thence outward and filling up the low places in the reef to the plane of mean low water as the work progressed. Owing to the almost constant recurrence of a heavy swell over the reef the contractor experienced great difficulty in mooring his vessels in position to deposit the rock properly in place. He had recourse, therefore, to a tramway extending from the island. By this means the breakwater was advanced about 300 feet beyond the island and built above high water throughout that length. To the close of the fiscal year there had been delivered and placed in the above length of structure and in the depressions beyond a total of 7,870.5 tons of rock.

This contract is still in force, and work under it will be completed in gust. The time of completion has been extended three times, the ays in the work being due partly to causes beyond the control of the tractor, but in a great measure to the imperfect plant with which ras attempted to carry on the work. The latter defect was remedied a complete change in the outfit for transporting the rock from Morro he site of the work.

Under permission granted by the Light-House Board the material ill out the present contract is obtained at Morro Rock, a light-house ervation 20 miles to the northward of Port Harford. This locality he only one within any reasonable distance where suitable rock for breakwater can be obtained, and it is considered that we must de- d upon that locality entirely for all future supplies of material for breakwater.

The difficulties attending the passage of loaded barges over Morro and the distance which the material must be transported under ditions of heavy seas and winds necessarily add greatly to the cost construction. Any small amount appropriated would only deter lers from seeking the work, except at prices greatly in excess of at it should cost. It is, therefore, desirable in the interests of econ- y that appropriation be made large enough to justify anyone under- ing the work to provide a suitable plant for the operations.

The amount of $130,000 could be profitably expended in continuing erations during the next fiscal year.

The total amount appropriated for this improvement is $65,000, as llows:

t of August 11, 1888	$25,000
t of September 19, 1890	40,000

And the total amount expended, including outstanding liabilities, is 2,053.07.

Money statement.

ly 1, 1891, balance unexpended		$39,082.56
ne 30, 1892, amount expended during fiscal year		19,435.79
ly 1, 1892, balance unexpended		19,646.77
ly 1, 1892, outstanding liabilities	$6,699.84	
ly 1, 1892, amount covered by uncompleted contracts	11,952.04	
		18,651.88
ly 1, 1892, balance available		994.89
ount appropriated by act approved July 13, 1892		30,000.00
ount available for fiscal year ending June 30, 1893		30,994.89
Amount (estimated) required for completion of existing project		189,900.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		130,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

	Year the improvement began (1888).		Year ending December 31, 1891.	
	Incoming.	Outgoing.	Incoming.	Outgoing.
Vessels:				
Steam .... number..	603	603	506	[illegible]
Sailing .... do....	34	34	13	[illegible]
Total	637	637	519	[illegible]
Tonnage	452,149.34	452,149.34	335,970	[illegible]
Draft, greatest .... feet..	18	....	18	....
Merchandise, general .... tons..	8,802	5,669	7,418	[illegible]
Coal .... do...	2,985	....	1,211.8	....
Lumber .... feet..	8,884,400	....	2,175.9	....
Grain .... tons..	....	23,305	20.5	[illegible]
Bituminous rock .... do...	....	15,342	....	[illegible]
Butter .... do...	....	....	....	[illegible]
Cheese .... do...	....	....	1.2	[illegible]
Live stock .... do...	....	....	85.5	[illegible]
Hides .... do...	....	....	5.3	....
Asphaltum .... do...	....	....	....	[illegible]
Chrome ore .... do...	....	....	....	[illegible]
Onyx .... do...	....	....	....	[illegible]

Statistics for both years furnished by the Pacific Coast Railway.

	Tons.
Total amount of freight entered and cleared in 1888	68,425
Total amount of freight entered and cleared in 1891	48,771.6

No new lines of transportation have been established during the year.

R R 4.

IMPROVEMENT OF WILMINGTON HARBOR, CALIFORNIA.

Before the commencement of this improvement in 1871 there was a depth of less than 2 feet at the entrance to the harbor at mean low tide. The extension of jetties from Rattlesnake Island and Timms Point on the easterly and westerly sides of the harbor respectively, and the dredging of a portion of the interior space, have resulted in giving a depth in the interior channel of not less than 16 feet, and at the entrance of fully 14 feet at the same stage of water. It is expected that future operations will increase this latter depth to 16 feet.

Operations during the past year have consisted in making needed repairs to the east jetty, in raising and extending the west jetty, and in dredging and removing, by blasting, portions of hard material from the inner channel in the vicinity of Deadmans Island.

At the commencement of the fiscal year two contracts for the delivery of stone for the jetties were in force. The total amount of rock delivered during the season of active operations was 21,309 tons. Of this amount 17,763 tons were deposited upon the line of the west jetty, extending that structure a further distance of 800 feet. The remainder, 3,546 tons, was used in strengthening the line of single work of the east jetty at the south end of Rattlesnake Island, where the encroachments of the sea threatened to result in serious damage to the work. The west jetty has now a length of 3,450 feet, and the east jetty, extending to Deadmans Island, has a length of 6,600 feet.

At the close of the dredging operations last year it was found that certain shoal places existed in the channel in the vicinity of Deadmans Island, consisting of material too hard to be removed by the dredging machine. Experiments were therefore made with dynamite, with a view of disintegrating the material and permitting the strong current of the ebb tide to complete the work of removal.

These operations, conducted at intervals when weather and sea would permit, were entirely successful, and a channel depth of not less than 16 feet at mean low tide can now be carried inside Deadmans Island.

Surveys were made from time to time during the year for a study of the changes taking place in the interior and exterior channels as a result of the operations in progress. The survey made at the close of the fiscal year shows a deepening of the entire channel, giving as a final result a depth at the entrance of fully 14 feet at mean low tide.

The various operations at the locality were in charge of Lieut. James J. Meyler, Corps of Engineers.

The Board of engineer officers appointed to consider the subject of harbor lines, rendered a report under date of July 18, 1891, recommending for adoption certain bulkhead and pier head lines on the easterly and westerly sides of the harbor. The lines as laid out received the approval of the Secretary of War, July 28, 1891.

Any funds made available for the coming fiscal year will be expended in extending the east jetty beyond Deadmans Island, and in keeping in repair the works already constructed. Should the full amount of $51,000, required to complete the present project, be appropriated, no further project will be presented until the results obtained by contemplated jetty extension are fully determined.

The total amount appropriated for this work is $904,000, as follows:

Act of—		Act of—	
March 3, 1871	$200,000	March 3, 1881	$33,000
June 10, 1872	75,000	August 2, 1882	100,000
March 3, 1873	150,000	July 5, 1884	50,000
March 3, 1875	30,000	August 5, 1886	75,000
June 18, 1878	20,000	August 11, 1888	90,000
March 3, 1879	12,000	September 19, 1890	34,000
June 14, 1880	35,000		

The total amount expended to close of the fiscal year, including outstanding liabilities, is $894,450.64.

This work is in the collection district of Los Angeles.

Money statement.

July 1, 1891, balance unexpended	$85,568.18
June 30, 1892, amount expended during fiscal year	75,893.60
July 1, 1892, balance unexpended	9,674.58
July 1, 1892, outstanding liabilities	125.22
July 1, 1892, balance available	9,549.36
Amount appropriated by act approved July 13, 1892	51,000.00
Amount available for fiscal year ending June 30, 1893	60,549.36

COMMERCIAL STATISTICS.

Commercial statistics for the year the improvement began (1871).

	Incoming.	Outgoing.
Vessels:		
Steam	160	160
Sailing	65	65
Total	225	225
Freight ... tons	25,313	9,575
Lumber ... feet	10,938,336	....

Statistics of commerce for the year ending December 31, 1891.

[Furnished by the collector of customs at Wilmington, Cal.]

	Foreign commerce (outer harbor).		Domestic commerce.	
	Incoming.	Outgoing.	Incoming.	Outgoing.
Vessels:				
Steam	....	....	392	[illegible]
Sailing	41	35	156	15[illegible]
Total	41	35	548	54[illegible]
Tonnage	62,231	53,455	261,455	....
Draft, greatest .... feet..	28.5	....	18.5	....
Merchandise, general .... tons..	2,648	1,626	5,250	10,[illegible]
Coal .... do....	95,239	....	....	....
Lumber .... feet..	....	....	67,151,268	....

The total amount of revenue collected at the port during the year ending December 31, 1890, was $93,279.77.

The rates upon freight have been reduced since the first expenditure for the improvement of this harbor from $7.50 to 62½ cents per 1,000 feet on lumber and from $5.00 to 75 cents per ton on general merchandise from the outer anchorage.

	Tons.
Total amount of freight entered and cleared in 1871	50,059
Total amount of freight entered and cleared in 1891	208,831
Increase	158,772

One new line of transportation has been established during the year, viz, the Los Angeles Terminal Railway.

R R 5.

IMPROVEMENT OF SAN DIEGO HARBOR, CALIFORNIA.

The present approved project for the improvement of San Diego Harbor contemplates the construction of a jetty on Zuninga Shoals at the entrance of the harbor, keeping in repair the dike built across the mouth of the San Diego River to divert the waters of that stream into False Bay, and maintaining a channel of 24 feet at mean low water through the middle ground.

Jetty.—It is intended to construct a jetty about 7,500 feet in length on Zuninga shoals, extending out from Coronado North Island, with a view of gaining a depth of 26 feet at mean low tide where there is now at same stage scant 21 feet. No work has yet been done. Proceedings were instituted in the United States circuit court for the southern district of California for the purpose of condemning a strip of land, 18.85 acres in extent, on Coronado North Island, needed for jetty purposes. The case was brought to trial about the middle of June, and an award of $13,942.46 was made by the jury for the land in question. Upon possession of the same being obtained by the Government the construction of the jetty will be commenced with the balance of the appropriation of September 19, 1890, combined with any funds appropriated by the bill now being considered in Congress. The work will project from the shore on Coronado North Island about 1,600 feet east of the entrance to the harbor. It will be built of stone deposited upon a brush foundation in the shape of mattresses, both materials being deposited in place from a tramway built from the shore. The structure will first be carried to half tide, with a view of ultimately raising it ...gh water.

In view of the fact that the auxiliary works, such as the wharf and :amway, needed in connection with the construction are only of a :mporary character and will be exposed to the destructive action of ıe sea and teredo and will therefore need frequent repair and renewal, is desirable that the work be carried to completion as early as possible. he recommendation made in the report of last year for sufficient funds ır carrying on the work is therefore repeated.

Dike.—Previous to the adoption of the present project for the im-rovement of the entrance to the harbor the only work undertaken by ıe Government had for its object the prevention of injury to the inner arbor by material brought down the San Diego River in flood stages ıd deposited in the bay in the vicinity of Old Town.

The object was accomplished by building a strong earthen levee, osing up the mouth of San Diego River, and excavating a new channel ading to False Bay. This work was completed in 1876, and operations ıce have been simply with a view of keeping the levee in repair.

The work was examined several times during the year and was found be in good condition and needing no repairs.

Middle Ground.—At the commencement of the year dredging at the ead of the middle ground was in progress with an allotment made om the appropriation of September 19, 1890. A channel 250 feet wide ıd 22 feet deep was completed, enabling the deeper-draft vessels take a straight channel into the harbor instead of turning Ballast oint. The channel, however, did not maintain its full depth, and it ırtially shoaled up again. It is not intended to attempt the further ıprovement of this channel until the jetty construction shall have een extended out sufficiently to cut off the movement of sand over uninga Shoals.

A survey of the entire bay, from National City to Ballast Point, in onnection with the establishment of harbor lines, was completed Oc-ber 7, 1891. The report of the Board of Engineer Officers, recommend-ıg for adoption certain pier head and bulkhead lines, was forwarded the Chief of Engineers June 13, 1892. The lines as laid out received ıe approval of the Secretary of War June 21, 1892.

An appropriation of $200,000 could be profitably expended in jetty onstruction during the fiscal year ending June 30, 1893.

The total amount appropriated for San Diego Harbor since 1875 is 142,500, as follows:

ct of—	
March 3, 1875	$80,000
March 3, 1879	1,000
August 11, 1888	1,000
September 19, 1890	60,500

ıd the total amount expended is $91,740.19.

Money statement.

ıly 1, 1891, balance unexpended	$58,512.16
ıne 30, 1892, amount expended during fiscal year	7,752.35
ıly 1, 1892, balance unexpended	50,759.81
mount appropriated by act approved July 13, 1892	50,000.00
mount available for fiscal year ending June 30, 1893	100,759.81
Amount (estimated) required for completion of existing project	284,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	200,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Commercial statistics for the year the improvement began.

	Vessels.	Freight.
	No.	Tons.
Entered	201	24,509
Cleared	195	11,647

The vessels (including 109 steamers) had an aggregate tonnage of 122,311 tons.

Commercial statistics for the year ending December 31, 1891.

[Furnished by Mr. A. E. Higgins, special deputy collector.]

	Incoming.	Outgoing.
Vessels:		
Steam ....No..	296	295
Sailing ....do..	141	138
Total	437	433
Tonnage	233,869	231,6[illegible]
Draft, greatest ....feet..	24½	....
Merchandise, general ....tons..	85,963	....
Coal ....do..	73,265	....
Lumber ....feet..	37,044,000	....
Value of imports	$579,473.82	....
Value of exports	....	$552,4[illegible].00

Amount of revenue collected at the port during the year ending December 31, 1891, $94,644.61.

Total amount of freight entered and cleared in 1876..................tons.. 36,156
Total amount of freight entered and cleared in 1891..................do.. 210,606

Increase 174,150

One new line of transportation has been established during the year, viz: The Pacific Mail Steamship Company, San Francisco to Panama and intermediate ports.

R R 6.

EXAMINATION FOR DEEP-WATER HARBOR ON THE PACIFIC COAST BETWEEN POINTS DUME AND CAPISTRANO, CALIFORNIA.

[Printed in House Ex. Doc. No. 39, Fifty-second Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 18, 1891.

SIR: I have the honor to submit herewith a copy of report, dated December 8, 1891, of the Board of Engineer Officers constituted under the terms of the river and harbor act approved September 19, 1890, to examine the Pacific coast between Points Dume and Capistrano with a view to determining the best location for a deep-water harbor, together with project and estimates for the work.

The Board after full examination concludes that the selection of a site for a deep-water harbor within the limits designated by the act is ricted to the harbors in Santa Monica Bay and San Pedro Bay, and f the opinion that San Pedro is the better of these, and submits al- native estimates of the cost of the necessary breakwaters as follows:

onstructed of rubble and concrete	$4,594,494
onstructed entirely of rubble	*4,126,106

After a careful consideration of the facts in the case as presented by Board, its views as to the location and general estimates of con- uction are concurred in by me. The difference in cost of the two akwaters, for the same arcs of protection, is over $700,000 in fa- of San Pedro, and when the other advantages of San Pedro, as ailed by the Board, are taken into consideration, it would seem that selection has been properly made.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Ion. L. A. GRANT,
Acting Secretary of War.

PORT OF BOARD OF ENGINEERS ON DEEP HARBOR ON PACIFIC COAST BETWEEN POINTS DUME AND CAPISTRANO, CALIFORNIA.

SAN FRANCISCO, CAL., *December 8, 1891.*

ENERAL: The Board of Engineer Officers appointed under the pro- ons of the river and harbor act of September 19, 1890, to examine Pacific coast between Points Dume and Capistrano, with a view letermining the best location for a deep-water harbor, has the honor ubmit the following report.†

he section of the act under which the Board was appointed is as ows:

at the Secretary of War is authorized and directed to appoint a board of three neer officers of the United States Army, whose duty it shall be to examine the fic Coast between Points Dume and Capistrano, with a view to determining the location for a deep-water harbor. The said board shall report to the Secretary 'ar a project for said harbor, with the estimated cost of the same, who shall lay report before Congress at its next session, with the views of the commission and he Chief of Engineers of the United States Army thereon; and the sum of five isand dollars, or so much thereof as may be necessary, is hereby appropriated for purpose.

TOPOGRAPHY.

'oints Dume and San Juan Capistrano differ in latitude thirty-five utes, and in longitude a little more than a degree, and in direct dis- ce they are about 75 miles apart. The general trend of the coast ween them is southeast, broken by two bays, Santa Monica Bay, ig between Point Dume and Point Vincente, and San Pedro Bay, ig to the eastward of Point Firmen. The shore between Points Vin- te and Firmen is high and rocky, forming the seaward boundary of 1 Pedro Hill, which rises to the height of 1,475 feet. Passing from int Dume towards Santa Monica, the foreshore for a distance of 15 es is abrupt and rocky, being the foothills of the adjacent Cuhuenga untains.

Proceeding to the eastward, there is a stretch of about 16 miles of eshore ending at Malaga Cove, which is in greater or less degree cticable in a commercial way.

A correction of this amount since the above letter was written makes this esti- e $4,137,591.

†Maps accompanying this report not reprinted; printed in House Ex. Doc. No. 39, Congress, first session.

At and above the village of Santa Monica, the shore is a plateau about 80 feet above the sea, nearly vertical to the sea, covered in front by a sand beach. A depression in the plateau enables a railway to reach the level of a wharf built in front of the town.

About 2 miles to the eastward, low land encircling a lagoon called La Ballona extends for 2 or 3 miles, separated from the ocean by low sand dunes and a fine beach. Thence to Redondo, the foreshore consists of sand dunes, the plateau being retired. Railroads reach the shore both at Ballona and Redondo.

At Malaga Cove a rocky formation having San Pedro Hill close in the background abuts on the ocean, and including Rocky Point, Points Vincente and Firmen, and the intervening ground, extends to the northern end of San Pedro Bay, a distance of 12 miles, quite impracticable for commercial purposes.

Between Point Firmen and Point Lasuen, 16 miles to the eastward, lies San Pedro Bay. In this interval are included Wilmington Harbor, Long Beach, and Anaheim Landing.

The foreshore from Point Firmen to Point Lasuen is practicable throughout its length for commercial uses both upon the plateaus and the lower lands.

Within the limits of San Pedro Bay two lines of railway reach the shore at Wilmington and Long Beach. A short distance beyond Point Lasuen lies Newport Bay, a lagoon which receives the waters of the Santa Ana River. This point has connection by rail with Los Angeles.

To the eastward of Newport Bay the shore again becomes impracticable, and maintains this character to Point San Juan Capistrano, a distance of 15 miles.

It appears from this description that possible commercial sites are topographically limited in Santa Monica Bay to a shore-line length of 16 miles, and in San Pedro Bay and Newport Bay to the same distance of 16 miles. Of the shore line between Points Dume and Capistrano the three impracticable portions, namely, east of Point Dume, about Point Vincente, and between Newport Bay and Capistrano, include 42 miles.

Los Angeles is the metropolis of all adjacent territory, and is the center of all the railroads herein mentioned. It is distant from—

	Miles.		Miles.
Santa Monica	18	San Pedro	22
Ballona	17	Long Beach	22
Redondo	22	Newport	40

A notable characteristic of the shore line of San Pedro Bay and in less degree of Santa Monica Bay is the occurrence of shallow lagoons close to the ocean and separated from it by thin lines of sand beach.

The most important of these lagoons is close under Point Firmen, known now as Wilmington Harbor, it having been improved by the Government. In its natural state it had at the entrance a depth not exceeding 2 feet at low water. It has now 14 feet at that stage. It is hoped, by operations now in progress, to increase the depth by 2 or 3 feet. Vessels drawing 18.6 feet have entered at high water.

The other lagoons in San Pedro Bay are Alamitos and Anaheim. Ballona Lagoon is situated on the shore of Santa Monica Bay.

Reference to these lagoons is made principally in order to state the opinion of the Board to the effect that no one of them is capable of the degree of improvement necessary to make a deep-sea harbor as contemplated by the law.

HYDROGRAPHY OF SANTA MONICA AND SAN PEDRO BAYS.

Santa Monica Bay.—The hydrography between the village of Santa nica and Redondo is quite uniform. Just to the westward of Re-ido the 10-fathom curve of depth lies about seven-eighths of a mile n the beach, and the interval gradually increases towards Santa nica, where it becomes 1½ miles. Over all this frontage changes of oth are very gradual. A breakwater of given length placed along r assumed contour of the bed of the bay must on this account shelter nuch larger area at Santa Monica than at any other point in Santa nica Bay. At Redondo a submarine valley heads close to shore, the fathom curve being only about 500 feet distant. Seaward of this nt the valley widens and deepens rapidly, reaching a depth of 100 ioms in 1½ miles. Excessive depth of water makes a breakwater at s point impracticable on account of cost. The practicable locations a harbor in this bay, topographically possible for a stretch of 16 es, are limited by the last-named consideration to a line 14 miles in gth.

'he bay is free from hidden dangers. The bottom is sandy. There small area of rocky bottom indicated on the surface by the presence kelp.

'he approach to Santa Monica Bay is free from danger.

San Pedro Bay.—This bay lies shoreward of a line drawn from Point men to Point Lasuen, the direct distance being about 14 miles. The pest water in the bay is about 15 fathoms. The slope of the bed n the shore seaward is fairly uniform.

Near the mouth of Wilmington Harbor, there is a rock with 3 ioms over it, having deeper water around it. The presence of kelp icates rocky bottom about Point Firmen, and in the present an-rage of San Pedro there are also areas of rocky bottom. The east-end of San Pedro Bay appears to have a sandy bottom.

WINDS, WAVES, AND EXPOSURE.

'he prevailing wind on the California coast is from the northwest, rly parallel to the coast line north of Point Conception, which is in tude 34° 27′ N. At this point the trend of the coast changes from thwest to west. This fact in connection with the bold topography he shore causes the prevailing winds along the southerly coast of ifornia to be westerly. This wind never becomes more than a mod-te gale. It never produces the heaviest waves. The disturbance of water due to it is, however, always an inconvenience to vessels ig at a wharf exposed to its action, and when the disturbance is atest there is danger to vessels. This wind prevails on the south-coast during the greater part of the year with intermission of ns in the autumn and winter. In the last-named season occur the therly offshore winds, which produce the heaviest waves to which coast line is exposed.

A northeasterly land wind, known as the "Santa Ana" occasionally ws from the dry hot plains lying to the eastward. Its duration is rt, and it is severe, but having no fetch over the sea it raises no ves near shore. It occurs both on Santa Monica and San Pedro rs.

'he southeaster comes in the winter and spring, and brings rain. storm first manifests itself by a wind from the southeast, which tinues for a few hours, shifting then to the south and southwest.

The storm clears up when the wind gets to the northwest. In these storms a heavy sea is developed, which breaks upon the coast line in waves of great magnitude. These waves come from the south and southwest. The waves produced by the southeast wind are short, designated by sailors as choppy. The south and southwest seas, on the other hand, are long and heavy. A vessel at anchor under this exposure must, under these circumstances, get to sea with the possibility of otherwise going ashore. It is the heave of the sea rather than the wind, although the latter alone is sufficiently dangerous, that makes the strongest ground tackle, at times, of no avail.

Although southerly winds prevail during the winter seasons, and bring rain, yet their occurrence in violent form is not frequent, and a season has been known to pass without a severe storm. Nor is the duration of a storm rarely extended over two or three days.

In this respect the conditions of the southern coast of California are much less severe than in higher latitudes. This consideration is of great importance, for the reason that owing to it a lighter profile may be adopted for a breakwater than would be permissible much farther north.

It also happens that a heavy westerly sea sets in unaccompanied by wind due to a cyclonic disturbance in midocean. The propagation shoreward of waves generated at long distance seaward is favored by the unusual depth of the Pacific Ocean.

It appears, then, that Santa Monica Bay is entirely open to the moderate down-coast or west winds, which prevail during the greater part of the year, and that it also is exposed to the dangerous winds and seas which occur during the winter months, coming from the south and southwest. The degree of exposure is, however, not absolutely equal in all parts of the bay. The easterly end, near Malaga Cove, is afforded protection from the winds and seas from the south by the high land to the southward, and which also affords partial protection from the southwest seas. Catalina Island also aids in some degree to shelter this portion of the bay from southerly seas.

On the other hand, Santa Monica Bay is entirely sheltered from the southeast winds by the high lands of San Pedro Hill.

San Pedro Bay is protected by the same high land from the prevailing down-coast wind. In ordinary weather the Bay of San Pedro is quiet and vessels lie safely at anchor, and for the most part discharge cargo with lighters while the wind prevails. It was doubtless this circumstance which made this point the embarcadero of this part of the coast for the Mexican trade before California was acquired by the Americans. In more recent times the greater part of the commerce of this part of the country has also been transacted here. Formerly all the deep-draft vessels from Australia and Puget Sound discharged cargoes in this bay; recently one of these ships discharged at the wharf at Redondo.

San Pedro Bay is also protected to a great extent from the southwest sea and wind by the island of Santa Catalina, which lies about 18 miles offshore to the windward. This island is 17½ miles in length, and its height of 1,500 to 2,000 feet makes its shelter, as far as it extends, complete. It covers 48 degrees of the total arc of exposure from southwest seas, but leaves uncovered the angle between the westerly end of the island and Point Firmen, through which interval the direct southwest swells reach the San Pedro anchorage.

San Pedro Bay is also directly exposed to the southeast seas which approach through the interval between Point San Juan and the east end of Catalina Island. While the winds and seas from the south- are not regarded as formidable, those from points farther around e south that enter through the open space last referred to are con- ed to be heavier and more violent than those that approach the orage ground from the westward of Catalina.

e record of vessels wrecked at San Pedro shows, with one excep- that the disasters occurred during the southerly storms, the heavy coming to the eastward of Catalina Island. The vessels were n ashore on the west line of the bay. Among those lost were the *las Biddle, Callao, Adelaide Cooper, San Luis, American, R. P.* ; and the *Kennebec*. The exception noted was that of the *Amy*, n was driven ashore at Point Firmen during a northeast storm from anta Ana wind gap.

e arc of exposure of Santa Monica, extending from Point Dume on est to Point Vincente on the east, is 101 degrees, at Ballona 104 es, and at Redondo 90 degrees. Leaving out of consideration the named point, regarded as impracticable on account of depth, we call the arc of exposure of Santa Monica Bay 102 degrees. From Firmen as a center the arc of exposure of San Pedro Bay around e west end of Catalina Island is 60 degrees. The arc protected by sland is 48 degrees, and the arc included between the easterly end e island and Point Loma is 42 degrees, making the total exposure n Pedro Bay to southeast and southwest winds and seas of 102 es. The aggregate angle of exposure of the two bays is therefore ame.

order to secure a deep-water harbor in either bay a breakwater be constructed in depths of 8 to 10 fathoms, and so located as to the interior space over the arcs of exposure. These considera- make the undertaking one of great expense.

San Pedro Bay the best location for the proposed harbor is at the ent anchorage ground on the westerly side of the bay under Point en. The projection of the westerly shore, by which protection is ded from westerly winds, and from which a breakwater could , affords advantages over any other section of the bay to the east- for securing a protected anchorage.

od holding ground exists at the anchorage. Protection from storms the open arcs of exposure to the southwest and southeast could cured by the construction of a breakwater having two arms. Cat- affords protection from southwest seas, as before stated, over an e of 48 degrees. As indicated on the chart the westerly arm could arted from a point on the shore under Point Firmen, and be ex- ed in a direction south 41 degrees east (magnetic), for a distance of t 2,400 feet, which would carry it beyond a line projected from the lle of the present anchorage ground to the westerly end of Cata- Island. The end of this arm is in 6 fathoms depth. Then leav- gap of 1,500 feet the easterly arm could be given a direction north degrees east along the 9½-fathom curve, and be extended about feet, which would afford protection from the southeast seas. This could be extended easterly, as increased commerce would require interior space.

iere will be some disturbance in the anchorage ground owing to the entrance, but not to any serious extent, as the westerly arm and lina Island cover the dangerous arc of exposure to the southwest, the projection of the easterly arm beyond the line of the westerly prolonged cuts off the heavier seas from the southeast.

entering or leaving the anchorage ground sail vessels can take

the entrance or pass around the end of the easterly arm accordi
the most favorable conditions of the weather.

In Santa Monica Bay the practical location of a breakwater wo
in front of the town of Santa Monica. A structure, located as s
on the chart, and in length about 8,250 feet, would cover an anch
ground over the angle of exposure between Point Dume and
Point. The westerly 2,000 feet is in water of 7½ to 9 fathoms, t
mainder of the structure being in 8 and 9 fathoms.

As at San Pedro, there must be some disturbance in the anch
ground, due to the approach of waves through the open spaces be
the ends of the breakwater and the shore.

In view of the fact that a lighter profile can be adopted at thi
ity than would suffice for similar structures on the upper coa
breakwaters are designed, the profiles of which are shown on th
ing herewith. One is built entirely of rubble deposited in pla
other has a rubble base and a concrete superstructure. The fo
20 feet thick on top, 10 feet above high water, with slope in fro
on 2½ to a depth of 12 feet below low water. The slope belo
depth and in rear is 1 on 1. In the other the rubble rises to a
of 12 feet below low water, at which point it is 20 feet thick wit
of 1 on 4 for a distance of 21 feet in front, and in rear of 12 f
lower slopes being 1 on 1. The concrete superstructure is 20 fe
and rises to a height of 10 feet above high water.

The estimated cost of these breakwaters is as follows:

Rubble and concrete.

Santa Monica:
- 232,222 cubic yards concrete at $15 ....
- 991,383 cubic yards rubble at $1.50 ....

Contingencies, 15 per cent ....

San Pedro:
- 157,630 cubic yards concrete at $15 ....
- 988,082 cubic yards rubble at $1.50 ....
- 74,320 cubic yards rubble at $2 ....

Contingencies, 15 per cent ....

The westerly arm being built entirely of rubble.

All-rubble breakwaters.

Santa Monica:
- 282,250 cubic yards at $2 ....
- 2,431,458 cubic yards at $1.50 ....

Contingencies, 15 per cent ....

San Pedro:
- Westerly arm:
  - 74,320 cubic yards rubble at $2 ....
  - 194,355 cubic yards rubble at $1.50 ....

'edro—Continued.
terly arm:

4,267 cubic yards rubble at $2	$388,534
846,133 cubic yards rubble at $1.50	2,769,200
	3,597,906
ontingencies, 15 per cent	539,685
	4,137,591

stituting a comparison of the two sites selected, it will be seen that e aggregate the total arc of exposure is about the same in each, oximating 102°, though the distribution is different in the two bays. e total at Santa Monica, 77° included between lines drawn to the erly end of Catalina Island and Point Dume, are fully exposed to lirect approach of the winds and seas from the west and south-. The site receives but little protection on the southeast from lina Island, distant 36 miles, while the open area between this d and Point Vincente permits the approach of southerly seas that around the easterly end of the island. To the moderate south- swell, which is known to prevail the greater part of the year, the is fully exposed.

n Pedro Bay is sheltered from the westerly winds by Point Firmen. open to the winds and seas from the southwest and to the prevail- southwest swell above noted, over an angle of 60° to the westward atalina Island. The other arc of exposure of 42° to the eastward atalina permits the approach of seas from the southeast, and also e from the south, that double the easterly end of the island.

its natural condition San Pedro Bay is better protected from the gerous winds and seas than Santa Monica Bay.

insure complete protection requires at the former place the con- ction of two detached breakwaters covering the exposed arcs, the bined length of these structures being about 8,000 feet.

Santa Monica, a breakwater about 8,250 feet would be required ver the anchorage ground over the arc between Point Dume and t Vincente.

s shown by the foregoing estimates, the cost of the breakwater, the adoption of either type, will be less at San Pedro than at Santa ica.

e cost of construction for equal lengths of breakwater is in favor an Pedro on account of the fact that at Santa Monica the break- r must be located in depths of 7 to 9 fathoms. At San Pedro the erly arm will be built of rubble in either case, and starting from shore is extended only to the 6-fathom curve, the easterly arm alone g entirely in the greater depth of 9½ fathoms.

ith the commencement of the construction of the westerly arm at Pedro some protection from westerly swells will immediately be ed.

n Pedro has further advantage in being supplemented by an inte- harbor, which is expected, when completed, to afford at mean low a depth of 16 feet at the entrance. This can accommodate shipping 0 feet draft, and will relieve the anchorage ground to that extent. inner harbor will also be a place of security for the plant during period of construction.

e material for the breakwater at San Pedro must be brought from lina. At Santa Monica it may prove to be possible to obtain suffi- rock from the hills to the northward, but there is at present no factory evidence that such will be the case. If stone shall be derived from the shore, it must be deposited from a trestle bu fathoms depth, and exposed to heavy seas. If Catalina ha depended upon for the supply, the cost of the work will be in somewhat, as the length of carriage will be double that to San The risk attending transportation is also increased.

In view of the fact that San Pedro Bay in its natural condi fords better protection both from prevailing winds and from da storms than Santa Monica Bay; that protection can be secured cost for equal development of breakwater at the former than latter; that a larger area of protected anchorage from the pr westerly swells can be secured, the severe storms from the so being infrequent, and that there is already an interior harbor t be a valuable addition to the outer harbor, the Board consid Pedro Bay as the better location for the deep-water harbor p for by the act.

A breakwater with either of the profiles designed will fulfill ditions of affording a protected anchorage. The cost is in fav one built of rubble. As the westerly arm in either case will b type and should be built first, the data obtained during its c tion will determine the question as to the profile to be adopte easterly arm.

Respectfully submitted.

G. H. MENDELL,
Colonel, Corps of En
G. L. GILLESPIE,
Lieut. Col., Corps of En
W. H. H. BENYAU
Lieut. Col., Corps of En

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

R R 7.

ESTABLISHMENT OF HARBOR LINES AT SAN PEDRO, WILMING BOR, CALIFORNIA.

UNITED STATES ENGINEER OFFI
San Francisco, Cal., July

GENERAL: The Board of Engineer Officers constituted b Orders No. 20, from Headquarters Corps of Engineers, Wash C., March 25, 1891, to consider the subject of harbor lines at S Wilmington Harbor, California, rendered a report, under da 18, 1891,* recommending for adoption certain pier head and lines along the easterly and westerly sides of the harbor. Th laid out and described in the report, received the approval o retary of War.

On the westerly side of the harbor the lines covered the en practicable for commercial purposes. On the easterly side were laid out to a limited extent only, covering the front to be by the wharves of the Los Angeles Terminal Railway Comp ing, as stated in the report, any future extension of these l governed by the commercial necessities of the harbor.

*See Annual Report, Chief of Engineers, 1891, page 2976.

The Los Angeles Terminal Railway Company desire to have these lines extended northward in contemplation of the establishment of lumber yards on the southerly end of Rattlesnake Island. The Board therefore recommends for adoption the following described pier head and bulkhead lines on the easterly side of the harbor, forming an extension of those heretofore approved by the Department:

Pier-head line.—Starting from the point last mentioned in the description of the pier-head line in previous report of the Board, which point is on range through northerly end of single work of east jetty and distant therefrom 320 feet; thence in a straight line to a point 805 feet easterly of the northeasterly corner of the San Pedro Lumber Company's wharf, as at present constructed, said distance being measured on a line at right angles to the direction of the main track of the Southern Pacific Railroad on west side of harbor; thence to a point on range through initial point "A" of survey, on Smiths Island, and distant therefrom 1,400 feet.

Bulkhead line.—Starting from the terminal point of the bulkhead line described in previous report of Board, which point is on range through the northerly end of the single work of the east jetty and distant therefrom 30 feet; thence to a point on same range and distant 230 feet from single work; thence parallel to pier-head line to a point on range through the northeasterly corner of the San Pedro Company's wharf; thence to a point on the range through initial point "A" of survey and distant 200 feet from the pier-head line.

As the original map, with the harbor lines previously adopted delineated upon it, is on file in the Department, the lines here recommended and described have been laid out upon a blue print of that map, which is transmitted herewith.*

Respectfully submitted.

G. H. MENDELL,
Colonel, Senior Member.
W. H. H. BENYAURD,
Lieut. Col., Corps of Engineers.
W. H. HEUER,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
August 9, 1892.

Respectfully submitted to the Secretary of War.

The Board of Engineers constituted by Special Orders No. 20, headquarters Corps of Engineers, March 25, 1891, recommend for adoption harbor lines at San Pedro, Wilmington Harbor, California, additional to those established at this locality by the Secretary of War, July 28, 1891 (see Annual Report Chief of Engineers, 1891, page 2976).

It is recommended that the additional lines now proposed be approved, and that the Secretary place his approval both upon the report and the tracing* submitted.

H. M. ADAMS,
Major, Corps of Engineers, in charge.

WAR DEPARTMENT, *August 10, 1892.*

Approved.

L. A. GRANT,
Acting Secretary of War.

*Not printed.

ommending for adoption bulkhead and pier-head lines
the fronts of San Diego and Coronado.* The lines
received the approval of the Secretary of War. A co
lines, as contemplated by the order, was not establish
insufficiency of funds for a survey of the entire bay.

Funds having afterwards been provided and the n
made, the Board has the honor to recommend for ado
ing described lines for San Diego Harbor and adjace
on the accompanying chart.† The lines formerly laid
form a part of the system here described.

NATIONAL CITY.

Bulkhead line—Beginning at a point on the prolongation of t
Thirty-first street 1,350 feet southeasterly from the westerly line
thence in a straight line to a point on the prolongation of th
Twenty-fourth street 2,100 feet from the westerly side of Eight
a point on prolongation of the north side of Nineteenth street
westerly side of Eighth avenue; thence to a point on the prolon
erly side of Eleventh street 400 feet from the west line of Eighth
point on the prolongation of the southerly side of Eighth str
westerly side of Seventh avenue; thence to a point on the prolon
erly line of Fifth street 400 feet from the westerly side of Eig
to a point on the prolongation of the boundary line between Na
Diego, and distant 400 feet from the westerly side of P avenue
ured at right angles to the direction of said P avenue.

SAN DIEGO, ROSEVILLE, AND LA PLAYA.

Beginning at the point last above mentioned, thence in a stra
P avenue to a line midway between Thor and Una streets pro
point on the prolongation of the southerly side of South Thirty-
from the westerly side of M avenue; thence to a point on the
easterly side of Twenty-eighth street 440 feet from the southerly si
thence to a point on the prolongation of the southeasterly sid
eighth street 550 feet from the easterly side of Pierce avenue;
the prolongation of South Twenty-seventh street 810 feet from

ortherly side of H street; thence parallel to Atlantic street to the prolongation ie northerly side of Cedar street; thence to a point on the prolongation of the ierly side of Hawthorne street 400 feet from the westerly side of California t; thence to a point on the prolongation of the southerly side of Palm street, 300 from the westerly side of California street; thence parallel to California street e prolongation of the southerly side of Thorn street; thence to a point on the ngation of the southeasterly side of Vine street 425 feet from the southwesterly of California street; thence to a point on the prolongation of the southeasterly of Wright street 530 feet from the southwesterly side of Atlantic street; thence point on a line 50 feet south of and parallel to the southeasterly side of rland street prolonged 2,000 feet from the southwesterly side of Atlantic t; thence to a point on the line 50 feet south of and parallel to the southeasterly f Sutherland street prolonged, 4,400 feet from the southwesterly side of Atlantic t; thence to a point on the prolongation of the southeasterly side of Noell street, feet from the southwesterly side of Atlantic street; thence to a point on the protion of the northwesterly side of Bandini street, 5,400 feet from the southwesterly of Atlantic street; thence to a point on a line 300 feet north of and parallel to iorthwesterly side of Couts street prolonged, 5,200 feet from the southwesterly of Atlantic street; thence to a point on the prolongation of the southeasterly of Wetherby street, 3,600 feet from the southwesterly side of Atlantic street; e to a point on the prolongation of the southwesterly side of Thirty-second t in Roseville, 2,900 feet from the southeasterly side of Main street, Roseville; e to a point on the prolongation of the southwesterly side of Thirty-second t, 1,800 feet from the southeasterly side of Main street; thence to a point on prolongation of the southwesterly side of Thirtieth street, 1,700 feet from the ieasterly side of Main street; thence to a point on the prolongation of the southerly side of Twenty-seventh street, 1,200 feet from the southeasterly side of street; thence to a point on the prolongation of the northeasterly side of ity-third street, 400 feet from the southeasterly side of Main street; thence to nt on the prolongation of the southwesterly side of Nineteenth street, 200 feet the southeasterly side of Main street; thence to a point on the prolongation of southwesterly side of Fourteenth street, 1,200 feet from the southeasterly side in street; thence parallel to Main street to the prolongation of the northeasterly of Twelfth street; thence to a point on the prolongation of the southwesterly of Eighth street, 500 feet from the southeasterly side of Main street; thence llel to Main street to the prolongation of the northeasterly side of Sixth street; e to a point on the prolongation of the southwesterly side of Second street, feet from the southeasterly side of Main street; thence parallel to Main street e prolongation of the southwesterly side of New Main street in New Roseville; e to a point on the prolongation of the southeasterly side of Water street, 1,200 from the southwesterly side of New Main street, New Roseville; thence to a on a line parallel to New Main street prolonged, and 1,900 feet westerly of its rly side, 220 feet from the southeasterly line of Main street prolonged; thence point on a line parallel to New Main street prolonged, and 2,550 feet westerly westerly side, 380 feet southerly from the southerly side of Main street prod; thence to a point on a line parallel to New Main street prolonged, and 2,700 westerly from its westerly side, 920 feet from the southeasterly side of Main t prolonged; thence to a point on a line parallel to New Main street prolonged, ,930 feet westerly from its westerly side, 1,050 feet from the southeasterly side ain street prolonged; thence to a point 110 feet due east, true meridian, from orner stone of the United States military reservation at La Playa.

CORONADO.

irting from a point on the prolongation of the easterly side of Prospect street, listance of 1,030 feet from the northerly side of Second street; thence to a point ie prolongation of the easterly side of Orange avenue, and 450 feet from the ierly side of First street; thence to a point on the prolongation of the westerly of K street, 250 feet from the northerly line of First street.

SPANISH BIGHT.

r the purpose of describing the bulkhead lines in Spanish Bight a true meridian umed, passing through the U. S. Coast and Geodetic Survey triangulation staon the northeast extremity of Coronado North Island, called "Channel Point," ey of 1887; points being designated by their distances east or west of this line north or south of the parallel of latitude passing through the triangulation sta- "Channel Point." The position of this station as determined by the U. S. t and Geodetic Survey in 1887 is latitude 32° 42′ 38.61″, longitude 117° 11′ 35.55″.

Starting from a point on the prolongation of K street, Coronado, 250 feet from northerly line of First street, thence to a point 3,050 feet south and 1,800 feet e Station "Channel Point;" thence to a point 3,850 feet south, 1,620 feet e said Channel Point; thence to a point 4,000 feet south, 125 feet west of said Ch Point; thence to a point 4,450 feet south, 430 feet west of said Channel I thence to a point 5,330 feet due south of said Channel Point; thence to a point feet south, 1,000 feet west of said Channel Point; thence to a point 8,320 feet 1,250 feet west of said Channel Point; thence to a point 8,150 feet south, 2,7 west of said Channel Point; thence to a point 6,150 feet south, 1,620 feet w said Channel Point; thence to a point 6,000 feet south, 2,275 feet west of said nel Point; thence to a point 4,400 feet south, 1,300 feet west of said Channel thence to a point 3,300 feet south, 570 feet west of said Channel Point; th a point 120 feet due east of said Channel Point; thence in a quadrant of a of 120 feet radius, with the center at said Channel Point, to a point 120 feet du of said Channel Point.

NORTHWESTERLY FRONT OF CORONADO NORTH ISLAND.

All points of the bulkhead and pier-head lines along this front are refe straight lines connecting the triangulation stations on Coronado North known as "Channel Point," "Middle," and "Mud," located by the U. S and Geodetic Survey in 1887. The connecting lines run from Channe to Middle and from Middle to Mud. For convenience of reference the po these lines from which points on the bulkhead and pier-head lines are meas designated by letters of the alphabet, the respective distances apart being lows: From Channel Point to A, 500 feet; A to B, 500 feet; B to C, 500 feet; 500 feet; D to E, 1,000 feet; E to F, 1,000 feet; F to G, 1,000 feet; G to H, 1,(H to I, 1,000 feet; and along the second line from Middle to J, 1,000 feet; 1,000 feet; K to L, 1,000 feet; L to M, 1,000 feet; M to N, 1,000 feet; N to Mud), 1,000 feet; O to P, 500 feet; P to Q, 500 feet; Q to R, 300 feet; R t feet.

The distances of all points of change of direction of the bulkhead and p lines are measured on lines at right angles to said connecting station lines respective points. The bulkhead line may therefore be described as follows

Beginning at a point 120 feet due north of the triangulation station Point, thence to a point 800 feet from A, thence to a point 1,150 feet from B to a point 1,300 feet from C, thence to a point 1,300 feet from D, thence to 1,000 feet from E, thence to a point 730 feet from F, thence to a point 200 fe Middle, thence to a point 200 feet from Middle, with reference to line from through Mud, thence to a point 450 feet from J, thence to a point 600 feet thence to a point 600 feet from L, thence to a point 400 feet from N, the point 500 feet from O, thence to a point 800 feet from P, thence to a point from Q, thence to a point on R on the connecting line Middle through Mud.

PIER-HEAD LINES.

The pier-head lines are laid out in straight stretches, following essentially foot contour, except south of the National City Wharf. It is not possible t this contour exactly. To avoid abrupt changes, and to interfere as little as with tidal currents, some departure from that contour has been made at a few This has had the effect of giving slightly increased or decreased depths points. The ruling depth, however, as adopted by the Board for the pier-h is 24 feet, except south of the National City Wharf, where the ruling depth at 18 feet.

In front of National City.—The approximate distance of the National City pi line from certain fixed points is as follows:

On the prolongation of southerly side of Thirty-first street, 4,600 feet f westerly side of Eighth avenue; on the prolongation of southerly side of T fourth street, 3,650 feet from the westerly side of Eighth avenue; on the pr tion of the southerly side of Nineteenth street, 3,550 feet from the westerly Eighth avenue; at the southwesterly corner of present National City Wharf; prolongation of the southerly side of Ninth street, 3,600 feet from westerly Seventh avenue; on the prolongation of the boundary line between San Di National City, 3,350 feet from its intersection with the easterly line of Q ave

In front of San Diego.—Approximate distances from certain fixed points follows:

On prolongation of northerly side of Rigel street, 2,400 feet from northeaste of Q avenue; on prolongation of southeasterly side of South Twenty-eighth 1,390 feet from northeasterly side of Pierce avenue; on prolongation of nor

f South Twenty-first street, 2,090 feet from northeasterly side of Pierce
1 prolongation of easterly side of Fifth street, 4,180 feet from southerly
street; on prolongation of westerly side of Atlantic street, 1,070 feet from
side of H street; on prolongation of southerly side of C street, 3,740 feet
rly side of Atlantic street; on prolongation of northerly side of Ivy street,
from westerly side of California street; on prolongation of southeasterly
raszthy street, 8,000 feet from southwesterly side of Atlantic street; on
on of southeasterly side of Sutherland street, 8,300 feet from southwest-
f Atlantic street; on prolongation of southeasterly side of Wright street,
from southwesterly side of Atlantic street; on prolongation of southeast-
f Conts street, 9,420 feet from the southeasterly side of Atlantic street.
of Roseville.—Approximate distances from certain fixed points are as fol-

rolongation of the southwesterly side of Fourteenth street, 5,500 from the
rly side of Main street; on the prolongation of the southwesterly side of
t, 4,525 feet from the southeasterly side of Main street; on the prolongation
hwesterly side of Fourth street, 3,950 feet from the southeasterly side of
t; on the prolongation of the southwesterly side of New Main street, New
3,650 feet from the southwesterly side of Main street.
of New Roseville and La Playa to the United States military reservation.—Ap-
distances from certain fixed points are as follows:
parallel to New Main street prolonged and 1,200 feet distant westerly
outhwesterly side, 3,000 feet from the southeasterly side of Water street
; on a line parallel to New Main street prolonged and 2,000 feet westerly
uthwesterly side, 3,200 feet from the southeasterly side of Main street pro-
a line parallel to New Main street prolonged and 3,000 feet westerly from
sterly side, 3,050 feet from the southeasterly side of Main street prolonged;
arallel to New Main street and 4,000 feet westerly from its southwesterly
feet from the southeasterly side of Main street prolonged.
of Coronado.—Approximate distances from certain fixed points are as fol-

rolongation of the southeasterly side of Prospect place, 1,175 feet from the
rly side of Second street; on the prolongation of the southeasterly side
avenue, 650 feet from the northwesterly side of First street; on the pro-
of the northwesterly side of K street, 1,300 feet from the northeasterly side
eet; a point 350 feet due north of triangulation point, Channel Point, on
North Island.
of Coronado North Island.—Approximate distances from the points desig-
scribing the bulkhead line at this place are as follows:
350 feet due north from Channel Point; 1,050 feet from A; 1,500 feet from
et from C; 2,150 feet from D; 2,550 from E; 2,900 feet from F; 3,100 feet
200 feet from H; 3,150 feet from I; 2,950 feet from Middle; 2,800 feet from
h reference to line running through Middle and Mud; 2,920 feet from J;
rom K; 3,100 feet from L; 3,180 feet from M; 2,650 feet from N; 1,800 feet
0 feet from Q; thence to S on the line Middle through Mud.

tfully submitted.

G. H. MENDELL,
Col., Corps of Engineers.
W. H. H. BENYAURD,
Lieut. Col, Corps of Engineers.
W. H. HEUER,
Major, Corps of Engineers.

Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
June 21, 1892.

tfully submitted to the Secretary of War.
rbor line board for San Diego Harbor and adjacent waters,
a, constituted by paragraph 3, Special Orders No. 51, Head-
Corps of Engineers, October 11, 1888, recommends for the
of the Secretary of War harbor lines at National City, San

Diego, Roseville, La Playa, Coronado, Spanish Bight, and Corona North Island, described in the within report and delineated upon t accompanying chart.

It is recommended that the lines selected be approved and that t Secretary place his approval both upon the report and the tracing su mitted.

These lines include the harbor lines established at San Diego a Coronado by the Secretary of War April 2, 1890.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineer

WAR DEPARTMENT, *June 21, 189*

The harbor lines described in the within report and delineated on accompanying tracing are approved.

L. A. GRANT,
Acting Secretary of Wa

APPENDIX S S.

ROVEMENT OF SAN JOAQUIN, MOKELUMNE, SACRAMENTO, AND ATHER RIVERS, PETALUMA CREEK, AND HUMBOLDT HARBOR AND Y, CALIFORNIA.

ORT OF MAJOR W. H. HEUER, CORPS OF ENGINEERS, OFFICER IN ARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892, WITH OTHER CUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

n Joaquin River, California.
okelumne River, California.
cramento and Feather rivers, California.
4. Petaluma Creek, California.
5. Humboldt Harbor and Bay, California.

UNITED STATES ENGINEER OFFICE,
San Francisco, Cal., July 1, 1892.

ENERAL: I have the honor to transmit herewith annual reports of ations on the public works under my charge for the fiscal year ng June 30, 1892. * * *

Very respectfully, your obedient servant,

W. H. HEUER,
Major, Corps of Engineers.

ig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

S S 1.

IMPROVEMENT OF SAN JOAQUIN RIVER, CALIFORNIA.

e project for the improvement of this river was adopted in 1877 slightly modified in 1888. Its object was to secure and maintain by ging a channel 9 feet deep at low water and 100 feet wide through idal portions of the river and Stockton Slough to Stockton; a chan- feet deep at low water and 100 feet wide to Miller's warehouse in mon Slough; the temporary improvement of the low-water channel dredging, scraping, small wing dams, the making of cut-offs to ghten the river, and the closure or partial closure of Paradise Cut Laird Slough.

Up to June 30, 1892, the following appropriations have been made for this river:

August 14, 1876	$20,000	August 5, 1886	$18,750
June 14, 1880	20,000	August 11, 1888	25,000
March 3, 1881	40,000	September 19, 1890	75,000
August 2, 1882	40,000		
July 5, 1884	20,000	Total	258,750

Of this amount up to the present time there has been spent $257,886.69, of which $62,033.08 was spent in the last fiscal year.

Before the improvement of this river was commenced the low-water channel to Stockton was only about 6 feet in depth, while the upper river, above Stockton, was navigable to Hills Ferry for only a few months in the year during the high-water stage, and then only for boats drawing 2 feet or less of water. To-day the work of improvement has given a low-water channel of 9 feet to Stockton and rendered steamboating comparatively easy and safe. It has not, however, lengthened the time of navigation in the upper river.

The commerce of the river is carried on 10 steamboats of from 98 to 880 tons, averaging 462 tons, and drawing from 1½ to 6 feet of water, and on 14 barges of from 160 to 660 tons, averaging 300 tons.

Work on the river and sloughs has been continous whenever funds permitted.

Up to 1888 all the dredging, as well as other work, had been done by contract, and the cost of dredging varied from 46 to 15 cents per cubic yard. In 1888 the Government built a dredge and did the work by hired labor and has done so ever since. This has brought the cost of dredging down to less than 10 cents per cubic yard, and this year it has been less than 7 cents.

At the end of the last fiscal year the dredge was laid up in Stockton Slough.

The river having fallen considerably, the United States dredge was put in order and work resumed in Stockton Slough on October 27, 1891. This was continued until March 9, 1892.

To maintain the required channel to a depth of 9 feet at low water, cuts were made 50 feet wide of an aggregate length of 16,166 feet, and 153,530 cubic yards of material removed. To do this cost $10,526.16, or 6.8 cents per cubic yard.

On March 9, 1892, the river had risen so as to render further dredging unnecessary, and the dredge was shortly afterwards transferred to Lieut. Col. Benyaurd for work in Redwood Creek, California.

On May 15, 1891, a contract had been made with Charles L. Bigelow to build a dam across Laird Slough, in the San Joaquin River, but it was not until August that the river had fallen sufficiently to enable work to be commenced.

The slough is situate about 2 miles above the village of Grayson, quite an important grain-shipping point on the river. The junction of the slough and the river is at a very sharp bend in the latter, and at this locality the slough is fully as wide as the river, about 200 feet, and has a cross-sectional low-water area of about 1,000 square feet. That of the river above the slough is probably 25 per cent greater, while immediately below the upper end of the slough the low-water cross-sectional area was only 320 square feet. It was estimated in August, 1891, just before the dam was commenced, that fully 75 per cent of the river flowed through Laird Slough and reëntered the river by two branches of the slough at 1 and 2 miles, respectively, below the village of Grayson. The banks in this vicinity are apparently of hard pan.

ey are quite flat and generally about 10 feet above low-water level. e rise in flood stages is from 10 to 12 feet, both banks being overwed.

The necessity of closing Laird Slough was first urged in 1888 by the vigation companies, who claimed that unless the flow of water through was checked the crevasse would become the channel of the river and as cut off the town of Grayson as a shipping point altogether.

The contract with Charles L. Bigelow was made on the following basis r unit of material: Piles, at 26 cents per linear foot; driving piles, at .20 each; brush, at 70 cents per cubic yard; sand bags in place, at cents each; sand boxes in place, at $3.60 each.

Work was commenced on August 19, 1891, by driving two parallel ws of piles across the slough; the rows were 10 feet apart; the piles ere 6 feet apart between centers, and each pile was driven as far as acticable into the bottom, generally penetrating about 26 feet in depth. rush was cut, tied up into bundles from 12 to 20 feet in length, each undle being from 12 to 15 inches in diameter. These bundles were then aced across the current between the rows of piling to a height of about feet. This formed a sort of brush mattress, which was sunk to the botom of the stream by means of loaded sand bags. While sinking the lower mattress a considerable scour occurred in the bottom and one flank of he dam. This was checked by throwing in additional brush and bags f sand. When the bottom had thus been protected with brush beween the piles similar mattresses were sunk in contact with the first n both the up and down stream sides of the dam, the banks in the imediate vicinity of the dam were revetted with brush, held down by and in bags, and the work was thus carried on in tiers of brush mats ntil the desired height was obtained. Waling pieces and stringers ere then bolted and spiked to the piles and the crest of the dam was overed with boxes, each 10 feet long by 20 inches wide by 15 inches eep, each divided into 5 separate compartments and filled with sand. he tops were then nailed on and each box was fastened to its neighors by nailed battens. In this manner 9,737 cubic yards of brush, 4,000 sacks of sand, 186 boxes of sand, and 54 piles aggregating 2,259 unning feet entered into the construction of the dam. At its crest he dam is 10 feet deep and 310 feet in length; at its base the thickess is about 60 feet. The crest is 10 feet above low-water stage in he middle and raises gradually 2 feet higher at the bank. The uptream slope of the dam is 1 on 1; the downstream slope is about 1 on . The water on the upstream side of the dam is 3 feet higher than n the lower side. The leakage through the brush is very slight. The ork was completed on September 29, 1891, in forty-one working days, nd cost $11,994.38, of which amount $312.74 is chargeable to engineerng expenses, superintendence, advertising, and contingencies, or about .6 per cent.

The dam was examined on May 29, 1892, when the San Joaquin iver was in flood, about 10 feet above its low-water mark. The river as about bank full and level with the tops of the piles in the dam, nd although the water was pouring over the dam it was perfectly inct and every pile in place. On June 3 or 4, 1892, a breach occurred the east bank of the slough, undermining about 50 linear feet of ore-protection work at the eastern extremity of the dam. This each should be repaired, but as the extent of the damage can not t be determined it is impossible to estimate the cost.

At the end of the last fiscal year contract had been made with John . Ferris for building a dam across the crevasse known as Paradise

Cut, but work had not been commenced. The contract was made at the following prices per unit of material and based on the following assumed quantities:

7,900 feet of piles, at 21 cents per foot	$1,575.00
Driving 155 piles and fastening wales to same, at $4.75	736.25
6,000 cubic yards brush in place, at 67½ cents per cubic yard	4,050.00
10,000 bags of sand in place, at 15 cents each	1,500.00
350 boxes of sand in place, at $3.50 each	1,225.00
1,000 tons of rock in place, at $3.30 per ton	3,300.00
1,000 running feet wale pieces, at 12½ cents per running foot	125.00
	12,511.25

Actual construction was commenced early in August and the dam was finally completed and accepted on November 13, 1891.

The dam is situated within and across Paradise Cut, about 100 feet distant from the left bank of the San Joaquin River, and consists of piles of brush and rock ballast. The piles for the main weir are driven in four parallel rows across the stream; the rows are 10 feet apart, the piles in each row being 6 feet between centers; each pile is driven into the bottom of the cut an average distance of 26 feet. The crest of the weir is 8 feet above low-water level of the San Joaquin River; its length along the crest is 220 feet. On the prolongation of the crest of the weir on both sides of the river are flanks whose crests are 8 feet higher than that of the weir, and whose lengths are 50 and 72 feet, respectively.

These flanks consist of two rows of piles driven into the sloping banks of the cut and on the shore. The rows are 10 feet apart and the piles of each row 6 feet between centers.

Piles were also driven across the bottom and sides of the cut for a distance of 20 feet in front of the dam and 40 feet behind the dam to confine brush mats to the approach and overfall sides of the structure, as well as to protect the banks from washing. When the 322 piles which compose the skeleton of the dam were all driven, a temporary dam 108 feet long of sheet piling was made between the weir and the San Joaquin River and the great mass of water in Paradise Cut was pumped out so as to expose the bottom at the weir site and enable it to be prepared in a suitable manner to receive the brush. Brush (green willow in bundles) was then placed all along the bottom between all piles of the weir, dam, approaches, and overfall, the direction of the axes of the bundles of the brush being always parallel to the crest of the weir. Each bundle, after being placed in position, was cut and packed down as snugly as was practicable, and thus tier after tier of brush was built up until the mattresses of the approach and overfall were 4 feet in vertical height; that between the first and second rows of piles in the weir proper was, at reference, 8 feet; that between the second and third rows was, at reference, 6 feet, and that between the third and fourth rows, at reference, 4 feet above mean low-water level in San Joaquin River. The flanks were filled with brush to reference 16 feet. When the brush was thus placed throughout the dam all piles had wale pieces and caps bolted to them so as to form a series of cribs, and on top of this brush rock, in pieces varying in weight from 300 pounds to 1 ton, was placed until all the rock, aggregating 1,166 gross tons, was in position. This rock compressed the brush very materially, and in places the column of rock was nearly 10 feet in vertical height. No rock was placed in the approaches or overfall apron, the brush therein being held down by waling pieces bolted to the piles themselves.

short earthen levees run along the banks of Paradise Cut, one anks of the dam connects with one levee, and a crib 30 feet long, ith earth, connects the dam with the other levee.

	Feet.
l length of weir is	220
f prolongation of north flank	50
f prolongation of south flank	72
f crib on south bank	30
tal length	372
mat on approach side	20
width of mats on south side of bank	80
f face of south wing	60
from dam to extreme end of north wing	60
f mat at overfall	40

vered with brush on both sides at overfall for a distance of 50 feet.

is in the work the following amount of material: 9,026.46 cubic f brush; 1,166 gross tons of rock; 322 piles, round and square. ment was made for square piles except for driving as they came e old dam; 7,055 linear feet of round piling; 90 posts for secursh in shore protection; 1 crib at end of dam.

mount of money paid to contractor for work done was $11,079.55.

are sent herewith photographs showing both the upper and iew of the dam.

g to compression of the brush and some settlement, it will be le to again raise the crest of the dam to its original height by nd ballast. Estimated to cost $2,000.

uly 6, 1891, contract was made with John W. Ferris to dredge a at Head Reach, a bend in the river about 26 miles below Stock- 11¾ cents per cubic yard, measured in place in the cut. Work nmenced immediately and continued until October 6, when it pped until the banks, which were very soft, had time to dry out tly to bear the weight of additional material. By this time the been carried completely through, a distance of 3,084 feet, with width of 150 feet and depth of 7 feet at low water. To make 210,132 cubic yards of material were excavated and placed on In December, 1891, the banks having dried and hardened, work umed, and on December 29, 1891, the contract was completed, itional 16,800 cubic yards of material having been dredged and shore. The cut, as completed, is 3,084 feet in length, with a dth of 150 feet between banks. The approaches to the cut have of 234 and 215 feet, respectively. The depth is 7 feet at low with an additional cut through the center, 70 feet wide, and 9 low water, making a practical channel 9 feet deep at low water. cut-off is a complete success, and is used by all craft going up wn the river. The total cost of it was $27,234.41. It is prowhen more money is appropriated, to widen and deepen this projected. Estimated cost, $37,750.

ious Annual Reports have recommended a cut-off at Twenty-one ough at a cost of $65,000, but no appropriation has been made purpose. A double cut-off in the narrows in the river just bejunction of Stockton Slough and the San Joaquin River would highly beneficial, as since the improvement of the river larger ger boats have been built, and these with great difficulty make rp bends. In case this cut-off should be made it is recomthat it should have a cross-sectional area about equal to that river in the immediate vicinity. This would give it a width t 150 feet and a uniform depth of 9 feet at low water. This nvolve the removal of approximately 11,700 cubic yards of material at an estimated cost of $20,000. This is exclusive of the purchase of the right of way, and as this cut-off, if made, will be of great benefit to the people living in Stockton, by facilitating the tidal movements of the water in seasons of flood, it is thought that the right of way for the proposed cut should be deeded to the Government free of expense.

Wherever cut-offs have been made they have been self-maintaining.

Annual dredging will be necessary to keep Stockton Slough in a navigable condition; in fact, without it, in a short time, steamboats would be unable to reach Stockton.

While it can not be asserted that any reduction in the rates of freight or insurance have been made in consequence of the improvements, it is probable that if they were discontinued a considerable increase would soon follow. It is certain that the work done has been of the greatest benefit to the navigation of the river generally, and particularly to the city of Stockton.

With any future appropriations, depending on the amounts appropriated and the requirements of commerce, it is proposed to continue work in the following order, unless Congress should otherwise direct:

1. Dredging to maintain 9 feet depth to Stockton	$25,000
2. Repairing dam at Paradise Cut	2,000
3. Making a cut-off at Twenty-one Mile Slough	65,000
4. Making a double cut-off below the mouth of Stockton Slough	20,000
5. Increasing cut at Head Reach, in depth, width, or both	37,750
6. Survey of upper river to Firebaughs Ferry	5,000
7. Snagging and wing dams	10,000
Total	164,750

The above amounts could be advantageously expended in one fiscal year.

Money statement.

July 1, 1891, balance unexpended	$63,002.53
June 30, 1892, amount expended during fiscal year	62,033.08
July 1, 1892, balance unexpended	969.45
Amount appropriated by act approved July 13, 1892	65,000.00
Amount available for fiscal year ending June 30, 1893	65,969.45
Amount (estimated) required for completion of existing project *	
Amount that can be profitably expended in fiscal year ending June 30, 1894	164,750.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

The following statistics of the trade of the San Joaquin River were kindly supplied by Capt. H. J. Corcoran, manager of the California Navigation and Improvement Company, who own most of the steamboats and barges running on the river. A large amount of freight is carried between San Francisco and Stockton in small schooners, and of this it is impossible to get a correct statement:

	Tons.
Wheat	70,000
Lumber	86,000
Coal	45,000
Mill stuffs	69,000
Miscellaneous freight and manufactured products	50,000
Produce	30,000
Pulp, hides, and other raw materials for manufacturing purposes	20,000
Total	370,000
Passengers	56,000

* Indeterminate.

S S 2.

IMPROVEMENT OF MOKELUMNE RIVER, CALIFORNIA.

Before improvement the navigation of this river was difficult and ngerous on account of numerous snags and overhanging trees, and 1884 a project for its improvement was made, having for its object e removal of the snags and trees obstructing navigation. Both forks the river were cleaned out in 1884, 1885, 1886, 1887, and 1888, renderg travel to Bensons Ferry, the head of navigation, easy and safe. is completed the project as outlined, and since then no work of improvement has been done on the river.

The following are the appropriations made for this river:

84, July 5	$8,500
86, August 5	2,500
88, August 11	2,000
Total	13,000

Of this amount $12,457.62 has been expended up to the present time. lothing was spent in the last fiscal year.

Since 1888 snags have reformed, which require removal, and overanging trees have regrown. These should be again cleared out. 'rivate parties have also cut a drainage canal, opening into the river ear New Hope Landing. This has caused a serious bar to form, which akes the landing of boats difficult. The remedy is to compel the losure of the ditch and remove the bar by dredging.

Another obstruction is a point of land jutting out into the channel n the right bank near New Hope Landing. This landing, one of the nost important shipping points on the river, is on the left bank of the iver proper, at the junction of the two forks. From this point a ponoon bridge extends across the south fork of the river, which fork for a nile and a half below this point is not navigable. The river proper and he north fork at New Hope Landing make a junction which is nearly right angle. The point of land referred to, being a tongue between he river and the north fork, is gradually but constantly extending into he fork, increasing the curvature of the bend, and, in consequence of he current, making it very difficult for a boat to make the landing at New Hope. To make the landing easy and safe and give a more direct ntrance for the river into the north fork, this point, which contains bout two-thirds of an acre, should be removed to a depth of 6 feet elow low water.

The estimated cost of the improvements referred to is as follows:

Removing snags and overhanging trees	$2,000
'ile and brush dam to close drainage canal	1,000
Removing sand bar caused by canal, 50,000 cubic yards, at 10 cents	5,000
'utting off point near New Hope Landing, including grubbing and purchase of land	1,100
Total	9,100

All this work could be advantageously done in one fiscal year.

The statistics of trade, furnished by the California Transportation 'ompany, for the Mokelumne River for the year from June 1, 1891, to une 1, 1892, are as follows:

reight ... tons	44,241
assengers	3,669

This commerce is carried on one stern-wheel steamer, the *Constance* (385 tons; draft, light, 2½ feet; loaded, 6 feet), which makes three round trips per week and carries all the freight offered. The effect of the improvements on the rates of freight and insurance is uncertain, but as the rate of freight by river is $1 per ton less than by railway from competing points, a yearly saving is effected on the above statement of freight of $44,241.

Money statement.

July 1, 1891, balance unexpended	$542.38
July 1, 1892, balance unexpended	542.38
Amount appropriated by act approved July 13, 1892	2,500.00
Amount available for fiscal year ending June 30, 1893	3,042.38
Amount (estimated) required for completion of existing project	6,600.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	6,600.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

SS 3.

IMPROVEMENT OF SACRAMENTO AND FEATHER RIVERS, CALIFORNIA.

The Sacramento River is a navigable stream from McIntosh Landing to the mouth of the river, a distance of 230 miles. Formerly it was navigable 45 miles farther upstream, to Red Bluff, but since the railroads have been in operation the boats have not found it commercially profitable to go above McIntosh.

The Feather River is a tributary of the Sacramento, entering that river about 16 miles above the city of Sacramento. It is a navigable stream up to its junction with the Yuba River, at the town of Marysville, a distance of 30 miles.

Before improvement navigation in these rivers was dangerous, on account of numerous bad snags, shallow bars, and rapids, and in 1874 a project for improvement was made and approved. It had for its object the temporary improvement of the low-water channel, by removing snags, building wing dams, and scraping bars. Work on this project has been continuous ever since whenever funds were available.

The following appropriations have been made for these rivers:

1875, March 3	$15,000	1884, July 5	$40,000
1878, June 18	15,000	1888, August 11	20,000
1879, March 3	20,000	1890, September 19	30,000
1880, June 14	45,000		
1881, March 3	60,000	Total	495,000
1882, August 2	250,000		

There has been expended up to the present time $481,680.99, of which $12,846.44 was expended during the last fiscal year.

At the commencement of the present fiscal year the snag boat *Seizer* was at work in the Upper Sacramento River and continued until September 11, 1891, when she was again laid up at Sacramento. During the season's work, which lasted ninety-one days, she removed and destroyed 974 snags, built 5 wing dams in the shallows below Placer City, aggregating 536 feet in length, and ran 914 miles. She consumed during the work 89½ tons of coal.

The cost of the work was $10,719.54.

This left the river in good condition to the head of navigation, and amboating was uninterrupted.

In June 1892, the river having again fallen, numerous snags brought wn by the winter floods began to show themselves. The snag boat ser was accordingly again put in commission and sent to the upper er, where she is now at work.

The snagging during the present fiscal year has been under the arge of Assistant Engineer H. L. Demeritt, C. E., and the work has n satisfactorily and well done.

The commerce of the Sacramento River is carried on 8 steamers, 14 ain barges, and 7 brick barges belonging to the Sacramento Transtation Company; 5 steamers and 7 barges belonging to the California Transportation Company; and 2 steamers belonging to the Southern cific Company. The steamers vary in size from 183 to 619 tons, eraging 303 tons, and the barges from 115 to 800 tons, averaging 581 ns. The larger of the steamers only go a short distance up the river, commerce of the Upper Sacramento being carried on barges towed small, light-draft steamboats.

On the Feather River a small steamer, 247 tons gross tonnage, benging to the Southern Pacific Company, makes one round trip per ek, with a barge, and carries all the freight that offers.

The snagging heretofore done had been of great benefit to navigan; without it, in fact, steamboating in the upper Sacramento River uld be impossible. Freight and insurance rates have been greatly luced in consequence, and navigation is now safe.

At present all that has been attempted in these rivers is the tempoy improvement of the low-water channels, and Congress by its appriations has contemplated nothing more. To even continue this, nual snagging must be carried on or traffic in the upper Sacramento l be stopped.

The river and harbor act of September, 1890, provided for a Board Engineers to examine and report on the Sacramento and Feather ers, with a view to their future improvement. Their report has been nted as House Ex. Doc. No. 246, Fifty-first Congress, second sesn,* and contains information as to the condition and requirements these rivers, to which attention is respectfully invited.

The following appropriations are recommended therein:

1) A specific yearly appropriation of $25,000 for snagging, building ng dams, etc., by means of the snag boat and crew, above the city of cramento.

2) A specific appropriation of $275,000 for removal of obstructions the lower Sacramento River, and $25,000 for the closure of Jacobs ugh, on the east bank of the river, above the city of Sacramento.

3) A specific appropriation of $300,000 for treatment of the Yuba ver, near and above Marysville.

4) A specific annual appropriation of $20,000 for improving the navible channel of the Feather River.

Of these amounts the whole of items Nos. 1, 2, and 4, and $100,000 item 3, making a total of $420,000, can be advantageously expended ring the fiscal year ending June 30, 1894.

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*Printed also in Annual Report, Chief of Engineers, 1891, page 2990.

Money statement.

July 1, 1891, balance unexpended	$26,165.[illegible]
June 30, 1892, amount expended during fiscal year	12,846.[illegible]
July 1, 1892, balance unexpended	13,319.[illegible]
July 1, 1892, outstanding liabilities	350.00
July 1, 1892, balance available	12,969.[illegible]
Amount appropriated by act approved July 13, 1892	150,000.00
Amount available for fiscal year ending June 30, 1893	162,969.[illegible]
Amount (estimated) required for completion of existing project*	
Amount that can be profitably expended in fiscal year ending June 30, 1894	420,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

The following is a return of the freight carried on the Sacramento River by the California Transportation Company during the year from June 1, 1891, to June 1, 1892, kindly furnished by the company. Their boats only run as far as Clarksburg, about 35 miles above the mouth of the river:

	Tons.
Merchandise, fruit, produce, etc	86,347
Lumber	19,000
Total	105,347
Passengers	14,455

The following is the amount of freight carried by the steamers of the Southern Pacific Company between San Francisco and Sacramento, including all way-freight, kindly furnished by Mr. E. C. Wright, general auditor of the company:

	Tons.
Freight taken north	60,424
Freight taken south	61,343
Total	121,767

The following is the amount of freight carried by the boats and barges of the Sacramento Transportation Company, kindly furnished by the president of the company:

On the lower Sacramento River:

		Tons.
Wheat and other grain brought from the upper river for Port Costa and San Francisco		102,040
Wood brought from upper river for San Francisco		11,250
Merchandise brought from San Francisco to be taken to upper river		11,440
Lumber brought from San Francisco to be taken to upper river		4,000
		128,730
	Tons.	
Merchandise between San Francisco and Sacramento	20,000	
Coal, San Francisco to Sacramento	12,000	
Lumber, San Francisco to Sacramento	13,000	
Brick, Sacramento to San Francisco	50,000	
		95,00[illegible]
Total carried on lower river		223,73[illegible]

* Indeterminate.

Ipper Sacramento River:

at, down river	102,040
d, down river	11,250
:handise, up river	11,440
iber, up river	4,000
tal carried on upper river	128,730
nage of Lower Sacramento River for year	450,840
nnage of Upper Sacramento for year	128,730

llowing is the freight carried on the Feather River during the year, kindly d by Mr. E. C. Wright, General Auditor of the Southern Pacific Company, e boat the freight was carried:

	Tons.
taken north	3,911
taken south	13,030
tal	16,941

s the total tonnage of the Feather River for the year.

S S 4.

IMPROVEMENT OF PETULUMA CREEK, CALIFORNIA.

project for the improvement of this creek was made in 1880. Its was to straighten the channel by cut-offs, and to obtain, by ng, a channel 50 feet wide and 3 feet deep at low water, up to n of Petaluma. Up to the present time $36,000 have been ap-ted for the improvement of this creek, of which amount $35,892.95 n spent in completing the project, leaving a balance yet on hand '.05.

following appropriations have been made for this work:

ne 14	$8,000
rch 3	8,000
gust 3	14,000
gust 11	2,000
tember 19	4,000
tal	36,000

:e improvement the channel was very crooked, and in places bare water. Dredging was done by contract in 1880 and 1881, at 29 nd 45 cents per cubic yard; 21,135 cubic yards of material were d from cut-offs and from channel. In 1882 and 1883 25,290 cubic f material were dredged at 25½ cents, and in 1883 and 1884 43,267 'ards were dredged, completing the project. The estimate for ting the project was $25,868; the actual cost of completing the was $27,656.91.

88 the channel refilled and was again redredged at a cost of 25 er cubic yard, or $2,116.39. This gave a channel about 40 feet nd 1 foot deep at low water and partially relieved the immediate of navigation. The channel again deteriorated and in 1891, urther funds became available, a contract was made for redredg-hannel at 15 cents per cubic yard.

his last contract work was commenced in August, 1891; the re-is a completed channel 6,800 feet long and 40 to 45 feet in Of this length 4,200 feet was excavated to a depth of 3 feet the lowest low water, while the other 2,600 feet was dug to a of 28 to 30 inches below the same plane. Much of the dredging hard-pan.

[illegible] appropriation was insufficient to complete the whole work t[illegible] th[illegible] water depth. The excavated channel extends from the railro[illegible] b[illegible] below the town up to the steamboat wharf in the town. Sin[illegible] the [illegible]nnel was completed there has been no detention therein of boa[illegible] on account of lack of water. The cost of this last piece of work wa[illegible] $5,846.36, and 37,025 cubic yards of material were removed from th[illegible] channel. Experience has proved that this channel is not self-mai[illegible]taining, and navigation can only be kept up by occasional dredgin[illegible] Nearly all the drainage of the creek flows over highly cultivated agr[illegible]cultural land, in consequence of which deposits are large. The cree[illegible] carries a very large commerce, as can be seen by the statistics her[illegible]with, and is sufficiently large to warrant the securing of a channel 4[illegible] 5 feet deep at low water, to obtain which it is estimated will cost abo[illegible] $30,000. As this channel will not be self-maintaining it will have [illegible] be redredged about once in every five years at an estimated cost [illegible] $5,000.

The commerce of the creek is carried on one stern-wheel steamer, t[illegible] *Gold*, of about 294 tons, which makes six round trips per week, a[illegible] many small schooners which carry the heavier freight.

Money statement.

July 1, 1891, balance unexpended	$5,8[illegible]
June 30, 1892, amount expended during fiscal year	5,8[illegible]
July 1, 1892, balance unexpended	[illegible]
Amount appropriated by act approved July 13, 1892	10,0[illegible]
Amount available for fiscal year ending June 30, 1893	10,[illegible]
Amount (estimated) required for completion of existing project*	
Amount that can be profitably expended in fiscal year ending June 30, 1894	30,[illegible]

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The following statistics of the trade of Petaluma Creek are taken from a[illegible] of a committee appointed by the board of trustees of the city of Petaluma [illegible] purpose of collecting such statistics, and kindly furnished by them:

	Tons.		
Grain	24,000	Lumber	[illegible]
Coal	2,272	Mill stuff	[illegible]
Merchandise	25,845	Live stock	[illegible]
Produce	28,606		
Cannery products	6,348	Total	[illegible]
Iron	100		

Passengers, 6,460.

S S 5.

IMPROVEMENT OF HUMBOLDT HARBOR AND BAY, CALIFORN[illegible]

The project for this improvement was adopted in 1881, and ha[illegible] its object the securing of a channel 13 feet deep and 200 feet w[illegible] the head of Eureka wharves, and one 10 feet deep and 100 feet w[illegible] Arcata and Hookton. This portion of the project was comple[illegible]

* Indeterminate.

at a cost of $96,061.55. These channels have since deteriorated what, but not sufficiently to impede navigation.
1882 an additional project was made, contemplating the increase pth over the bar at the entrance to the harbor by means of a stone built up to low water and extending seaward from the south spit distance of 6,000 feet. The estimated cost of this was $600,000. tober, 1890, a Board of Engineer Officers, appointed to consider this , advised the modification and increase of this project to embrace tone and brush jetties starting from the shores of the north and spits and extending seaward to the 18-feet curve. The estimated f the two jetties was $1,957,615. This project was adopted. Ap- iations for improving the entrance aggregating $342,000 were in the years 1884, 1886, 1888, and 1890; but as the amount for ne year was too small to warrant commencement of work, and, ver, by a clause in the act money was not available until title to on the south spit was acquired free of expense to the Government, ng was done until 1888, when the land required was obtained and tract let to the American Bridge and Building Company for work e south jetty. Under this contract, which as extended expired er 31, 1890, 1,605 feet of shore track, 1,152 linear feet of protec- work, and 2,767.6 linear feet of pier over water were built; from atter 14,669 cubic yards of brush mattress, weighted with 44,943.5 of stone, were placed, building the jetty out 2,767.6 feet and rais- t to the level of high water for 900 feet of that distance. In May, operations were commenced under a contract made with Messrs. son & Brown in the preceding February, and work was vigor- prosecuted until the expiration of the contract in December, 1891. June 30, 1891, the contractors had delivered in the south jetty tons of stone, which were used in raising that jetty to a high- plane out from 900 feet reference to 1,800 feet. Early in May rosion of the north spit caused the widening of the entrance from to 5,600 feet, the forming of a shoal in the north channel, and be- so serious that it was determined to transfer operations to that , and in June the contractor prepared to commence work by build- wharf and approaches, laying shore track, and driving piles needed e construction of the jetty. All this was ready by the commence- of the present fiscal year.

rth Spit.—In July it was found that a succession of high tides heavy seas caused an erosion of the bank in the vicinity of the f the shore track making its protection necessary. This was done ilding 300 linear feet of protection work requiring 252.24 cubic of brush mattress and 150 tons of stone. Work was begun on the proper and continued until September, when a spur raised to high- level had been run out 1,480.5 feet in a southerly direction; this sted of a trestle and track, from which brush mats weighted with were sunk. This was found to be sufficient to arrest the erosion ause the North Spit to reform, as the sand on the seaward side deposited to the top of the stone in one tide after dumping. In ruction of this jetty it was found practicable, owing to the de ed action of the waves, to use two brush mattresses, one sunk on f the other, and thereby lessen the amount of stone. This effected ing of 6 tons of stone per running foot.

th Spit.—The operations here were confined to raising the jetty dy built to 6 feet above low water, and in building an extension 600 feet. Progress was slow until after the north jetty was d for the season, about the 15th of September, when operations were vigorously pushed to the end. This jetty is now 3,699.2 feet in length, of which 3,200 feet is completed up to high-water level. The outer portion slopes from high-water level for a length of 499.2 feet to a depth of 7 feet below low water. During the construction of the extension a scour commenced off the end of the trestle, and at one time the depth was 28 to 30 feet, necessitating the use of piles 60 feet in length. Fears were entertained that this scour might continue and make the further prosecution of the work very expensive, but this proved to be unfounded, as the conditions shortly afterwards changed, and the water again shoaled as the work proceeded.

The following is the amount of the different items delivered into the jetties during the fiscal year, at a cost of $156,413.68:

		North jetty.	South jetty.
Track way on shore	feet	1,488	
Trestle and track over water	do	1,480	69.1
Brush mattress	cubic yards	8,777.19	4,73[illegible]
Stone	tons	15,930	30,7[illegible]

One spur and wharf on North Spit.

The above work being finished by October 31, and being the amount contemplated in the contract, operations were stopped and will not be resumed until a fresh appropriation is available, as the amount of funds on hand, $28,122.77, are not sufficient to warrant entering into a new contract.

As the south jetty is not yet extended to half the estimated distance, and the north one only commenced, it is hardly to be expected that very material results as to increased depth over the bar would be produced, yet as an indication in that direction the fact is noted that for the past year there has been a channel of 18 to 20 feet depth maintained, a condition never before known for so long a period in the history of this work.

Three tracings are sent herewith showing the progress of the work.

With the funds now on hand and any further appropriations that may be made it is proposed to continue the construction of both jetties, extending them out to the 18 foot-curve, a distance of 7,800 feet and 6,750 feet for the south and north respectively. The total cost of this work, less the amount already appropriated, is estimated to be $1,715,115, of which amount $700,000 can be used to advantage in the next fiscal year, it being cheaper to prosecute the work with all possible dispatch. Owing to the ravages of the teredo the life of the piles supporting the trestle can not be expected to exceed three or four years, and further, any contractor bidding on this work calculates so as to reimburse himself for the outlay in his plant, costing $40,000 to $50,000 in every contract, it is therefore manifestly cheaper to the Government to complete the work as soon as possible.

The following appropriations have been made for the improvement of Humboldt Harbor and Bay, California:

March 3, 1881	$40,000
August 2, 1882	40,000
Since estimates for training wall were made:	
July 5, 1884	62,500
August 5, 1886	75,000
August 11, 1888	125,000
September 19, 1890	80,000
Total	422,500

Money statement.

l, 1891, balance expended	$184, 525. 45
30, 1892, amount unexpended during fiscal year	156, 412. 68
l, 1892, balance unexpended	28, 112. 77
ınt appropriated by act approved July 13, 1892	150, 000. 00
ınt available for fiscal year ending June 30, 1893	178, 112. 77
ount (estimated) required for completion of existing project	1, 565, 115. 00
ount that can be profitably expended in fiscal year ending June 0, 1894	522, 000. 00

ɔmitted in compliance with requirements of sections 2 of river and arbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

ı following statistics of trade of Humboldt Bay, from June 1, 1891, to June 1, are approximate calculations taken from information kindly furnished by the ;ary of the Humboldt board of trade at Eureka, Cal.:

ıer of departures, steam vessels	291
ıer of departures, sailing vessels	442
Total	733
rts:	Tons.
umber	304, 329
roduce	17, 508
lerchandise	648
ive stock	408
Total	322, 893

the above lumber 17,132 tons, valued at $155,287.10, were shipped direct to for- ports, and 7,424 tons, valued at $89,546, were sent to San Francisco to be re- ed from there to foreign ports on vessels of too deep a draft to enter Humboldt

gn imports, direct:	
'oal ...tons	2, 155
ıger traffic:	
ırrivals	6, 875
)epartures	5, 821
Total	12, 696

ə following is a statement of the freight carried by the steamer *North Fork*, ng regular trips between San Francisco and Humboldt Bay, during the year June 1, 1891, to June 1, 1892, kindly supplied by Capt. Charles Nelson, the ; of the steamer:

'rancisco to Humboldt Bay:	Tons.
leneral merchandise	5, 127
boldt Bay to San Francisco:	
leneral merchandise	382
,umber	12, 760
hingles	3, 720
hakes	2, 610
Total	24, 599
ıgers:	
an Francisco to Eureka	524
;ureka to San Francisco	707
Total	1, 231

ring is a statement of the freight, passengers, and treasure carried by fic Coast *Steamship* Company, making one round trip per week

APPENDIX T T.

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN OREGON AND WASHINGTON.

REPORT OF CAPTAIN THOMAS W. SYMONS, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Coquille River, Oregon.
2. Entrance to Coos Bay, Oregon.
3. Umpqua River, Oregon.
4. Mouth of Siuslaw River, Oregon.
5. Entrance to Yaquina Bay, Oregon.
6. Tillamook Bay and Bar, Oregon.
7. Entrance to harbor at Nehalem Bay, Oregon.
8. Upper Columbia and Snake rivers, Oregon and Washington.
9. Columbia River between head of Rock Island Rapids and foot of Priest Rapids, Washington.
10. Chehalis River, Washington.
11. Skagit, Stillaguamish, Nooksack, Snohomish, and Snoqualmie rivers, Washington.

EXAMINATIONS AND SURVEYS.

12. Olympia Harbor, Washington.
13. Tillamook Bay and Bar, Oregon.
14. Swinomish Slough, Washington.
15. Ship canal to connect Lakes Union, Washington, and Samamish with Puget Sound, Washington.

HARBOR LINES.

16. Establishment of harbor lines in Olympia Harbor, Vancouver Harbor, and Bellingham Bay, Washington.

UNITED STATES ENGINEER OFFICE,
Portland, Oregon, July 12, 1892.

GENERAL: I have the honor to forward herewith annual reports * * * for the fiscal year ending June 30, 1892, for the following works of improvement of rivers and harbors under my charge.

* * * * * * *

Very respectfully, your obedient servant,

THOMAS W. SYMONS,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

Y Y 2.

IMPROVEMENT OF COQUILLE RIVER, OREGON.

Description of original condition.—At the time the work of improve ment was begun the entrance to the Coquille River was considere very dangerous. It was by a long, tortuous, and narrow channel, skirt ing the south headland, studded with rocks from beyond the bar o the outside to a distance of one-half mile inside. The depth at lo water was only about 3 feet, and the position of the bar channel wa constantly shifting. The channel sometimes, at long intervals apar broke through the north spit and ran directly out to sea just south o Rackliffe Rock, but did not remain long in this position. The entranc at such times was comparatively safe and the channel was at its ver best. The mean rise of tide was 4.1 feet.

Plan of improvement.—The plan of the improvement is to constru two parallel high-tide stone jetties, 600 feet apart, running out to se a sufficient distance to open and maintain a channel over the bar wi a least depth of 8 feet at low water, the north jetty starting from Rac liffe Rock and the south jetty from a point on the left bank inside th entrance. The cost of this work, as estimated in 1878 by Major J. M Wilson, is $[illegible]. The law of August 11, 1888, authorized in add tion $5,000 to be expended for snagging between Coquille City an Myrtle Point.

The law of September 19, 1890, authorized an amount not to exce $5,000 to be used in snagging.

Under date of May 8, 1891, the plan of improvement was chang to provide for an entrance width of 600 feet instead of 800 feet.

A careful estimate of the cost of completing the works at the entran to the Coquille in accordance with the plan of improvement give above has been made, and it is found to be $180,000. The correspond ence on this subject is given under the head of "Recommendations an remarks."

The approved estimate of the cost of completing the work is $180,00

APPROPRIATIONS.

Act of—

July 14, 1880	$10,00
August 2, 1882	10,00
July 5, 1884	10,00
August 5, 1886	20,00
August 11, 1888	25,00
September 19, 1890	30,00
Total	105,00

Amount expended to June 30, 1891.—The amount which had bee expended on the project for the improvement of the mouth of th Coquille to June 30, 1891, was $77,012.61, and the amount expended fo snagging was $6,883.90, a total of $83,896.51.

Results obtained to June 30, 1891.—The entrance has for considerabl periods been straight and with a depth of from 8 to 10 feet at lo water, but winds and currents have at other times heaped the movabl sands into the channel, causing the waters to spread out over a wid angle, or the channel to break away to the northward, shallow in dept and bad in direction. A study of the various changes at the mouth o the Coquille led to the belief that the best results could not be attaine unless the channel was kept from breaking away to the north and th n sands were kept from encroaching on the channel. It was 'e decided to use the present appropriation in building the north provided in the project.

ɔing this it is hoped and expected that the periods when the e is good can be materially prolonged.

'vey of the entrance to the Coquille was made in September, Mr. John R. Savage, assistant engineer.

survey shows a governing depth on the bar of 4 feet at low water. verning depth is constantly varying from this minimum to a f 10 feet at low water. The function of the jetties is to prolong iods of greater depth as much as possible.

int expended during fiscal year ending June 30, 1892.—The amount ed during the fiscal year ending June 30, 1892, was $18,403.47.

'ts obtained to June 30, 1892.—The results obtained at the river e over the condition a year ago have not been of a marked na- The construction of the north jetty has helped to concentrate rents upon the bar, and at times a good depth of 8 to 10 feet at ter has been prevalent. Ocean swells, however, soon occur and out the sands and bring the return of the ordinary bar depth 7 feet.

rt of operations for year ending June 30, 1892.—The snagging one during the previous fiscal year on the upper river between e City and Myrtle Point has been productive of very good re- much better than was anticipated. The removal of the snags ibled the currents to scour away the accumulated débris at the shoals, and this has enabled boats to run on the river continu- uring the autumn, winter, and spring just passed.

experience gained leads to the hope that if the river channel be oroughly cleared out, a good permanent navigable channel will

ie beginning of the fiscal year work was in progress extending th jetty tramway and connecting it with Parker's Wharf and in ıg the Fahey Quarry near Randolph. At this time the tramway 2 feet long.

he required plant and materials were brought over from the ide, and in September, connection was finally made with Parker's by means of the tramway built across the sandy uplands on the side of the entrance. Parker's Wharf has been materially hened and enlarged, and a building over the hoisting machinery ilt.

he quarry, fender piles were driven for convenience of landing ıoisting engine and derrick put into operation. During Sep- , 428.10 cubic yards of stone were quarried and moved to posi- the jetty.

ng October, 830 cubic yards of stone were added to the jetty and November 244.32 cubic yards of stone were added.

small buildings were erected, one for sheltering the locomotive e for the pile-driving machinery.

ember 18, 1891, funds being practically exhausted, all work ceased e machinery was housed. From that date to the end of the fiscal o more active work was done upon the project. The matter of extension of the work was studied and the country was explored etter quarry, as the Fahey Quarry turned out to be very poor.

umber of photographic views were taken of the Coquille work, of which were sent to the World's Fair.

mmendations and remarks.—A careful consideration of the condition of the work at the mouth of the Coquille led me to write the following letter:

UNITED STATES ENGINEER OFFICE,
Portland, Oregon, February 8, 1892.

GENERAL: I have the honor to forward herewith a blue print exhibiting the latest survey of the Coquille River entrance, which shows the extent of the jetties at the present time.

This work has been done in practical conformity with the project of Maj. J. M. Wilson in 1878, at which time the cost of the completed work was estimated at $164,200.

The following are the appropriations which have been made for the work:

1880	$10,000
1882	10,000
1884	10,000
1886	20,000
1888	25,000
1890	30,000
Total	105,000

Of this amount $6,884 was expended in snagging on the Upper Coquille River, and there remains on hand at present, exclusive of outstanding liabilities, $3,700. There has been expended on the project up to the present time $94,416.

The work which has been done has been productive of great benefit, not so much by deepening the bar channel as by changing its direction from a southerly and variable course among the rocks shown on the plot to a more direct and more permanent course out to sea.

But the portions of the jetties shown on the plot are not completed in a satisfactory manner to be left with the assurance that they will be permanent.

There has never been a sufficient amount of money on hand at any one time to procure a plant suited to carry on the work properly and economically, and the design of the work and the method of carrying it on varies materially from those designs and methods which have been so successful and economical in other places where more money has been available.

I send herewith a series of photographs, which exhibit the improvements, at present existing, and their construction. The jetties are double rows of piles driven close together and surmounted by longitudinal and cross caps of heavy sawed timber. Upon these there is a single-track railway, upon which runs the revolving pile driver, and upon which are taken out the piles, rock, etc. The space between the rows of piles is filled with rock up to high water, and rock is to be dumped along the foot of the piles to give the necessary security when the piles shall be destroyed.

Photographs 167, 180, and 181 exhibit the condition of the south jetty. The outer portion of the pile tramway is in fair condition. The inner portion, built ten or twelve years ago, is nearly destroyed. The enrockment along the lagoon (the site of the old channel) has settled to about low water, and it is entirely within the realms of possibility that unless this portion of the jetty is strengthened the river may cut through this old channel. Before the work can be considered as completed this south jetty should be materially strengthened. The north jetty will require much more rock before it is finally completed.

I have made the following estimate for the permanent and thorough completion of the existing jetties, as follows:

South jetty:	
Repairs to tramway, 1,920 feet, at $2.50 per foot	$4,800
Enrockment of south jetty, 1,920 feet, at $12 per foot	23,040
Enrockment of north jetty, 530 feet, at $12 per foot	6,360
Total	34,200

Jetty extension.—The project for the improvement of the Coquille Entrance is rather indefinite as regards the length to be given the jetties. Maj. Wilson's project was for the jetties to be extended out to a depth of 12 feet in order to get a 12 foot channel over the bar. It was subsequently changed on the recommendation of Capt. Powell to an extension capable of giving a depth of 8 feet in the bar channel, he believing that this is the most that can reasonably be expected. To reach a depth of 8 feet, according to the present survey, will require an extension of the south jetty of 740 feet and an extension of the north jetty of 1,067 feet.

I have estimated that the extension of the south jetty will cost $51,090.75 and the extension of the north jetty $78,998.40.

The total estimate for the completed project, in the light of past experience, is, therefore:

Completion of existing jetties	$34,200.00
Extension of south jetty, 740 feet	51,090.75
Extension of north jetty, 1,067 feet	78,998.40
	164,289.15
Add 10 per cent for contingencies	16,428.91
	180,718.06

In round numbers, $180,000 will be required to complete the project by extending the jetties to a depth of 8 feet at low water. The existing bar channel, shown by the survey of 1891, has a governing low-water depth of 4 feet. At times this has been increased to 8 and 10 feet.

The discrepancy between my estimate of cost and that of Maj. Wilson is due primarily to the fact that at the time the latter was made but little was known of the cost of doing work along the Oregon coast, and experience had not determined the strength and solidity required to withstand the storms of this section.

Also, there has never been an adequate amount of money to carry on the work economically, and the desire to produce beneficial results has caused the works to be extended to a greater extent than they could be fully completed, and from this has arisen the necessity for going over the work twice and three times at a large increase over what it would have cost if it had been fully and substantially completed as it progressed.

It is designed, if more money is appropriated for this project, to make a change in the plan of the work by adopting jetties more in conformity to those at Coos Bay and Yaquina Bay; that is, to build a tramway with pile bents 15 feet apart, and a jetty of brush and stone, instead of a close pile tramway with stone enrockment.

It is recommended that the estimates for the Coquille River be corrected to correspond with the figures above given.

Very respectfully, your obedient servant,

T. W. SYMONS,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

The recommendations contained in this letter were approved by the division engineer and yourself, and will be the guide in future operations.

The amounts of money appropriated for this work have always been inadequate and have resulted in greatly increasing the cost of the work.

The least appropriation which should be made for the work is $50,000, the sum recommended.

Future operations.—It is proposed to expend any future appropriation, first, in strengthening the present north and south jetties, and, second, in extending them. To this end it will be necessary to procure another quarry, and it will probably be found best to buy or build two or three scows for transportation of rock and brush.

Report of Capt. R. S. Littlefield, in charge of the work at the Coquille, is herewith.

Money statement.

July 1, 1891, balance unexpended	$21,103.49
June 30, 1892, amount expended during fiscal year	18,403.47
July 1, 1892, balance unexpended	2,700.02
July 1, 1892, outstanding liabilities	110.00
July 1, 1892, balance available	2,590.02
[illegible]ount appropriated by act approved July 13, 1892	25,000.00
Amount available for fiscal year ending June 30, 1893	27,590.02
[illegible] required for completion of existing project	155,000.00
[illegible]ofitably expended in fiscal year ending June 30, 1894	50,000.00

[illegible]nce with requirements of sections 2 of river and [illegible]nd 1867.

the sea beach.

During the winter months, including March, 1891, a smal constructing twelve side-dump cars of the Yaquina pattern months, April, May, and June, the Government pile-driver jetty on the south side of the river to the north shore by high tide, which necessitated the building of 705 feet of trac including track to land the driver, and to transport the sam the new jetty.

A small submerged crib was sunk at the end of an incline into the river; so that piles could be floated onto a car truc ing and thence be taken over the tramway 525 feet in length jetty. This tramway had been the route for transporting t spit.

During the three months above named the jetty was built driving and framing, a length seaward of 373 feet; 780 feet c lagoon on the south side, which formed the harbor for the t of the locomotive, rails, coal, and hoisting engine for the merly used, which latter was applied to the construction of roadway across the north spit mentioned above. Also, during 1891, a tramway for transporting the stone from the Parker with the inshore end of the jetty, a distance of over 3,600 rails partly laid. A considerable amount of stripping was do the prospective stone supply at Randolph, 6 miles up the ri

Three rocks in a cluster near mid-channel just inside the with 600 pounds of No. 1 giant powder, and the depth ov from 2 feet to 9 feet at low water.

The work from July to November, 1891, when the operat the transfer, as needed, of the remaining parts of the plant south to the north shore of the river, the laying of the balan way, 3,786 feet in length, connecting the jetty with Parker's of this wharf to double its former size; the building of a transferring the stone from the barges to the cars; the buil Randolph Quarry for loading the barges, for which derrick a purchased, and the extension of the jetty 137 feet, including a breach made by the sea. The total length of the jetty bui is 510 feet.

For the whole work 771 piles were used on jetty constructio and 11 piles for a small wharf at the Randolph Quarry. Th after reaching open ocean water, were 36 feet in length. L 30 feet, were used on the beach approach, Rackliffe Rock to

The penetration of the piles, when the sea was reached, s their points struck a layer of gravel bowlders, and generally a to a greater depth than the average stated, which, however, ran parallel to the south jetty and 100 to 150 feet north of the same. Throughout year, except during parts of December, January, and February, the channel had d depths for the class of vessels employed in this trade, for which light-draft ooners are used. From the record of least soundings, as taken by the bar tug *Tri-h* in sounding the bar, the channel over the same shows 6 to 7 or more feet at low er, giving at ordinary high tide 10 to 12 feet as least depths, while the usual draft, ded, of the vessels trading from here ranges from 8 to 9½ feet. It may be stated his connection that except when the bar is smooth no craft should draw within et of the least depth on the same, for, unlike lake harbor bars, or even those on Atlantic coast, the seas on these Pacific bars, when rough, cause an abnormal pitch- of the vessel, with the resultant effect of striking heavily on the bottom if the is shoal.

hile the bar was in bad condition during the months named above, the southwest s, accompanied by heavy rains, were prevalent. These heavy rains kept the r at a freshet stage, which caused the deposit, no doubt, of some of the detritus ied in suspension by the river. At any rate the conclusion has been arrived at hose engaged in commerce here that the immediate effect of a freshet is to shoal bar, a conclusion contrary to the opinions formerly held upon this subject.

he long continuance of a full, and in consequence a rapid stream, during this on, resulted in benefit to the upper part of the river, *i. e.*, the reach between Co-le City and Myrtle Point. The steamboats plied with more regularity between se two places than for years, and the strong, steady current shortened up the three r bars obstructing navigation for a mile or so below Myrtle Point, which is the d of navigation.

he end of the south jetty, built in 1877, was disrupted by the seas and drift trees uch an extent that by March the bulkhead piles at the extreme end and 14 feet the jetty piling were carried away.

he Coquille is exceptional to all other rivers of the coast in the amount of drift, sisting of whole trees and logs, brought down and deposited on the beaches out- e the entrance. To the south of the south jetty the high-tide line receded fully feet by a "panning down" process resulting from the heavy seas during storms; low-water line moved back correspondingly.

uring the year there were built: near the north jetty, a tool house; at Randolph, uarry engine house; on Parker's Wharf, a shed over the hoisting engine, a house tore the locomotive in, and another for the protection of the pile-driving ma-nery.

or building the jetty tramway, wharves, houses above-mentioned, etc., 93,521 of new lumber was purchased and expended, and in addition there was used e a quantity from the old tracks torn down on the south side.

he bulk of the steel rails used were on hand from a former appropriation.

here were quarried 1,501 cubic yards of stone and dumped in the jetty near the and on both sides for nearly its full length, as riprapping.

he north jetty stands without injury, and, for the greater part of its length, sand drift equal its height, or, in other words, the deposit formed is 17 feet above n low water.

here are two rocks whose removal by blasting I would recommend; one just above town of Bandon on the right-hand side of the river, and the other on the left-d side opposite Randolph Slough, where the steamboats turn in making a land-at Randolph.

oth of these rocks are submerged, except at extreme low water, and are danger- to navigation, being in or near the channel.

good sized twin screw coasting steamer, the *Homer*, was built at Bandon during present fiscal year. Tonnage, gross 433; net 330; length over all, 153 feet; m, 32 feet 8 inches; depth of hold, 10 feet.

r. Adam Pershbaker has under construction at his mill a schooner for the Co-le trade, designed to carry 300,000 feet, B. M., of lumber.

espectfully submitted.

R. S. LITTLEFIELD.

apt. T. W. SYMONS,
Corps of Engineers, U. S. A.,
Through Mr. J. S. Polhemus, U. S. Assistant Engineer.)

COMMERCIAL STATISTICS.

The mouth of the Coquille River is in the collection district of southern Or[illegible] Empire City, on Coos Bay, is the port of entry. The nearest light-house is on [illegible] Arago, 22 miles northward.

The following returns relative to the commerce of the Coquille River for the [illegible] year ending June 30, 1892, are furnished by Capt. R. S. Littlefield, in personal c[illegible] of the work.

SHIPPING—VESSELS ARRIVED AND CLEARED.

The number of vessels of all descriptions crossing in over the bar during the [illegible] was 92; the number crossing out was 93. Their names, registered tonnage, [illegible] and number of trips made are as follows:

Name.	Trips.	Registered tonnage.	[illegible]
Steam schooners:			
Gen. [illegible]	15	71.17	
Homer	4	420.33	
Schooners:			
Antelope	9	117.79	
Ralph J. Long	9	85.64	
Berwick	5	95.67	
Laura Pike	8	91.10	
S. Danielson	10	83.20	
Parkersburg	8	117.54	
Coquille	10	97.95	
Free Trade	5	87.17	
Eureka	7	117.74	
Del Norte	6	95.67	

One steam schooner, the *Homer*, was built at Bandon during the year. Her le[illegible] is 124 feet; beam, 32 feet; draft, 10 feet; and registered tonnage, 420.33.

Arrivals and departures.

	Number.	Aggre[illegible] tonn[illegible]
Arrivals	92	8,[illegible]
Departures	93	9,[illegible]
Total	185	17,[illegible]

Owing to the high stage of water in the Coquille River, and as a result of [illegible] snagging operations, the river steamers plying between Bandon and M[illegible] [illegible] have been able to reach the latter place with more regularity and less d[illegible] [illegible] during the present year than hitherto.

No new routes of travel have been established since date of last annual repor[illegible]

Articles.		Quantity.	Articles.		Quant[illegible]
Exports.			*Exports—Continued.*		
Lumber	feet B. M.	8,[illegible]	Lard	pounds	
	tons	16,[illegible]	Beeswax	do	
[illegible]	do	187.14	Sheep pelts	tons	
[illegible]	do	53.14	Shingles	do	
Salmon:			Liquors	do	
In barrels	do	60.70	Brick	do	
In cases	do	91	General merchandise	do	
[illegible]	do	17.[illegible]	Cheese	do	
[illegible]	do	13.73			
[illegible]	do	107	Total		17[illegible]
[illegible]	do	33.50			
[illegible]	do	3.42	*Imports.*		
[illegible]	do	32.78			
[illegible]	do	7.25	General merchandise	tons	1[illegible]
[illegible]	dozen	5,268	Machinery	do	[illegible]
[illegible]	tons	13	Household goods	do	[illegible]
[illegible]	do	1			
[illegible]	do	7.90	Total		2[illegible]
[illegible]	do	1.06			

Estimated value:

Imports .... $2[illegible]

Exports .... 1[illegible]

T T 2.

IMPROVEMENT OF ENTRANCE TO COOS BAY, OREGON.

scription of original condition.—The obstructions which existed at entrance to this harbor before the works of improvement were begun sisted, first, of the outer bar, which is of sand and is shifting in racter, and second, of the inner shoals formed by the sands which imulate in the spring, summer, and autumn during the times when northwesterly winds prevail.

nder the action of these winds the spit on the north side advanced ard the south, contracting the navigable passage under Coos Head very narrow width, and usually making the outer channel follow west side of the spit in a long and tortuous course across the bar. he channel had at times broken through the north spit on a line, the eral direction of which is from Fossil Point to a point just to the th of Coos Head. It was then direct, the depth of water was great, and vessels could enter or go out without trouble. The mean rise the tide above the plane of reference was 5.6 feet.

Plan of improvement.—The project for this improvement, adopted in 9, was to construct, at an estimated cost of $600,000, a jetty of wood l stone, as may be found best, from a point 250 yards below the rthern extremity of Fossil Point, on a line toward the east end of s Head, this line in plan curving so as to be directed at its outer l to the Head or a little to the north of it.

The object is to prevent accretion to the south end of the sand spit the north side of the entrance and to open and maintain a deeper l more direct channel across the bar.

The present plan for the improvement of the entrance to Coos Bay, l under which operations are progressing, consists in the abandonnt of any further work on the Fossil Point Jetty and the building of o high-tide jetties of stone, one from Coos Head and one from the thern end of the north spit out toward the bar, ending at a distance rt of about 1,500 feet.

n addition to this the project includes the reclamation and holding the sands of the north spit, to prevent as far as possible their blow; over into the harbor.

The estimated cost of the work as approved is $2,466,412.20.

APPROPRIATIONS.

of—	
March 3, 1879	$40,000
March 3, 1881	30,000
August 2, 1882	30,000
July 5, 1884	30,000
August 5, 1886	33,750
August 11, 1888	50,000
September 19, 1890	125,000
Total	338,750

Amount expended to June 30, 1891.—The total amount expended in proving the entrance to Coos Bay to June 30, 1891, was $269,840.48. Of this amount, $210,317.74 was expended on the old project and ,502.74 on the new project.

Results obtained to June 30, 1891.—The work done up to June 30, 1 consisted of the building of the Fossil Point Jetty under the old t to a total length of 1,761 feet, but a considerable portion of this ted simply in a paving of heavy stone on the bottom in advance of the jetty to prevent scour. The results of the work thus f been to keep the channel over the bar from varying its posi much as formerly and to commence an erosion of the north spit

Instead of this erosion continuing as expected, the wate through the spit in a swash channel, thus greatly reducing th iveness of the currents on the bar.

I quote the following from my last annual report as to the re tained to June 30, 1891:

There has been practically no change in the results since the precedin report.

There has been considerable trouble with the bar, during the past year, the waters spreading out in an uncontrolled way and the prevalence of sto repeatedly filled with sand the bar channel made by the ebbing and floodin The erosion of the north spit went on during the year, and a better dir the outflowing and incoming currents has been thus secured. The troubles currents and eddies which formerly prevailed inside the bay, due to the m the waters of the main and south bays, have practically disappeared.

The bar has sometimes had a good depth of 12 to 15 feet at low wat other times has shoaled to about an equal depth at high water. The wo have been done have not increased the bar depths, and no increased dep expected until the north jetty, now under construction, has been very con extended.

Amount expended during fiscal year ending June 30, 1892.—The expended during the fiscal year ending June 30, 1892, was $6

Results obtained to June 30, 1892.—The north jetty and appr been built to a total length of 4,800 feet from the wharf locate inside of the north spit near its end. Of this length 1,808 fe yond the low-water mark, 1,392 feet is between high and lo and 1,600 feet above the ordinary high-water mark, as high water existed at the time the work was commenced.

As a result due to this extension, or due to this and othe there has been a marked improvement in the entrance to C during the past winter. Reports were constant during the wi the bar depths were from 18 to 21 feet at low water. In order the exact condition of the bar a survey was made during Mar and the platted results show the bar some 2,000 feet inside the of the bar at the time of the survey in August, 1891, and a cha the bar with 18 feet of water on it at low water. This bar cha little to the north of the bar channel existing the previous sum has been in continual existence for about eight months.

The exceptionally great results from the small amount of w is explained by the fact that the jetty cut off the swash chann the north spit directly opposite Fossil Point, throwing a larg the ebbing waters over against Coos Head, and thus tending to trate the waters upon the bar. It is not expected to mai depth shown by the present extension of the jetty at all time the summer.

Report of operations.—At the beginning of the fiscal year tramway had been built to a length of 1,600 feet. The work of it was in progress and continued uninterruptedly until Octobe at which date there had been completed 303 trestle bents, or 4 One thousand eight hundred and eight feet was built beyond of low water.

The work has been done by day's labor, with material furn contract.

A contract was entered into with Mr. Patrick O'Neil for fu brush fascines (1,000 cords, more or less) at $2 per cord. The of fascines was received from him August 22, and he comp ct in January, having furnished 1,158¼ cords, while on account ty on his part 368¼ cords were procured by hired labor.

tracts were entered into with George W. Loggie for furnishing 2,000, more or less) at 22 cents each, and with Mr. William E. for quarrying and delivering rock (20,000 tons, more or less) at ts per ton.

work of making mattresses and dumping rock was begun August 12.

he middle of December mattress work ceased for the season, and time the brush work consisted of—

	Feet.
mattresses from Bent 103 to 303	3,200
tier mattresses from Bent 100 seaward	160
nattresses on bay side from Bent 60 to 103	592
ttresses on sea side from Bent 140 to 164	384
r mattresses 20 feet square.	

siderable trouble was experienced in getting rock fast enough Contractor Baines, but by the end of December the crest of the ment had reached half tide, and by the middle of March it had d ordinary high tide. The cost of unloading and dumping rock und to average 8 cents per ton. During the year 23,923.4 tons lumped on the jetty.

loyés were subsisted at the Government mess house while oper- were being carried on.

cost of feeding employés per day per man at north spit was to be 36.9 cents.

h miscellaneous work was done during the year, such as building age platform, gridiron for brush and piles, constructing an addi- scow, building a locomotive house and trestle sidings, assembling st 12 cars of the 20 sent from Fort Stevens, overhauling and re- g cars, etc. A small dwelling house for the superintendent in of the work has also been constructed.

lamation of sand dunes.—As stated in my last annual report, a ity of Holland grass roots was received from San Francisco and d in several localities on the north spit.

ut one-third of the roots sprouted, and give promise of a vigorous h.

ing April, 1892, another consignment of 100 sacks of roots was ed, and these have been set out on the north spit.

ire fence has been built across the spit to keep cattle from the portion of it, and during March, 1892, about 80 bushels of oats, , and mixed grass seeds were sown.

ut 600 young pine and spruce trees were dug up and transplanted north spit.

n Fort Stevens we secured a quantity of Scotch broom seed, which anted early in the spring of 1892.

re was also gathered a large quantity of the seeds of plants grow- turally about the locality. These consisted of marine pine cones, nick berries, salal berries, and other plants, the names of which t known. These were all planted, both as mixtures and sepa- . The knowledge gained by these experiments will be valuable further prosecution of the work of the reclamation of the sand

vey.—A survey of the bar was made in March, 1892. For this se the tug *Hunter* was secured. This survey was made by Mr. F vage, assistant engineer.

[illegible] the [illegible] of the bar [illegible] the regular channel [illegible] when she got in [illegible] began to form from the [illegible] the surface currents [illegible]

[illegible] my arrival in [illegible] water-tight during the morni[illegible] great attention and we [illegible] as well as the presen[illegible] [illegible] In all abou[illegible] [illegible] these sand sp[illegible] upon them, but the sa[illegible] [illegible] and one has to be [illegible] further than [illegible] the weather [illegible] the [illegible] the bar with [illegible] is [illegible] The [illegible] near the bar [illegible]

[illegible] the bar in August, 1881, the [illegible] is no longer the straigh[illegible] extends from Cape He[illegible] the bar [illegible] after [illegible] the bar [illegible] the direction in which the littoral current is moving. There were a number its put in a couple of thousand feet outside the bar on a flood tide, and they ed in toward the bar very slowly, not averaging 1,000 feet per hour, even with a wind from the northwest, and as the tide changed, they began to work south out- he bar, with very little increase in velocity, toward the inside of Yokam Point. sequently three other floats were tried on the ebb from well inside of Coos , and as a result of observing them, I should judge that the amount of water ing out over the spits was not very great in comparison with the amount pass- ing the channel. One float was put in well toward the end of the jetty and out directly over the north spit, while the other two, being more in the main nel, followed the same well out beyond Guano Rock, when one of them being to the south, began to be drawn toward the south spit, and finally passed out over that spit, while the other followed the main channel for awhile and slipped out to the north of the bar buoy.

the ebb tide there is a very noticeable and interesting tide rip, as the current e bar proper must run at the rate of 5 miles per hour, or perhaps faster, which, ined with the swell rolling in, makes an extremely rough-looking bar, on h, however, there is really only a bad chop sea, but to anyone who did not the channel from ranges on shore, it would be impossible to pick it out at a time, on account of the nasty looking and ever-changing seas on the bar. ile the tide is running out this way the whole mass of water is seen to carry in great quantities, which is probably deposited in the smoother water a short nce beyond the bar, as soundings show 2 or 3 feet less water just outside the f taken on an ebb tide instead of on the flood.

as told that frequently the greatest current runs directly under Coos Head, uring this survey the water seemed to have a greater velocity upon the bar.

littoral currents would seem to be directly affected by the wind and its ges, and during the summer months when the wind is from the northwest the al trend of the current is southerly, and in winter with the prevailing south- winds the current is nearly always moving to the north.

ad several conversations with the men on the bar tugs and with Capt. James e, of the *Hunter*, in particular, as I know he is a very observant man and one hose word and judgment reliance can be placed. All the bar men are unani- in their opinions in regard to the action of the winds upon the littoral cur- and their general directions, but they notice very little of a littoral current in the bar, but it is always noticeable at the whistling buoy where the current runs from 1 to 2 miles per hour. This alongshore current is usually percepti- from one-fourth to 15 miles offshore and its direction, at least on the surface, lly shifts with a change of wind, and oftentimes before the wind changes, in the way, that the direction of the swell will change before the wind shifts.

times a slight eddy has been noticeable in near the bar with a direction opposite at of the main littoral current. The presence of this eddy, or of so slight a ral current in near the bar is due, I think, to the fact of the proximity of Cape gory, which helps to form the small bay in which the entrance to Coos Bay is ated.

the time of this survey the prevailing winds were about shifting from the hwest to the northwest, and one day the littoral current would be in one direc- and the next day perhaps running exactly opposite, on account presumably of wind shifting. As an example, on Thursday, March 10, out at the whistling there was a strong northerly current with the wind blowing strongly from the hwest, from which there was quite a heavy swell noticeable outside the protec- of Cape Gregory, while on the following day, Friday, there was a rather strong herly current with the sea very smooth indeed, and practically no wind, what there was coming from the northwest. On Saturday the conditions were very the same as on Friday, only with less current and a little more wind.

pt. Magee, of the tug *Hunter*, states that the best water and safest channel is ys found when the channel across the bar is in its most southern position, *i. e.*, t 500 or 1,000 feet south of the present position of the bar buoy. It is safest use it affords the shortest and most direct route out to the sea, and enables a l generally to take the swell head on, or nearly so. At one time, when the nel was in the above position, there were 27 feet at low water across the bar. would have been inconvenient to have plotted the lines as we ran, on account e lack of a reliable recorder and proper drafting facilities, etc., on board the er. I did most of the recording myself, and Mr. Polhemus and Morton L. Tower the sextants during this survey. The leading was done by the deckhand of the er, who proved quite competent.

Very respectfully, your obedient servant,

J. R. SAVAGE.

pt. T. W. SYMONS,
Corps of Engineers, U. S. A.

[illegible] as possible.
[illegible] engineer.

Money statement.

[illegible] expended [illegible]

[illegible] fiscal year ending June 30, 18[illegible]

[illegible] completion of exist[illegible]
[illegible] expended in fiscal ye[illegible]
[illegible] requirements of section [illegible]

[illegible]

rtion of the jetty tramway had been extended nearly 1,600 feet from
vharf. Only four of the geared dump cars had been received from

iast fiscal year operations at Coos Bay consisted chiefly in continuing
dy begun with the $125,000 appropriated September 19, 1890, of which
ialance was something over $56,000.
ttension of the north jetty under the general plans approved by the
d States Engineers October 27, 1889. From 30 to 40 men were employed
l the jetty as completed consists of a ridge of pieces of rock dumped
n mattress of brush fascines 20 feet wide. Its crest is brought up to
tide level, and the enrockment takes such slopes as the surges natur-
eing about 2 to 1. The mattress is laid and the rock dumped from a
ile-trestle tramway, constructed in advance by an overhang revolving
arly in July the last of the four large scows for transporting the
ipleted. In the same month we finished the gridiron for brush, 50
t, and a coal bunker 12 feet by 30 feet. Also a trestle spur track
long to accommodate cars not in use. Finding our car shop not large
work, we extended it into the locomotive house, and erected another
ie latter 20 feet by 30 feet.
jetty tramway.—As before stated, at the commencement of the fiscal
way had reached a point about 1,600 feet from the receiving wharf.
ι double track, 3-foot gauge railway, 13 feet from center to center be-
resting on longitudinal stringers of fir 12 by 16 inches by 32 feet, sup-
pile bents 16 feet apart, capped with fir timbers 12 by 12 inches by
3 by 12 inch planks are placed between the tracks for footwalks.
ns level from the wharf, and the elevation of top of rail is 21¼ feet
ie of mean lower low water.
y was extended by means of the large jetty pile-driver with its 10 by
Vorthington steam pump and water jets. It is the same driver with
iter part of the jetty tramway at the mouth of the Columbia River
a good general description of the machine and its working is given
t's report to Maj. Handbury on page 3021, Report of Chief of Engi-
cept that our machine has only single trucks of a somewhat different
roved an efficient machine in this locality.
ed were of fir from 45 to 56 feet long and about 17 inches in diameter
ost 4½ cents per foot. They were pumped into the sand from 20 to 27
lraulic jets were supplied by means of a 10 by 6 by 10 inch Worthing-
am pump, with hose connection attached to two 1½-inch pipes tempo-
to each pile with staples.
were drawn up when the pile top had reached a point within a few
equired elevation, and it was then driven to grade by a few blows of
hus obviating the necessity of sawing it off.
mber, and rails were run out to the driver from the storage platforms
ıt cars. Up to the present time we have not found it necessary to use
ı the trestle, but in future this will be required.
ver crew, including those employed preparing and loading piles and
ted of eleven men with daily wages amounting to $29.50.
rf was reached the average daily extension was four bents, or 64 feet
ramway. The greatest day's work was five bents, and during the
tember a total tramway extension of 1,280 feet was accomplished,
id not work continuously on account of the weather.
ost for one 16-foot bent of tramway, being the average of the season,

[. lumber at $9.50	$13.15
200 feet at 5 cents	10.00
el rail at $50 per ton	16.00
	85
road spikes at 3.6 cents	40
t bolts at 3 cents	1.80
;e season)	9.83
st one bent	*52.03
ng foot	3.25

iarf, the first 1,600 feet of tramway is located above extreme high-
he next 1,392 feet is between extreme high water and ordinary low
iately after passing low-water mark, a small swash channel was crossed
wide and from 6 to 8 feet deep at low tide. Beyond this channel on the

*No allowance is made for first cost of plant.

[illegible]

He was allowed [illegible] of Coos River, [illegible]

The stone is a [illegible]

He used the steamer *Express* at first [illegible] Marshfield the steamer *Antelope*, a small propeller [illegible] substituted.

He commenced delivery August 24, 1891, and towed [illegible] 1892. He supplied [illegible] scow loads, equal to [illegible] tons.

The pieces of rock averaged 2 tons, and [illegible]

It cost us 8 cents to unload and [illegible]

It was nearly all dumped in [illegible] ment on the [illegible] worked on the scows and four on the wharf, including engineer of hoist-

w loads of the poorer rock were dumped on the side mattresses on the side of tramway for 592 feet between bents 66 and 103 to prevent the encroachment of the bay channel at this place.

active operations.—Active operations closed soon after the delivery of stone want of sufficient funds to continue purchase, about the middle of April. stone scows were moored alongside the boom at Yarrow, away from the in- the teredo, and the sheathing taken from their decks. The pile-driver on the turn-out prepared for it, the locomotive and hoisting engines oiled, and the smaller tools and appliances put away.

of sand dunes.—With a view to the future work of reclaiming the the north spit, to prevent the winds from carrying the sand into the bay, erimental work was done to ascertain the most suitable plant growths and advisable time of the year for planting.

sacks of Holland grass roots were obtained from the Golden Gate Park ners, of San Francisco, and set out in the sands here April 30, over a year planted about 3 acres with it, but only one quarter of it lived; but I notice survived has commenced to spread and grow.

ring we received 100 sacks of the same kind of grass roots, and set it out month earlier, planting 5 or 6 acres. We set the small bunches of roots inches deep in the sand and 2 or 3 feet apart. Up to date nearly every bunch to be growing well, and I believe it is the most suitable growth to start this h.

ll we gathered about 10 bushels of seeds of plants native to the spit, and 30 of Marine pine and spruce cones, and shook out and planted the seeds this We also planted 50 bushels of oats, 25 bushels of barley, and 5 bushels of grass seed.

storms continued late this spring, and I fear most of the oats and barley is d.

so planted a sack of Scotch broom and other seeds, and transplanted 400 arine pine and spruce trees, and set out a number of willow cuttings.

posed spit is a very difficult place to get any growth started, and from experience I think the Holland grass is the best to begin with, supple- with seeds of native plants and Marine pine.

probably be necessary to cover the higher dunes with a protection of brush plant life gets started. We built a barb wire fence one-third of a mile oss the spit from bay to ocean to prevent cattle from straying down and in- with the grass plantations.

y.—According to our contract with Mr. Baines, we were entitled to the use at when she was not employed in towing the rock scows. Although we e work out of the boat in this way, we were obliged to hire considerable wing to transport the brush, poles, piles, coal, etc. We employed the local r this purpose at an agreed price per trip. We often experienced delays and is method inconvenient, and I would recommend for another appropriation ter or purchase of a good-sized steam launch to tend on the works, tow small d piles, and deliver supplies.

supply.—The large and shallow well in the sands of the north spit furnished s supply of fresh water at the works. It was pumped into an elevated tank foot Aeromotor windmill.

—We received from the Government works at Fort Stevens 20 geared dump ich came knocked down for ease in shipment. These we assembled at the

ave on hand now the following plant, all in good order: Four large stone escribed in last Annual Report; one small scow 40 by 14 by 4; one 11-ton truck Baldwin locomotive; twenty geared dump cars (Fort Stevens pattern); cars; two mattress cars; four push cars; one jetty pile-driver; one double- 10 by 12 Lidgerwood hoisting engine; one small hoisting engine; an outfit boats, oars, pumps, blacksmith tools, saws, sledges, axes, hose, stoves, and all tools and appliances.

accomplished and changes effected to date.—Immediately after the extension of h jetty across the swash channel the sands on the sea side began to accumu- have built up above low-water level nearly to its end. At the same time emity of the north spit commenced to cut away along its southern and east- , widening and straightening the channel. In October the depth on the bar rapidly improve.

as for the year previous the least depth at mean low water in the bar chan- been about 10 or 11 feet, as soon as the jetty was extended to its present attained a depth varying from 16 to 18 feet at the same stage of tide, which maintained ever since for a period of eight months.

A survey of the bar was made last March, wh
Miscellaneous.—While the work was in prog
views was taken by Mr. Bratt, illustrating the
A careful record of the commercial statistics f
for the past fiscal year and forwarded to you m
A survey of quarry sites on Coos River was fi
of overseer is now being built.
Very respectfully, your obedient servant,

Capt. T. W. Symons,
Corps of Engineers, U. S. A.

COMMERCIAL STAT

Coos Bay is in the collection district of sou
bay, is the port of entry. The nearest light-h
side and west of the entrance.
The following returns are furnished by Mr. J.
charge of works at Coos Bay, and are for the fis

Arrivals and departures

Arrivals	
Departures	
Total	

Vessels built,

Schooner *Volant* ....
Schooner *Nuestra La Paz* ....
Steam launch *Fawn* ....
Schooner *Bowhead* (rebuilt from old tug *Columbia*
Number of passengers arrived by sea ....
Number of passengers departed by sea ....

No new routes of travel have been established
report.

Article.		Quantity.	
Exports.			Butter
			Hides
Lumber	feet B. M.	46,805,537	Borax
	tons	81,385	Miscel
Laths	number	3,614,500	Pickets
	tons	1,452	Barrel
Broom handles	tons	11	Barrel
Spruce slivers	number	2,126,444	Spars
Ship knees	do	780	Machin
Coal	tons	36,183	Railroa
Match wood	cords	2,674	Chicke
	tons	1,309	Redwo
Ties	number	302	Specie,
	tons	142	
Chittim bark	tons	36	T
Salmon:			
Canned	do	87.3	
Salt	do	22	
Apples	do	76.5	General
Pears	do	.2	ery,
Potatoes	do	216.9	Specie,
Cheese	do	6.1	
Eggs	dozen	1,650	T

Estimated value:
Imports ....
Exports ....

T T 3.

IMPROVEMENT OF UMPQUA RIVER, OREGON.

cription of original condition.—Just below Scottsburg, the head vigation on the Umpqua River, are five sandstone bars or ledges 15 feet wide and submerged from 1 foot to 2 feet at low tide on -river stage. They are separated by pools about 150 feet wide rom 5 to 10 feet deep at low water.

n of improvement.—The honorable Secretary of War having au- ed the expenditure of the balance remaining of the appropriation rch 3, 1871, viz, $4,685.89 in improving the river below Scotts- a project was submitted and approved in 1885 for making at an ated cost of $4,056, a channel 50 feet wide and 3 feet deep at low through the rock ledges above described, by drilling and blast- he rock and removing the broken pieces to deeper water in the

September, 1889, a survey was made of the Umpqua River from burg to its mouth, and a project prepared for its improvement was submitted January 16, 1890. This project provides for the ral of rock bowlders and ledges in the wharf basin at Scottsburg, elow this basin with the view of opening a channel way 50 feet lth and 4 feet in depth at low water. The project was approved date of October 28, 1890.

estimated cost of completing the project was $9,000.

APPROPRIATIONS.

rch 3, 1871	$22,500
gust 11, 1888	2,000
ptember 19, 1890	9,000
Total	33,500

ount expended to June 30, 1891.—The amount expended on the t to June 30, 1891, was $6,992.42.

ults obtained to June 30, 1891.—The result obtained was a naviga- annel 50 feet wide and 2 feet deep at low water, extending nearly gh the reefs below Scottsburg, where formerly there was only a r less in depth.

ount expended during fiscal year ending June 30, 1892.—The amount ded during fiscal year ending June 30, 1892, was $7,252.74.

ults obtained to June 30, 1892.—The project was nearly completed. e it could be entirely completed, however, the water in the river and became muddy, so that the finishing touches could not be . There are in consequence some points of rock which will have removed before the project can be considered as fully completed.

ort of operations.—Mr. C. M. Carlson was placed in charge of the s of rock removal on the Umpqua. This work commenced in July, and continued until November, 1891.

ring this time, 955 tons of rock were blasted, hoisted, and loaded scow and removed to a convenient locality where it could be ed without injury to navigation.

les were drilled by means of an Ingersoll steam drill. They were loaded with dynamite and exploded by fuse and sympathetic ation.

e rock broken was raised by means of a diver and a steam hoist- gine and dumped by hand.

[illegible]dations and remarks.—It is believed that sufficient mone[illegible] [illegible] to complete the project, and therefore no recommendatio[illegible] for [illegible] appropriation is made.

Future operations.—As soon as practicable the work of completi[illegible] the rock removal from the selected channel will be commenced.

Money statement.

July 1, 1891, balance unexpended	$8,60[illegible]
Amount refunded February 9, 1892	[illegible]
	8,60[illegible]
June 30, 1892, amount expended during fiscal year	7,25[illegible]
July 1, 1892, balance unexpended	1,44[illegible]

COMMERCIAL STATISTICS.

Umpqua River is in the collection district of Southern Orogon. Empire City[illegible] Coos Bay, is the nearest port of entry. The nearest light-house is at Cape Ar[illegible] entrance to Coos Bay, distance 22 miles.

The following returns, furnished by Mr. O. B. Hinsdale, of Gardiner, Oregon[illegible] for the year ending June 30, 1892:

VESSELS ARRIVED AND CLEARED.

The number of vessels of all descriptions crossing in over the Umpqua River[illegible] during the year was 16; the number crossing out was 16. Their names, regist[illegible] tonnage, and draft, are as follows:

Name.	Trips.	Registered tonnage.	D[illegible] lo[illegible]
[illegible] Leeds	8	217.70	
[illegible]	8	197.22	
[illegible]	11	135.40	
[illegible]	1	235.56	
[illegible] George H. Chance	6	71.17	
Schooner W. H. [illegible]	1	70.00	
[illegible]	1	451.84	
[illegible]	5	295.00	
[illegible]	8	294.00	
[illegible]	4	339.14	
[illegible]	1	366.48	
[illegible]	1	343.69	
[illegible]	1	135.40	
[illegible]	20	52.25	
[illegible]	20	....	
[illegible]	2	55.38	

[illegible] were no vessels built here during the year, and no new routes of tr[illegible] [illegible]

River traffic.

Steamer [illegible] (propeller), 22.28 registered tonnage:
- Miles run during year .... 8[illegible]
- Passengers carried during year .... 2[illegible]
- Freight carried during year .... tons..

Steamer [illegible] (stern-wheeler), 101.02 registered tonnage:
- Miles run during the year .... 5[illegible]
- Passengers carried during the year .... 1[illegible]
- Freight carried during the year .... tons.. 1[illegible]

icles.	Quantity.	Value.	Articles.	Quantity.	Value.
orts.			*Exports.*		
, B. M	12,142,000	....	Hides and furs....tons..	3	750
........tons..	24,284	$194,272	Grain ....do...	234	5,850
.........do...	733	7,335	Hops..............do...	3	1,050
.........do...	2	1,000			
.........do...	16	6,400	*Imports.*		
.........do...	5	3,000			
.........do...	5	100	General mdse.....tons..	1,880	150,000

ports (tons, 25,285½) $219,757
ports (tons, 1,880) 150,000
on exported, as cannery did not run this year.

T T 4.

IPROVEMENT OF MOUTH OF SIUSLAW RIVER, OREGON.

ption of original condition.—The Siuslaw River enters the ocean idst of a vast shifting sandy beach, without any headland or nt to determine or aid in determining the location of the en- annel.

nconfined channel has a range of about 1 mile, over which it in making connection with the ocean. In consequence of this ng and spreading out of the outgoing and incoming waters, the mes shoals very badly, while at other times it has a depth equal ontrolling depth inside the entrance. The depth on the bar om 5 to 12 feet at low water, and the bar channel changes very position and direction.

es a channel is developed inside the bar which runs nearly with the coast. This channel is narrow, badly defined, and is, as boats have to pass through it in the trough of the sea.

er times there are two channels.

f improvement.—The plan of improvement for the entrance to law is to confine the outgoing and incoming waters between stone jetties, so located as to direct the currents upon the r in a direction practically perpendicular to the coast, these converge till they are 600 feet apart at the crest of the bar.

cation of the jetties is approximately shown upon the map pub- ith the last annual report from this office. (Report of Chief of rs, page 3178.)

orth jetty leaves the mainland about half a mile north of Can- l and is 4,500 feet long. The south jetty extends from the end ndy peninsula and is 3,200 feet long.

harf for the north jetty is located just below Cannery Hill, and oach to the jetty is 3,000 feet long.

harf for the south jetty is opposite the north jetty wharf, and oach is 2,400 feet long.

tties are to be built of brush and stone from a pile tramway.

APPROPRIATION.

ptember 19, 1890 .... $50,000

nt expended to June 30, 1891.—The amount expended during l year ending June 30, 1891, was $601.96.

Results obtained to June 30, 1891.—No work w
obtained.

Amount expended during fiscal year ending June
expended during the fiscal year ending June 30

Results obtained to June 30, 1892.—The work
preliminary character and nothing has been d
any effect on the entrance to the river, and co
have been obtained.

Report of operations.—The report of the Boa
lished in my last annual report (page 3175, Rep
neers, was approved August 4, 1891, by the Chi

The following is the indorsement on the repor

[First indorsement.]

OFFICE CHIEF

Respectfully submitted to the Secretary of War.

By indorsement of the 18th February last, the Acting S
the recommendation of this office of February 13, that the
work be held to await further appropriation by Congress.

By authority of the Secretary of War a Board of Engine
by Special Orders No. 23, Headquarters Corps of Enginee
make and submit a project for improving the mouth of Siu
propriation of September 19, 1890, and the report of this
contains the following language in reference to beginning

"It would seem to be imperatively necessary, in order
and economically done, that it be not commenced until an
the north jetty to its full length up to at least low water
involves about three-fourths of the total cost of that jett
be found inexpedient to make so large an amount as this
one sum, or to await its accumulation by small appropriat
of operations might be adopted by which these smaller ar
with advantage perhaps to the channel over the bar.

"The change suggested would be to provide the necess
and then commence the construction of a dike on the sa
the river, at the northern end of the sandy peninsula, an
thus forming a west bank for the river which will keep th
until it passes around the north end. The result of this w
to the north ward and prevent the breaking through and f
ed. No permanent relief, however, can be expected unti
to direct the water across the bar are constructed."

It is recommended that the change of plan suggested by
the procurement of the necessary plant and appliances a
the construction of a dike on the sand spit near the mouth
ern end of the sandy peninsula, be authorized, and that
plied in this direction.

Major, Corp

This was approved the same day by the Secret
ignates the project under which work is to be ca

Immediately upon receipt of the requisite auth
prosecute the work began.

On account of his experience at Yaquina Bay
sistant engineer, was designated to take charg
Siuslaw.

On September 5, 1891, Mr. Lyell arrived at t
menced operations.

The land necessary for a wharf, storehouses,
the tramway approach to the north jetty was le
Cox for a term of years sufficient to complete the
for $100 per year.

The end of the sandy peninsula from which the south jetty must start, and upon which must be located the wharf, storage platforms, etc., for the south jetty, was purchased from Mr. S. J. Beswick for $5 per acre.

It was necessary to build a floating pile driver in order to construct the wharf at the mouth of the river. A locomotive was purchased from H. K. Porter & Co., of Pittsburg, Pa.

Cars of the Yaquina Bay type were procured from New Jersey, and two hoisting engines, steel rails, and the multifarious tools and materials needed in the prosecution of the work were procured.

Two rock scows have been built, and the work is fairly under way.

The wharf under Cannery Hill has been completed.

During September, 1891, a new survey of the entrance to the Siuslaw was made by Mr. John R. Savage, assistant engineer. This was forwarded to the Department with the following letter advocating a change in the project as approved by the Secretary of War:

PORTLAND, OREGON, *December 28, 1891.*

GENERAL: I have the honor to send herewith a blue print of the survey of the Siuslaw River entrance made in September, 1891.

Upon this I have marked, in full red lines, the project for the improvement of the entrance recommended by the Board of Engineers, consisting of Maj. Handbury, Lieut. Burr, and myself.

The position of the main-entrance channel varies naturally in location from the end of the south spit (so marked) to its present position 1 mile to the northward.

In its report, after recommending the project above named, the Board used the following language:

"It would seem to be imperatively necessary, in order that it may be efficiently and economically done, that it be not commenced until an amount sufficient to build the north jetty to its full length up to at least low water be made available. This involves about three-fourths of the total cost of that jetty, or $300,000. Should it be found inexpedient to make so large an amount as this available for the work in one sum, or to await its accumulation by small appropriations, a change in the plan of operations might be adopted by which these smaller amounts could be expended with advantage perhaps to the channel over the bar.

"The change suggested would be to provide the neccessary plant and appliances, and then commence the construction of a dike on the sand spit near the mouth of the river, at the northern end of the sandy peninsula, and extend this to the north, thus forming a west bank for the river which will keep the ebb water from spilling over until it passes around to the north end. The result of this will be to hold the channel to the northward and prevent the breaking through and formation of a south channel. No permanent relief, however, can be expected until the two jetties that are to direct the water across the bar are constructed."

This language was the result of a compromise on the part of the members of the Board. The work, as approved, is shown by the dotted line on the blue print.

The recent survey, made in September last, the results of which are incorporated on the blue print sent herewith, indicates very strongly that the work outlined and approved will be of scarcely any advantage, and give no permanent relief, and that it will form no part of the best plan for the improvement of the river entrance.

The work is so contrary to my sense of what is proper to be done that I feel it to be my duty to protest against it.

The building of the jetty on the dotted line will simply be extending the sand spit to the north and changing the locus of the channel variations to the north. It will do practically no good to the outer channel and bar. If it did, the benefit must of necessity be temporary. I can not but regard it as a waste of money.

Upon the chart can be noticed the southerly trend of the outer channel after it gets by the harbor throat, if it can be so called. This direction compels boats, desirous of entering or leaving, to run in the trough of the sea in a narrow channel only 5 feet in depth at low water, and makes the entrance a fearfully risky one. Any extension of the jetty on the dotted line would not materially better this direction.

If any benefit to the entrance to this river is to result from improvement works, this benefit will arise from doing away with the trough channel and making the entrance channel run directly out to sea, rather than from any increased depth which must remain slight and uncertain.

It is also more than likely that before work could be fairly started, the main channel will have shifted to the southern position, now indicated as a secondary channel.

[illegible]

[illegible] the northern limit of the channel in its permanent [illegible]

I would further state that I laid this matter before C[illegible] engineer, who replied to me as follows:

"In reply to your letter of the 16th instant, relating to [illegible] fund to assist in carrying out the approved project for th[illegible] River, I have to say that under the circumstances of the[illegible] been adopted without any action thereon by this office, it [illegible] to correspond directly with the Department. In case th[illegible] referred to me, I would then be my duty to consider the ma[illegible]

The work done so far consists in building floating pl[illegible] wharf on the main shore, at the foot of Cannery Hill.

Very respectfully, your obedient servant,

T[illegible]

Cap[illegible]

Brig. Gen. Thomas L. Casey,
Chief of Engineers, U. S. A.

This letter was referred to Col. Mendell and [illegible] ments were made upon it:

[First indorsement.]

Office Chief [illegible]

Respectfully referred to Col. G. H. Mendell, Corps of E[illegible] ment, San Francisco, for report and recommendation.

By command of Brig. Gen. Casey:

M[illegible]

[Second indorsement.]

U. S. [illegible]
San Francisco[illegible]

Respectfully returned to the Chief of Engineers, U. S. A. The alternative work proposed by the Board in the [illegible] was intended to construct the north jetty and shown on [illegible] in connection with the Board's project. [illegible]

[illegible]

menced by building the west or south jetty. It will serve as a directrix to the currents and it alone must have some influence in determining the new proposed channel. This influence will be aided by the partial obstruction of the north channel already proposed.

If, during the period of construction, the new channel shall be developed, then it would seem to be good policy to suspend work on the west or south jetty and begin on the north jetty, with a view to holding the new channel in place. It will at this time be expedient to entirely close the channel supposed to have been already partially obstructed.

The lines of the adopted project suggest remark:

The distance between these lines is as much as 1,600 feet. The river maintains a normal depth of about 12 feet where the width is 900 to 1,000 feet.

It is not understood how an adequate channel can be developed and maintained between jetties spaced farther apart than about 900 feet. It is suggested that the alignment of the jetties be reconsidered.

If this be done, it is thought that a modification will be advantageous in the way of softening the right angled change of direction which is observed at the head of the jetties.

The inclosed tracing shows an alternative alignment which eases the curvature by making the bend longer, and by shifting the entrance several hundred feet to the northward.

This alignment is proposed in the way of illustration. It may be varied to suit any local conditions or requirements not mentioned in the report of the Board.

The channel may be trained, if necessary, to a needful distance from the concave face by a few short groins or by paving with brush mattresses.

Reference may be made to indorsement of January 15, 1891, upon a project submitted by Capt. Symons.

G. H. MENDELL,
Colonel, Corps of Engineers, Division Engineer.

[Third indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
February 1, 1892.

Respectfully returned to Capt. Symons for remark, attention being called to the second indorsement.

To be returned through division engineer.

By command of Brig. Gen. Casey:

H. M. ADAMS,
Major, Corps of Engineers.

[Fourth indorsement.]

U. S. ENGINEER OFFICE,
Portland, Oregon, February 8, 1892.

Respectfully returned to the Chief of Engineers, U. S. Army, through Col. G. H. Mendell, Division Engineer.

I am in substantial accord with Col. Mendell as shown in the preceding indorsement.

In the Board's project the crossing of the channel by the north jetty was determined in location principally on account of the soft sandstone which there juts out from the main shore and upon which a stone jetty could be founded with more surety than upon the sands elsewhere.

As this turn is a critical point with the jetty, it was deemed best to take advantage of this hard bottom.

In order to utilize and take advantage of this hard bottom, it is suggested that the adopted north jetty start from the main shore at the Board's location and end at Col. Mendell's location. This would tend to somewhat ease the curve.

This, with the south jetty location suggested by Col. Mendell, would be entirely acceptable to me.

I inclose a second blue print upon which I have laid down the lines as above outlined. I believe it will be advisable to leave an increased width between the jetties at the turn. Further contraction here seems unnecessary as natural causes will cause a deep channel to exist along the concave side of the north jetty, and if this channel be narrowed, there might be an undue tendency to undermine the jetty.

As regards the sequence of the work, I would recommend that the tramway to the north jetty along the main shore be first built and the jetty extended out into the river, but stopped at such a point as to leave in the present channel ample room for the passage of boats. Then, in the open part of the channel, to put down the [illegible] tresses suggested by Col. Mendell.

The north jetty so built would be very valuable in handling these mattresses. [illegible] being done, work to be stopped, and the south jetty commenced.

With the north jetty in the state outlined we would be prepared to take ad[illegible]tage of the breaking through of the south channel at any time, to push the [illegible] and hold the channel in its southern position.

In this I believe I am substantially in accord with Col. Mendell's views.

THOS. W. SYMONS,
Captain, Corps of Engin[illegible]

[Fifth indorsement.]

U. S. ENGINEER OFFICE,
San Francisco, Cal., February 12, 1[illegible]

Respectfully returned to the Chief of Engineers, U. S. Army.

The existence of the ledge of sandstone not, however, mentioned in the B[illegible] report, is a good reason for the location of the north jetty proposed by the [illegible] and this location is for this reason recommended.

The order of work proposed, fourth indorsement, is recommended.

I am not at present prepared to recommend the location shown on blue pr[illegible] the south jetty, the interval between the two jetties at some points appearin[illegible] rather great. The work recommended for north jetty will, it is supposed, be a[illegible] as can be done with the present appropriation, and, if the Department shall ap[illegible] it is suggested that the final location of the south jetty be deferred for conside[illegible] at a future time.

G. H. MENDELL,
Colonel, Corps of Engineers, Division Engi[illegible]

[Sixth indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
February 19, 1[illegible]

Respectfully returned approved as recommended by division engineer i[illegible] indorsement.

When such record as may be necessary has been made, this paper will be ret[illegible] to this office.

By command of Brig. Gen. Casey:

H. M. ADAMS,
Major, Corps of Engin[illegible]

[Seventh indorsement.]

U. S. ENGINEER'S OFFICE
San Francisco, Cal., February [illegible]

Respectfully transmitted to Capt. Thomas W. Symons, Corps of Engineer[illegible] A., Portland, Oregon, attention invited to preceding indorsement of Chief of [illegible]neers.

G. H. MENDELL,
Colonel, Corps of Engineer[illegible]
Division Eng[illegible]

These indorsements convey an order changing the project for th[illegible] to the main project of the Board of Engineers, and upon this [illegible] work is in progress.

Early in 1892, the south channel opened, and since has be[illegible] principal channel used by boats entering and leaving the river.

Recommendations and remarks.—The south channel having [illegible] through and become the best channel, all questions, for the pre[illegible] least, concerning the stoppage of the north channel to navigat[illegible] the building of the north jetty across the river can be left out [illegible]sideration.

If the north jetty is once completed across the river, forming t[illegible] artificial headland to turn the waters into the south channel, it ıat this main entrance channel will be maintained generally in ıern position, although until the completion of the jetties it oubtedly wander about more or less.

;eneral methods of procedure in the construction of the north applicable, depending upon the amount of money available: there should be a sufficient amount of money available, this ɔuld be built out for its full length as rapidly as possible, the ıent being brought up to at least low-water level, and to subse- have rock added until it reaches full high-water level.

rry out the project by this method a sum of $250,000 can be ly expended during the next fiscal year.

econd method of procedure is to push the jetty toward the sea, ing it as it progresses by bringing the enrockment up to full e level.

rry out the project by this method a sum of $50,000 can be ly expended during the next fiscal year.

is probable this will have to be the method adopted, $50,000 is unt specified in the money statement that can be profitably ·d.

e operations.—Future operations will consist in the extension ıorth jetty to as great an extent as possible with the money e.

·eport of Assistant Engineer G. A. Lyell, which accompanies ort, gives in more full detail the operations and history of the

Money statement.

91, balance unexpended	$49,398.04
1892, amount expended during fiscal year	29,816.90
92, balance unexpended	19,581.14
92, outstanding liabilities	2,300.00
92, balance available	17,281.14
ıppropriated by act approved July 13, 1892	20,000.00
ıvailable for fiscal year ending June 30, 1893	37,281.14
t (estimated) required for completion of existing project	630,000.00
t that can be profitably expended in fiscal year ending June 30, 1894	50,000.00
ted in compliance with requirements of sections 2 of river and ɔr acts of 1866 and 1867.	

REPORT OF MR. G. A. LYELL, ASSISTANT ENGINEER.

UNITED STATES ASSISTANT ENGINEER'S OFFICE,
Florence, Lane County, Oregon, June 14, 1892.

N: I have the honor to submit the following report of operations on the ıent of the entrance to Siuslaw River, Oregon, for the year ending June 30,

the act of Congress passed September 19, 1890, $50,000 was appropriated encing work, and a Board of Engineer Officers appointed April 15, 1891, by rders No. 23, Headquarters Corps of Engineers, to formulate and submit for the improvement.

ɔliance with instructions contained in your letter of August 5, 1891, direct- proceed to the Siuslaw to start the work, I turned over the works at Ya- y to Mr. Ricksecker, and then proceeded to Portland to gather data in con- rith the project for improving Siuslaw River, and make estimates of ma- quisite for construction of plant for carrying on the work.

tember 5, 1891, following your letter of instructions, I arrived at Florence ıce proceeded to find quarters suitable for an office, and succeeded in ob-

most of them come down the river and are floated by high t
river. Some of them float as far up as Acme, about 7 miles, an
a structure of any kind built near the mouth of the river must
to resist the constant hammering and pounding of these large l

The best location for the tramway leading out to the propose
along the beach, between the high and low water line, as to foll
of the bluff will prove very expensive on account of the large
that lie buried under the sand, and will have to be removed
piles that support the tramway. The beach, for the most p
sandstone of a soft nature, but apparently not subject to sco
masses of rock can be placed without making an expensive m
support the rock.

When once the tramway is constructed to the root of the nort
rapped, sand will soon fill in behind the tramway and prevent
again.

At the time of my arrival quite a channel had developed at th
current, and this channel was quite wide on the inside; the
were found to have encroached to a very great extent on the ri
Hill and signal station "Gulch." Quite an elevation had been
ground since the survey of 1889, and quite an area of drift lo
The deepest water, about 7 feet, was found in the south chan
close to the middle sands; this at low water. The trend of th
decidedly to the southward, just as the north channel has al
direction; and my observations lead me to the belief that the
south along this part of the coast.

The prevailing winds are from the northwest, as evidenced
sand dunes are higher to the south than north of the entrance, a
clination on their south than on their north sides. The trees
southeast and have fewer limbs on their north than on their so

If the works of improvement are ever completed I believe th
will fill in entirely with sand from the northwest and will work
along the north jetty to its top, just as the sands have done a
north side of the north jetty.

On the 3d of last December a furious gale set in from the we
tained a high velocity and lasted for several hours; trees were u
of sand blew all the way across the river from the sand dunes
and a very high tide occurred, being about 4 feet above the a
immense drift logs. Considerable shoaling occurred all along
river to its mouth and choked up very perceptibly the inne
shoaled the bar at the north channel. At one time the sand du
so low that a vessel could be seen at sea, standing on the lowe

No damage was sustained by the storm.

The past spring was very stormy and much rain fell.

." So much has the south channel worked to the south that on the 8th of small spit had formed just inside the south channel, having been washed off of the south spit.

urf has laid bare all the rocky beach in the river opposite the south channel. r has been formed just north of the wharf which holds the sand in suspension, ch sand has been deposited at the north side of the wharf, making quite a ace. This is helped to a great extent by the projecting nature of the river ı the vicinity of Cannery Hill, which deflects the current toward the south t as the river widens just below, the force of the deflected current is lost by ng so much, and the river shoals from 20 feet opposite Cannery Hill to 9 feet opposite shore and at the wider part of the river.

nap of the 1889 survey, and that of the 1891 survey, show very nearly the nfiguration of the bed of the river just below Cannery Hill, *i. e.*, deep water ast side, and shoaling up in a northwesterly direction toward the west bank. to me these conditions ought to govern the distance of the jetties apart of their curves, and they should not be over 1,000 feet apart, converging to at their outer ends. These distances of the jetties apart would not create a velocity in the ebb and flood currents than now exists at the narrow porthe river above Cannery Hill, where the banks of the river are comparatively t.

ght be urged that the distance of 1,000 feet between the jetties on the inside end to throw the current against the north jetty, and undermine it; but, as ore stated, the point at Cannery Hill deflects the current toward the west which breaks its force below this point. The strongest currents are developed ast two hours of the ebb; the flood-tide currents are not so strong.

iver bed in the vicinity of the proposed jetties is, for the most part, sandf a soft nature, not however liable to be cut out by the currents. The map 889 survey shows the north channel at its best when fully developed, as it en the survey was made.

orth or right bank follows the direction of a curve with a radius approxi-3,000 feet, and very regular. I observed, at the time the 1889 survey was trong currents on the ebb, but the right bank was so uniform (fine sand) was scarcely disturbed to any great extent before the tide would change to nd counteract any tendency to much scouring. A study of these conditions the guide to a very great extent for the final location, degree of curvature, the jetties.

y.—On the 9th of September the steamer *Gen. H. G. Wright* arrived at Florith Mr. J. R. Savage in charge, to make a survey of the bar at the entrance river; having completed the survey, the steamer departed on the 20th for y.

tions.—Owing to infrequent trips made by the steamer *George H. Chance* to e, much time was lost in getting the work started, and this has caused many otions in carrying on the work since its commencement.

l house about 14 by 16 feet was built of rough boards near the cannery at e. This house has been used for storage purposes, and served well as a place h to spin oakum for calking, and also for light jobbing work.

ll landing place for receiving lumber for construction of pile-driver scow o built in front of the tool house.

ch ways were laid on the flat just west of the cannery, upon which the pilecow was built.

ng pile-driver.—On the 7th of October work was commenced on a derrick for ting driver, and on the 9th the steamer *Chance* arrived, bringing materials for k.

cow is built of sound fir lumber; length, 52 feet 8 inches; width, 22 feet 8 depth of hold, 4 feet. Deck and bottom planking, 3 inches thick; gunwales, s thick; two longitudinal bulkheads, 6 inches thick, with three intermengitudinal trusses and three equidistant cross trusses all strongly braced, and bolted.

are three wooden box pumps; three stout cavils each side, and three hatches. rick with leaders 47 feet long is provided. This derrick has double sheaves head block, one for hammer rope and the other for pile-hoist. Five platforms vided upon which to handle the piles while being driven. A movable provided at one end on the fourth platform upon which the hammer rests ot in use, and this block can be worked in and out of position by a small rope down the back brace nearly to the deck of the scow and obviates the neof sending a man aloft to chock the hammer. The leaders of the derrick are their inner edges with $\frac{1}{4}$ by $2\frac{1}{4}$ inch strap iron to prevent abrasion by the r. The hammer is of cast iron and weighs 3,600 pounds, and has a total fall eaders of about 30 feet.

cow and derrick were completeley finished and launched on the 28th of No-

[illegible] to await the arrival of the hoisting engine [illegible] construction of the scow, as there was no shed [illegible] while at work.

Skiff.—On the [illegible] of November a large skiff was complete[illegible] for use in connection with the floating pile-driver in ha[illegible] and has been used by the pile-driver crew in towi[illegible] also in towing piles and carrying other material [illegible] It is provided with rowlocks for six oars and has a [illegible] This boat has proved of valuable assistance to [illegible]

[illegible]—On the [illegible] of December the yard where the flo[illegible] was cleared of the [illegible] landing, etc., and everythi[illegible] was moved to [illegible] Point, about 1 mile below Florence, whe[illegible] to utilize ground near Cline & Smith's new sawmill [illegible] which to construct [illegible] scows, the ground being above hi[illegible] to the sawmill, where arrangements had been made fo[illegible] The ground was cleared and a shed erected, under which t[illegible] This shed is [illegible] by [illegible] feet, roofed with rough boards s[illegible] and left open at the ends and sides.

[illegible] a heavy gale of wind blew off a portion of one [illegible] damage.

A track was laid down about [illegible] feet from the shed to the sa[illegible] push car was placed upon it for transferring the scow [illegible] in handling the heavy timbers.

[illegible]—Two large [illegible] scows have been built. They ar[illegible] feet wide on deck; depth of hold, [illegible] feet. Gunwales are 6 in[illegible]

There are three longitudinal bulkheads 6 inches thick, an[illegible] Bottom and deck planking is 3 inches thick. T[illegible] is fastened with galvanized iron boat spikes and painted with [illegible] The sides are painted with two coats red metallic pain[illegible] has been found to stand the action of salt water better than t[illegible] is the cheaper.

The decks were given one coat of hot coal tar. These scow[illegible] anchor; a gypsy windlass, bitts, and chocks are [illegible] Three large wooden cleats are provided on each side. Th[illegible] and have a capacity of about 250 tons on a 4½-foo[illegible]

[illegible]—On the [illegible] of December last a [illegible] at work clearing the ground of logs and brush preparatory to [illegible] houses. Both houses are located at the base of Cannery Hill, [illegible] placed [illegible] feet apart. The floors of each building are [illegible] The posts were well braced all around, as t[illegible] at the mouth of the river during storms.

[illegible]—The bunk house is [illegible] by [illegible] feet inside, covere[illegible] diagonally to studding to brace the building. On the r[illegible] ceiling. The roof is covered with cedar shingl[illegible]

[illegible] to accommodate 36 men. Four small room[illegible] A public room is provided at one end.

[illegible]—The mess house is located 114 feet from the bu[illegible] constructed. It has a kitchen and pantry on one side o[illegible] and on the other side two dining rooms, one public and [illegible] The [illegible] dining room has a small bedroom adjoining.

The [illegible] has a [illegible] ventilator in the ridge of the roof for [illegible]

[illegible] of January the steamer Chase brought in the hois[illegible] and on the [illegible] it was placed aboard the sc[illegible] and setting up the machinery began.

The weather was stormy and little progress could be made wit[illegible]

[illegible] the [illegible] of January bids were received for furn[illegible] wharf at the mouth of the river, and a contract wa[illegible] delivered at Florence.

[illegible] February a raft of 100 piles was received, and on [illegible] the driver to the mouth of the river, where 8 piles [illegible] opposite the old cannery, to serve as a be[illegible] in use. The machinery worked very well, alth[illegible]

[illegible]—The receiving wharf is located with its front [illegible] Hill with an approach 20 feet wide. Dimension[illegible] width, [illegible] feet.

[illegible] longitudinal rows of fir piles driven 10 feet ap[illegible] with [illegible] pieces drift bolted to piles. Braces and [illegible] longitudinal and transverse rows of piles, all securely [illegible]

inches were placed over each transverse row of piles, and between the 3 by 12 inch joists were placed.
oring is composed of 2 by 12 inch planks spiked to stringers and joists.
line was placed at the south end of the wharf for landing lumber and other s.
iving, etc.—Pile-driving for the wharf was attended with some difficulty on of the heavy swells from the ocean making it difficult to keep the pile-driver on; the crew, too, were untrained for such work. The river bed being rather ving was very slow work. The average penetration was about 8 feet through f sand, then into decomposed or soft sandstone, and there will be no danger scouring effect of the current. The front row of piles for the warf was water 10 to 12 feet deep at low tide.
g engine for wharf.—The hoisting engine for wharf has been received and position on the wharf, but the boiler is not yet in position. This engine t at the works of J. S. Mundy & Co., Newark, N. J. Has two cylinders 9 hes; single drum; 50 horse power, and substantially built.
rrick machinery for wharf has been received, but has not yet been set up.
tive.—The locomotive "Siuslaw" has been received and stored on the wharf. motive was built at the works of H. K. Porter & Co., Pittsburg, Pa. It is ngine with 4 drivers; a saddle tank and trailing tender with 2 wheels. nt brakes, and altogether is very substantially built.
ars.—Irons for 12 dump cars have been received. These have been over- ad given a coat of metallic paint. Not having the wharf ready upon which the cars, the irons were stored under the mess house. The cars will be those in use at Yaquina Bay.
r for all the cars is now being prepared at one of the sawmills and they will as soon as practicable. They will have a capacity of 8 tons each, and with ocomotive on each jetty long trains of cars can readily be handled and the editiously done.
nd fastenings.—Thirty-four tons of 30-pound steel rails with the necessary frogs, and fastenings, have been received. They have all been given a coat etallic paint in boiled linseed oil, to protect them from the weather.
uarry.—The site selected for the rock quarry is located at Point Terrace e, about 12 miles above Florence. The rock crops out in bold pinnacles e river bank with very little vegetation growing on top of it, and can be arried. This rock is of a very fine grain, hard, and takes a polish, and suitable for all kinds of building purposes. Nearly 2½ acres have been in- r survey and comprise the best part of the quarry. Water for engine pur- l for mess and bunk houses is easily accessible. The river at quarry site is o with steep banks.
R. Stiles is the owner of the quarry, and has consented to make a lease to rnment for all rock needed on the works of improvement at 2½ cents per ton. ld carry with it also the privilege of erecting buildings, collecting water arious purposes of the work, and erecting a wharf and tank for the tow- c.
are other good ledges of sandstone rock on the river, but none so well located ying as that at Point Terrace.

Cost of plant, etc.

	$3,491.23
tive	2,824.99
pile-driver (complete)	2,921.32
oat	45.00
	81.00
cars (irons for)	2,000.00
rs	250.00
for tramway driver	667.00
g engine	2,000.00
	1,615.00
(incomplete)	260.00
s, frogs, switches, and fastenings	2,250.00
ieous (small tools, etc.)	431.00
tal	18,836.54
ness house and bunk house	1,620.00
harf approach, etc	1,760.00

[illegible]

[illegible] over [illegible] which [illegible] Bay [illegible]

[illegible] Bay.

[illegible] — [illegible] is [illegible] the [illegible]

The commercial importance of [illegible] now depends [illegible] irregular [illegible] and the small [illegible]

There is [illegible] steamers running direct to [illegible] over a very rough [illegible]

[illegible] Bay [illegible]

most exclusively for shingles, but none are shipped. Some cedar lumber is manufactured and shipped.

Spruce and hemlock abound, but are not manufactured into lumber to any extent.

Coal is said to exist in the hills to the southeast of Florence.

Rock has been found in the mountains back of Hecata Head indicating the presence of gold.

Clay of a fine quality abounds in the vicinity of Florence, but to what extent is not yet known. Samples have been fired and compare favorably with the manufactured article brought from California, and will make drain tiles, chimney flues, etc.

The run of salmon in the river is not as plentiful now as in former years when two or three canneries could be kept running each season, where only one runs at present with a very light catch. The product is shipped to San Francisco.

Shipping.—The following is a list of the steamers and sail vessels running to Florence during a portion of the year, with their tonnage:

	Tonnage.
Steam schooner *George H. Chance*	71.17
Steam schooner *Mischief*	48.43
Schooner *Free Trade*	86
Schooner *Albion*	70
Schooner *Amethyst*	71
Schooner *Helen Merriam*	70
Schooner *Mary De Leo*	50

The schooners were all from San Francisco, and brought merchandise, and returned loaded with lumber.

The small steamer *Lillian*, belonging to Florence, runs as a towboat on the river and tows the schooners to sea, but she is hardly large enough for the service. The trade does not as yet justify the employment of a regular tug.

The bar, with an average depth at present of about 7 feet at low water, does not justify the employment of large craft in the trade. The small schooners now running here bring loaded only 15 or 20 tons of merchandise, and therefore run very light. They can cross in at half tide, and the practice has been to station the steamer *Lillian* close down to the bar and let the vessels sail in to her; then they are taken in tow and brought up the river.

There are three small steamers running on the river; they are the *Lillian*, *Coos*, and *Mink*. The latter was engaged until recently in carrying the mails and passengers between Florence and the head of tide.

The *Coos* has now taken the place of the *Mink* on the route, as she is a side-wheeler and has better accommodations.

The question of building a railroad between Eugene and Florence has been agitated for some time past, but no definite arrangements looking to its early commencement have as yet been effected. Such an expensive undertaking does not, at the present time, seem to offer inducements for the investment of capital. A good well-graded wagon road, built from the head of tide to Eugene, would suffice for the present needs of trade.

Should the bar ever be improved, Florence would become quite a shipping point, and a railroad built from here to Eugene and on to a connection with some eastern line would offer another competing line for carrying the products of the Willamette Valley and the country east of the Cascade Range to market.

On the 14th instant the steamer *Lillian* towed the schooner *Amethyst* to sea loaded with lumber for San Francisco. The bar was smooth and the master of the *Lillian* reports that he found 12 feet at high water with a 6¼-foot tide; the inner channel showed 19 feet close to the bar, which is in the form of a ridge, with a steep slope outside running at once from 15 to 20 feet. It is to be regretted that a careful survey can not at the present time be made.

Northwest winds have prevailed of late with fog, but if an opportunity presents I will endeavor to run a few lines with the *Lillian* out over the bar.

Capt. S. R. Babbidge was connected with the work for several months as foreman, but recently resigned to accept a position at Newport. He proved of valuable assistance to me in getting the work started.

In compliance with regulations the men work 8 hours a day, but under emergencies, and to take advantage of the weather, tides, etc., this time is increased.

In conclusion I desire to acknowledge the prompt attention given by all employed

our obedient servant,

GWYNN A. LYELL,
Assistant Engineer.

I. A.

COMMERCIAL STATISTICS.

Florence is in the collection district of Yaquina, and was settled in 1876.

The commercial importance of Florence now depends solely upon the steamer *Chance*, which makes irregular trips, and the small coasting schooners which have been running to the place.

There is no line of steamers running direct to Florence at this time.

No outlet exists to the valley except over a very rough mountain road almost impassable in winter, and down the beach via the Umpqua River, over both of which routes mails and passengers are carried.

A mail now goes twice a week to Waldport on Alsea Bay, and Newport on Yaquina Bay via Hecata and Cape Perpetua, formerly on horseback; now, however, it goes as far as Hecata over the new light-house road.

The following table has been compiled from the records of this office and is approximately complete for the past year.

Commercial statistics for past years are not attainable, other than those already published in reports relative to this place.

Shipping, 1891-'92.

	No.	Tons.
Arrivals	22	76[illegible]
Departures	23	1,4[illegible]
Total	45	2,1[illegible]
Built	1	[illegible]
Steamers and vessels running to Florence	9	[illegible]

Arrivals and departures of passengers by steamer, 36.

Articles.	Tons.	Articles.	Tons.
Exports.		*Imports*—continued.	
Salmon:			
Salt ([illegible] barrels)	22	Hay	10
Canned ([illegible] cases)	74	Lime	18
Hides, green	2	Cement	36
Miscellaneous	3	Flour and feed	143
Lumber, fir, and cedar ([illegible] feet, B. M.)	1,529	Shingles (25,000)	5
		Boiler and fixtures	1
Total	1,6[illegible]	Powder	2
		Tin plate	34
Imports.		Salt	4
		Pig tin, and lead	3
Miscellaneous, merchandise, etc	346		
Steel rails, locomotive, hoisting engine, dump cars, etc., for jetty construction	165	Total	78[illegible]

T T 5.

IMPROVEMENT OF ENTRANCE TO YAQUINA BAY, OREGON.

Description of original condition.—The usual prevailing depths over [illegible] before improvement, were from 7 feet to 8 feet. [illegible] channels existed, known as the north, middle, and south channels. The south channel was the one mostly used, but was rendered [illegible] by the presence of rocks. The middle channel, though [illegible] was [illegible] the shallowest of the three, and so was little used. The north channel, besides being long and tortuous, was so [illegible] with rocks as to be considered unnavigable. Owing to the [illegible] of the bar these channels were constantly changing in position and depth.

[illegible]

Plan of improvement.—The project adopted in 1881 was to run out a ke or jetty on the south side of the entrance so as to cause the south annel to shoal up and the flow to be deflected northward, with a w to opening and maintaining the central channel with a least depth 17 feet at high water.

As originally projected the dike was to start from near low-water e and run out into the sea a distance of 2,500 feet, and was to rise to eet above mean low water. The beach on the line of the jetty from gh-water level was to be protected by sinking gabions in the beach th sand heaped over them, and by covering the surface with a layer mattresses and stone.

The stone for the jetty was to be deposited in place from barges, and bs were to be used if practicable. It was found, however, that cribs ald not be used on account of the strong currents and high seas, and at the ocean swell, even in quiet weather, was too great to permit the e of stone barges. Accordingly the jetty had to be built from the ore end by carrying the stone out over a tramway, and was begun at gh-tide line instead of at low-tide line, thus making the total proted length of the jetty in 1881, 3,700 feet.

In 1884, the jetty was extended shoreward a distance of 316 feet, to se a gap that had been washed out by the sea, making the total proted length at that time about 4,000 feet.

The present project, adopted in 1888, is to raise the south jetty to full gh water without extending it seaward, thus making its total length 48 feet, and to construct a mid-tide jetty on the north side of the trance about 2,300 feet in length, extending from the north head ong and behind the reef putting out from the head to a point opposite e end of the south jetty and distant from it about 1,000 feet.

APPROPRIATIONS.

t of	
June 14, 1880	$40,000
March 3, 1881	10,000
August 2, 1882	60,000
July 5, 1884	50,000
August 5, 1886	75,000
August 11, 1888	150,000
September 19, 1890	165,000
Total	550,000

Amount expended to June 30, 1891, was $451,239.57.

Results obtained to June 30, 1891.—The following extract from my st annual report gives the results which had been obtained to June , 1891:

The work during the past fiscal year has been chiefly confined to the extension of north jetty. The tramway of this jetty has been extended 600 feet, and 30,327 s of rock have been placed upon this new extension and the old portion of the ty.

Mr. Lyell, the assistant in charge, reports that there has been a general depth on bar throughout the year of 10 to 12 feet at low water.

The tendency of the channel to run straight out has been materially increased by extension of the north jetty. The full results of the work done can not be real-d until the north jetty is built out to an equal length with the south jetty.

Under the influence of the southerly winds, sand is moved and accumulates under lee of the south jetty, and the ebb current not being strong enough to scour it ay it is deflected to the north and finds its way to the ocean without doing much d on the bar. This accumulation of sand on the channel side of either jetty will , in all probability, be possible when the north jetty is completed.

The recent careful survey of the Yaquina entrance shows a low-water depth of 11 t.

The results obtained by the work done during t
been highly satisfactory. The extension of the nc
vented the formation of a sand bank under the lee
and the entrance channel has been continuously str

The bar depth of 11 feet at low water reported l
materially increased. During the past winter it
ported by the pilot in charge of the bar tug that th
15 feet on the bar at low water. Recent soundings
indicate even a greater depth than this, and it is bel
channel now has a least depth of 16 to 18 feet.

It is intended to make a careful survey during th
as the north jetty is extended to its full length to de
conditions on the bar.

Report of operations.—Mr. Eugene Ricksecker assu
of the work at Yaquina Bay on August 18, 1891, rel
A. Lyell, who was placed in charge of the improve
mouth of the Siuslaw River.

The extension of the north jetty tramway was cont
ginning of the fiscal year until early in October, 1891
on September 8, having torn away two completed b
tially completed one, and further damage being thre
ommended September 21 that work on the north jett
porarily and not resumed until the weather should
and that in the meanwhile operations be transferred
This was approved under date of October 1, 1891.
bents carried away had been replaced and the tram
bent farther, when operations ceased.

The amount of tramway built since March 28, 1891
1,035 feet, making a total length of 4,153 feet, of wh
constructed after June 30, 1891. The approach to
2,100 feet in length.

The work of dumping rock on the north jetty wa
February 13, 1892. By this time 41,530 tons had b
jetty since February 1, 1891, and the enrockment wa
that called for by the project. As the rock composi

'm elevation of 19 feet to a point where the sand dunes meet the jetty miles from the new wharf. Storms during December were unually severe and the south tramway suffered considerable damage in nsequence. During February the tramway was further repaired for distance of 500 feet.

During the year, 12,519.51 tons of rock were placed on the jetty.

The lower quarry was abandoned February 17th, another slide havg occurred there in January. The upper quarry was worked during le entire year. The removal of debris from the upper quarry proving oublesome, it was finally decided to use cars for carrying it away; 0 feet of track were laid. In February, the north side locomotive id cars were transferred to the quarry, and debris was dumped along e river bank on land purchased by authority for that purpose.

Two new scows were built during the winter at an approximate cost r the two of $3,400. They were launched on November 27 and on anuary 1.

Much miscellaneous work was done during the year, including the verhauling and repairing of several scows; the repairing of the locootive, cars, and rock boxes; the building and fitting out of a blackaith shop, and a large amount of general repairing. The plant has een kept throughout in good condition.

Authority having been granted therefor, a naphtha launch for the e of the assistant in charge at Yaquina Bay was purchased at a cost $937.50. She arrived at Newport on February 11, and is of great rvice.

By agreement with Mr. Samuel Case, the lease of a strip of land ocpied by the tramway leading out to the north jetty was renewed from eptember 17, 1891, for a period of three years, at a rent of $100 per ar, payable semiannually.

The lease of wharf and buildings at Newport expired December 15, 891, and was then renewed by agreement with Messrs. Winant, Buckly Warren for a period of three years, at a rent of $180 per annum, ayable quarterly.

The lease from L. E. Davis of land on the south side of Yaquina Bay ccupied by the tramway, which expired January 1, was renewed for a eriod of five years, at a rent of $15 per annum.

Recommendations and remarks.—The extension of the north jetty is aught with much uncertainty. It is founded upon rock. The tramay piles do not penetrate this rock more than a foot or two, and are ecured in place by bracing and as soon as possible by dumping rock bout them. If, before they are finally secured by the enrockment, a evere storm occurs, the piles are very apt to be washed away. Such as been the case on several occasions. It is hardly possible to estiate what will be the cost of completing this jetty owing to this cirumstance.

Last year the amount estimated for the completion of the existing roject was $165,000. The river and harbor bill now in Congress cares $75,000 for this work. This leaves a balance on the estimate of 90,000. This is the amount stated that can be profitably expended uring the next fiscal year for the completion of the project. It is possile that this amount is in excess of what will be required for the comletion of the work. A close estimate of the cost of completing the ork can be made one year from the present time.

Future operations.—It is expected to continue work on the north tty now until it is finally and fully completed in accordance with the

plan of the Board of Engineers. When this i
south jetty will be commenced and carried to
The report of Lieut. G. D. Fitch, Corps o
charge of the work, is herewith.

Money statement.

July 1, 1891, balance unexpended	
Amount refunded March 17, 1892	
Amount expended by Treasury Department	
June 30, 1892, amount expended during fiscal year	
July 1, 1892, balance unexpended	
July 1, 1892, outstanding liabilities	
July 1, 1892, balance available	
Amount appropriated by act approved July 13, 1892	
Amount available for fiscal year ending June 30, 1893	

Amount (estimated) required for completion of existi
Amount that can be profitably expended in fiscal year en
Submitted in compliance with requirements of sectio
harbor acts of 1866 and 1867.

REPORT OF LIEUTENANT G. D. FITCH, CORP

UNITED STAT
Ne

SIR: I have the honor to submit the following report
ment of the entrance to Yaquina Bay, Oregon, for the fis
I assumed local charge of this work on April 18, 1892
secker, who had been in charge since August 18, 1891, t
ceeded Mr. G. A. Lyell.

At the beginning of the fiscal year work was in activ
Removing débris from the upper quarry preparatory
Quarrying at the lower quarry.
Constructing a new wharf and approach on the south
Placing rock on the north jetty and driving piles for

Quarry operations.—The lower quarry was worked co
1892, upon which date it was abandoned on account of
in January, covering the greater part of the workable

The upper or Government quarry, which had been re
count of a former slide in the lower quarry during Ma
the entire year. The rock from this quarry is much ha
quarry. There was a large quantity of débris to remov
first this was placed on scows and dumped along the b
ity. This method proving objectionable, it was decide
Four hundred feet of track was accordingly laid in Feb
motive were transferred from the north side to the
dumped on land purchased for the purpose just above
By this means the earth could be disposed of rapidly.
quarry, except a small part at one end, is free from déb

During the year the lower quarry furnished 141 scow
quarry 110, averaging about 250 tons per scow. Abou
removed from the upper quarry.

The force employed at the quarry consists of: One
one engine tender, at 37½ cents per hour (he tends b
engine and has no fireman); one blacksmith, at 35 cen
cents per hour, and 24 quarrymen, at 25 cents per hour

South side.—At the beginning of the fiscal year the
receiving wharf had reached a length of 2,088 feet, and
During July, 1891, 1,200 feet of trestle was built. Dur

necessary for the approach and wharf were driven and the work completed in September. The new wharf is 3,500 feet from the old one.

Early in October operations were begun again on the south side, and during that month an engine and tool house was completed and a number of old dump cars were repaired. During November and until the middle of December repairs were made to the old tramway. Then the work of unloading and dumping rock on the south jetty was started.

By the middle of February the enrockment had reached a nearly uniform elevation of 10 feet from a point where the sand dunes meet the jetty out to the old crib, which is about 1¼ miles from the new wharf.

On December 16 the wreck of an old vessel, entering the bay under a heavy sea and high tide, struck the south tramway a few hundred feet inside the old wreck in *Yaquina Bay*, and tore away about sixteen bents of tramway and superstructure.

Storms during December were unusually severe, and the south tramway suffered in consequence considerable further damage.

During February the south tramway was repaired over a length of 500 feet.

During the latter part of March all work ceased on the south side, and preparations were made for resuming work on the north jetty tramway.

During the year about 12,500 tons of rock were dumped on the south jetty. The only employé on the south side at present is a watchman, at $60 per month.

North jetty.—At the beginning of the fiscal year the north jetty tramway had reached a total length of 3,720 feet, and the work of tramway extension was in active progress.

A heavy storm on September 8 having torn away two complete bents and one partially completed one, and further damage being threatened, authority was obtained to stop work temporarily on the north jetty tramway until the weather should be more favorable. By October 8 the two bents carried away had been replaced and the tramway extended one bent farther.

Operations, except that of dumping rock, were then transferred to the south side, and the extension of the north jetty tramway ceased for the season, twenty-nine bents, or 435 feet, of tramway having been constructed since June 30, 1891.

Work was resumed on the north jetty tramway on April 4, 1892, and by April 21 ten bents had been built. A severe storm on April 24 and 25 carried away six of these bents; three of them had been replaced when another severe storm on April 28 carried away the last bent replaced, and did more or less damage to the six preceding bents. Work had been resumed too early in the season. Since the second storm the weather has not caused further damage. The work of tramway extension has, however, proceeded at a slow rate necessarily, owing to the fact that the bottom is of rock, and as the piles can obtain no penetration, it is necessary to secure each bent by dumping rock before proceeding to the next.

From April 4 until the present time (June 16), 27 bents, or 405 feet, of tramway, have been constructed; making a total length of 4,560 feet, of which 840 feet were constructed during the fiscal year. The tramway will probably be completed by the latter part of July.

The work of dumping rock on the north jetty was continued from the beginning of the fiscal year until February 13, 1892. By this time about 41,000 tons had been placed on the jetty, and the enrockment of the portion already constructed was fully equal to that called for by the project. Rock dumping therefore ceased until April 4, since which date about 8,800 tons of rock have been dumped on the portion of the jetty since then constructed.

The total amount of rock placed on the north jetty during the year was about 49,800 tons. Little settlement is expected, as the dumping was practically on a rock bottom.

The portion of the jetty built this season has reached a height of about 2 feet above mean lower low water, except that the last 60 feet is somewhat lower. Sand is being deposited in large quantities along the ocean side of the north jetty.

The force employed on the north side consists of 1 clerk, at $90 per month; 1 pile-driver foreman, at $105 per month; 1 foreman, at $80 per month; 1 watchman, at $60 per month; 1 storekeeper, at $60 per month; 1 locomotive engineer, at 35 cents per hour; 1 engine tender (pile-driver), at 32½ cents per hour; 1 blacksmith, at 30 cents per hour; 1 engine-tender (hoisting engine), at 27½ cents per hour; 1 train foreman, at 27½ cents per hour; 1 scow foreman, at 27½ cents per hour; 1 dock foreman, at 27½ cents per hour; 4 riggers on pile-driver, at 27½ cents per hour; 3 laborers, at 25 cents per hour, and 6 laborers, at 22½ cents per hour.

Miscellaneous.—Much miscellaneous work was done during the year, including the overhauling and repairing of several scows; the repairing of the locomotive and cars; the construction of a large number of dirt boxes; the building and fitting out of a blacksmith shop, and a large amount of general repairing.

The only additions made to the plant during the past year were two scows built at Toledo by hired labor, and a naphtha launch purchased for the use of the assist-

By agreement with Mr. Samuel Case, the lease of a strip of tramway leading out to the north jetty was renewed from Sep period of three years, at a rental of $100 per year, payable sem

The lease of wharf and buildings at Newport expired Decem then renewed with Messrs. Winant, Buckley & Winant, by ag of three years, at a rental of $180 per annum, payable quarter

The lease from Mr. L. E. Davis of some land on the south which expired January 1, 1892, was renewed for a period of fiv $15 per annum.

A table of commercial statistics for the year will be sent month.

Very respectfully, your obedient servant,

GRA

First Lieut.

Capt. THOMAS W. SYMONS,

Corps of Engineers.

COMMERCIAL STATISTICS.

Yaquina Bay is in the collection district of Yaquina. Y entry. The nearest light-house is at Cape Foulweather, 4½ m trance. Yaquina Bay forms (with the Oregon Pacific Railroa from Portland and Willamette Valley to San Francisco.

The following returns were collected by Lieut. G. D. Fitch in local charge of the work at Yaquina Bay, and are for the fi 30, 1892:

Arrivals and departures of vessels.

Arrivals	
Departures	
Total	

Exports and imports.

Article.	Quantity.	Article.	Quantity.
Exports.		*Exports*—Continued.	
...tons..	7,260	Seal furs...do...	1.9
...do...	9,202.1	Miscellaneous merchandise...do...	753.8
...mber ... feet, B.M..	214,500	Oil...do...	1.5
.....tons..	429.1	Bones...do...	10
...ur and feed...do...	981.5	Trees...do...	3
...atoes...do...	1,270		
...al...do...	62	Total...do...	20,516.8
...p knees...do...	53.8		
...gs...pounds..	200	*Imports.*	
...number..	75		
...tons..	180	General merchandise...tons...	4,792.1
...do...	66.9	Machinery...do...	47.7
...rdware...do...	1.2	Coal...do...	201.7
...do...	27.2	Hardware...do...	1,437.8
...des...do...	18.3	Malt...do...	58.4
...ds...do...	6.9		
...do...	167.5	Total...do...	6,537.7
...xcelsior...do...	20		

...timated value:
Imports ... $515,558
Exports ... 317,294

T T 6.

IMPROVEMENT OF TILLAMOOK BAY AND BAR, OREGON.

Description of original condition.—The channel over the bar is direct d shifts but little, so that the bar is considered one of the safest on e Oregon coast. A fair depth of water is maintained throughout ›st of the year, and vessels drawing as much as 13 feet can usually ter without difficulty. The bay at low tide consists of three chanls running through sand and mud flats. These channels are of fair pth near the entrance, but gradually shoal up, giving depths of only ›r 2 feet near the head of the bay. Tillamook, the principal town of e region, is situated on a tidal slough above the head of the bay, and n only be reached by light-draft vessels at high tide.

Plan of improvement.—No general plan and project for the improveent of the bay and bar have yet been approved. A special project r the expenditure of the money appropriated by the act of August , 1888, has been approved. This consisted in making a survey of the r and entrance and the construction of longitudinal and spur dikes d shore protection works to deepen the water over Dry Stocking Bar the mouth of Hoquarton Slough and to remove snags and overhangg trees from Hoquarton Slough.

APPROPRIATIONS.

t of—
August 11, 1888 ... $5,200
September 19, 1890 ... 500

Total ... 5,700

Amount expended to June 30, 1891.—The amount expended to June 30, 91, was $4,922.95.

Results obtained to June 30, 1891.—No work was done during the year

1890–'91, and the condition of affairs remained practically the same as at the end of the previous fiscal year, June 30, 1890.

During the year ending June 30, 1890, a survey of the bar and entrance to the bay was made. Hoquarton Slough was cleared of snags as far as Tillamook City.

During the high water of November and December, 1889, the longitudinal dike and three spur dikes adjacent thereto were washed away. So no results of any practical importance or permanence had been obtained up to June 30, 1890.

The amount expended during the fiscal year ending June 30, 1892, was $709.90.

Results obtained to June 30, 1892.—No work was done beyond the survey hereinafter mentioned, and no results were obtained during the year.

Report of operations.—During July, 1891, a survey of the entrance to Tillamook Bay was made by Mr. John R. Savage. The results of this survey and report thereon are published in House Ex. Doc. No. 3[illegible], Fifty-second Congress.

Recommendations and remarks.—A special project for the improvement of Tillamook Bay having been submitted, no further recommendations and remarks are now deemed necessary.

Money statement.

July 1, 1891, balance unexpended	$77[illegible]
June 30, 1892, amount expended during fiscal year	70[illegible]
July 1, 1892, balance unexpended	6[illegible]
Amount appropriated by act approved July 13, 1892	15,00[illegible]
Amount available for fiscal year ending June 30, 1893	15,06[illegible]

COMMERCIAL STATISTICS.

Tillamook Bay is in the collection district of Oregon. Astoria, near the mouth of the Columbia River, is the nearest port of entry. The nearest light-house is at Cape Meares, about 4 miles south of the entrance.

The following returns furnished by Mr. Charles Lamb, of Tillamook, are for the year ending June 30, 1892:

The number of vessels of all descriptions crossing in over the bar during the year was 74. The number crossing out was 73. Their names, draft, and registered tonnage are as follows:

Vessels arrived and cleared.

Name.	Trips.	Registered tonnage.	D[illegible] loa[illegible]
			F[illegible]
Steam schooner Truckee	20	350	
Steam schooner Scotia	12	200	
Steamer Homer	1	420	
Steam schooner R. P. Elmore	12	30	
Steam schooner Augusta	21	87	
Steam schooner W. H. Harrison	5	70	
Steam schooner Gen. H. Chance	2	71.17	
Steam scow Improvement	1	13	

Vessels built during the year.

Name.	Tonnage.	Draft.
...er Gen. Garfield, rebuilt (runs on Tillamook Bay, towing and freight busi-...s)	10	*Feet.* 7

Articles.	Quantity.	Value.	Articles.	Quantity.	Value.
Exports.			*Imports.*		
...er ......feet B. M..	12,650,000	$164,450	Sawmill machinery† ......tons..	50	$14,000
Do...........tons..	25,800	....	Electric-light plant.do...	30	5,000
...n, canned .....do...	684	90,250	Stave factory......do...	80	5,000
...r...............do...	30	12,000	General merchandise, ...tons..	5,600	420,000
...............do...	6	1,500	Agricultural implements..........tons..	150	7,500
...............do...	25	5,000	Flour..............do...	380	11,400
...............do...	5	750	Feed...............do...	350	7,000
...rage stock*...do...	100	1,000	Shingles...........do...	125	500
...al merchandise, ...tons..	175	13,125	Brick..............do...	130	520
Total..............	26,825	288,075	Total.............	6,895	470,920

* Stave mill just started. † Now under construction.

T T 7.

...ROVEMENT OF ENTRANCE TO HARBOR AT NEHALEM BAY, OREGON.

...escription of original condition.—Nehalem Bay at high water is about ...les long by 1½ miles wide at widest part, and is connected with the ...n by a narrow channel extending in a southerly direction about 3 ...s. This channel varies in width from 1,000 to 2,000 feet at high ... A low, sandy peninsula, about 2½ miles long and one-fourth mile ...e, lies to the west of this channel and separates it from the ocean.

...he southern end of this peninsula forms the northern shore of the ...ance. Between this and the main shore, limiting the entrance on ... south, is a distance of 1 mile. The entrance channel shifts within ...e limits of 1 mile, occupying sometimes a southerly position and ...etimes a northerly one, and sometimes there are two channels sep...ed by a sand island bare at low water. At the time of the survey ...une, 1889, a depth of 6 feet was found on the bar at the northern ...nnel. The ordinary bar depth may be stated to be about 5 to 6 feet ...ow water.

...lan of improvement.—The plan of improvement recommended by ...t. Young was to build two high-tide stone jetties converging until ... distance apart is about 500 feet, and then, if necessary, running ... to sea parallel to each other to such distance as will insure a low...er depth on the bar of at least 8 feet; the north jetty to rest on the ... of the sandy peninsula and the south jetty upon the mainland, the ...ect being to hold the channel in its southerly position.

...he cost of the work, as estimated by Capt. W. Young, Corps of En...eers, was $325,927.50.

...ubsequent estimates made in May, 1891, show that the cost was ...erestimated by Capt. Young, and that the work will cost $712,388.

APPROPRIATION.

Act of September 19, 1890, "for commencement of jetty construction," $10,000.

Amount expended to June 30, 1891.—There were no expenditures for the year ending June 30, 1891.

Results obtained to June 30, 1891.—No work was done and no results obtained.

The amount expended during fiscal year ending June 30, 1892, was $415.08.

Results obtained to June 30, 1892.—No work other than the survey hereinafter mentioned was done and no results were obtained.

Report of operations.—The sum of $10,000 being inadequate even to procure the necessary plant to commence jetty construction at the mouth of the Nehalem, no final project was made or approved, and all work of actual construction was postponed.

During May, 1891, a reëxamination of the entrance was made, and it was found that the north channel had shoaled up, and only the south one was open.

A careful study of the project was made, and the cost of its carrying out estimated, with a result of forcing a conviction that the original estimate was far too low, in fact, not one-half of what the work would actually cost. This was laid before you in my letter of June 11, 1891.

Under date of June 25, 1891, I was informed that the Secretary of War had directed the withholding of the expenditure of the appropriation until Congress shall have taken further action in the matter.

In July, 1891, a resurvey of the Nehalem entrance was made by Mr. John R. Savage, on the steamer *Gen. H. G. Wright*.

Mr. Savage's report accompanies this report.

NEWPORT, OREGON, *July 28, 1891.*

CAPTAIN: I have the honor to submit the following report of the survey of the entrance to Nehalem River, Oregon:

Arrived off the Nehalem River on the steamer *Gen. H. G. Wright* on the morning of Monday, July 20, 1891, and crossed the bar at once and anchored about a quarter of a mile upstream. I found that none of the signals used in former years remained standing, so we started out at once and ran a meander line about 9,000 feet in length along the beach near high-water line, from which the various signals for sounding were located, either by offsets from the line, or, as in the case of the two signals on the spit, by cuts from the adjacent plugs on the meander line.

About two days were taken up in locating and erecting the necessary signals and about half a day in locating the high and low water lines along the shores as far as shown on the map, in each case the mean tide being taken.

The weather was very favorable for work on the bar while we were in the Nehalem, but on account of the shoalness of the water on the bar it was impossible to work more than two hours per day while sounding in the channel, and then only on the two hours of the flood tide preceding high water.

We worked two days on the bar and ran in all twelve lines in and out over the bar, sufficient to give a good idea of its shape and the depth of water to be found on the same, which at mean high tide is about 11 feet, or, in other words, 4 feet at low water with a narrow bar channel 5 to 6 feet in depth, as shown upon the plot.

While sounding upon the bar there were about 115 observations taken with the sextant and about 475 casts of the lead made.

About a day was spent in developing roughly the river for about a mile inside the entrance.

The channel has changed its position very much since the last survey two years ago, and it is now very much more to the south, and what was then the channel is now entirely filled up with sand above the low-water line. The change in the channel is by no means unusual, as I was told that the channel had shifted from the north channel across the spit to its present position and back again two or three times in the last two or three years. The last change occurred some time during this last spring, either in March or April. When Capt. Schrader, of the steamer *Augusta*, went in he used the north channel across the spit, and when he crossed the again a week later the channel had shifted to the southward, about where it is r.

'wo or 3 miles up the river, at a cannery wharf, I found the gauge used by Lyell in his survey of two years ago, and set up a new gauge with its zero 2 feet ɔw the zero of Mr. Lyell's gauge, which was set to the mean of the lower low ters.

set the gauge lower so as to catch the extreme low tides that were running while were in the Nehalem. I also checked the readings taken by comparing them h the times and heights of the tides for the Pacific Coast, which all in the mean e 2 feet less than the readings of the gauge; there was quite a noticeable differ- e in the times of the low waters, which, however, can easily be accounted for by gauge being nearly 3 miles from the ocean.

Very respectfully, your obedient servant,

J. R. SAVAGE.

apt. T. W. SYMONS,
Corps of Engineers, U. S. A.

Jnder date of February 17, 1892, by indorsement, I was directed to pare a project and estimate for the improvement of the Nehalem er entrance, including therein a historical account of the variations the entrance.

My report was made under date of February 29, 1892, and was as lows:

PORTLAND, OREGON, *February 29, 1892.*

ENERAL: I have the honor to acknowledge receipt, by indorsement, of orders to pare a project and estimate for the improvement of the Nehalem River entrance, luding therein a historical account of the variations of the same.

ehalem Bay, at high water, is about 2 miles long by 1½ mile wide at its widest t, and is connected with the ocean by a narrow channel extending in a southerly ection about 3 miles. This channel varies in width from 1,000 to 2,000 feet at h tide and from 500 to 1,500 at low tide. A low, sandy peninsula, about 2½ miles g and one-fourth mile wide, lies to the west of this channel and separates it from ocean. The southern end of this sandy peninsula forms the northern shore of entrance; between this and the main shore, limiting the entrance on the south, distance of 1 mile.

he entrance channel shifts within these limits of 1 mile, sometimes occupying a therly position and sometimes a northerly position, and sometimes there are two nnels separated by a sand island, bare at low water. The channel change from rthern to a southern position is a very common occurrence.

r. Savage, who made the last survey in 1891, states that the people told him that change had taken place two or three times within the same number of years. last change from a northern to a southern position, previous to the survey of 1891, rred in March or April of the same year, within the space of a week. He also es that most of the residents on the Nehalem are of the opinion that there is bet- water over the bar when the channel occupies the northern position.

the Pacific Coast Pilot, published by the Coast and Geodetic Survey, it is stated, iving an account of this survey of the river in 1875, that "at the time of the sur- in 1875 the low-water channel of the river at the entrance was 160 yards wide, at the bend, 3 miles inside, it was 650 yards wide. The bar of the river was not ded, but it was sufficiently near to the observers to be watched from the shore, for five months they never saw it without a break entirely across it. It was be- ed to have less than 6 feet of water upon it. The channel evidently shifts with y storms. * * *

In July, 1867, when we were passing close along the coast, we found the Nehalem ing abreast of the position of the north point in 1875. * * *

In 1868, during an examination of the river, the bar broke continuously and was pproachable. * * *

At high water the sea breaks entirely across the narrow channel as far northward e sand point, effectually closing the river."

e river and harbor act of March 3, 1875, directed that an examination should be e of the mouth of the Nehalem River. This was not done directly by the Corps ngineers, but was done by Capt. Gilbert, an assistant of the Coast and Geodetic rey, who was at work in that vicinity, and he made the examination in accord- with orders from the Superintendent of the Coast Survey.

e quotation just given from the Pacific Coast Pilot is based upon Capt. Gilbert's nination.

e mouth of the Nehalem was next examined by Mr. Philip G. Eastwick, under orders of Capt. Powell. No boat could be obtained for taking soundings on the bar, but vations as Mr. Eastwick was able to make confirmed the estimate of its d l at by Capt. Gilbert. Neither Capt. Gilbert's report nor the report of ck give any data as to the variations in the entrance channel.

Again, in nother examination was made by Lieut. Edward Burr, of the Corps of Engineers, under the directions of Capt. Powell.

Lieut. Burr states in his report that at the time of his visit to the Nehalem "it was not possible to get out on the bar, as the sea was breaking entirely across the entrance, and there was nothing available, besides, but a rowboat.

"I am under the impression that there is a very small depth of water on the Nehalem Bar. No white man has ever sounded across the bar as far as I could learn. An Indian is said to have done so, and reported 8 feet at low water. But parties interested in small steam coasters, having examined the entrance with the idea of entering there, have declined to do so. Yet an employé of one of these coasters informs me that his vessel enters Nestucca Bay, where the depth on the bar is about 3 feet at low water. Again, on one day that I was at Nehalem Bar, the sea was comparatively smooth, and with a small surf on the beach, yet across Nehalem entrance the sea broke almost as heavily as on the beach.

"The river flows southward parallel to the beach for some 2 miles, and is separated from it by a narrow sand spit. The entrance seems to be working still farther to the south, cutting away the riv channel on the bar is almost a continuation of the river channel abo ears to extend through the breakers at a very acute angle to their ge

As a result of both of these ex t. Powell reported that the Nehalem entrance was unworthy of impro

Lieut. Burr in his report make the changes in the entrance channel.

In August, 1888, another de of the Nehalem Bay and Bar by Mr. J. S. Polhemus, under t. Young, and in 1889 a survey was made of the entrance by also under the direction of Capt. Young.

Mr. Polhemus states in his report e no soundings on the bar as it was too rough for the small boat at his le also states "in my judgment, the Nehalem is worthy of improvement survey should show this to be possible for a reasonable sum, for the re would afford an outlet for one of the largest and most valuable forests of e State of Oregon, and enable a section of country to support a greatly pulation."

Mr. Polhemus further states that the channel shifts like on the other coast bars."

Mr. Lyell, in his survey, made in 1889, finds two channels.

Mr. Lyell states in his report: "A second channel exists about three-fourths of a mile south of the present navigable channel. The Coast Survey charts of 1868 and 1875 show this channel open, and that at the north entirely closed at low water. I am not informed as to the period in which the shifting of the channel occurs."

By comparing the surveys of 1889 and 1891 with the survey of 1875 it is seen that the high-water line on the sand spit has moved south about 300 feet, while the same line on the east shore near the southern outlet has moved seaward about the same distance.

Mr. W. H. Wood, assistant engineer, who visited the Nehalem in 1891, was told that the change in the channels usually occurred every year, and about the times when the winds began to change from north to south and south to north.

From all the data available, it is concluded that there is no regular cycle of change in these channels, but that any heavy storm is liable to shift the entrance channel to any point from its northern to its southern position.

Any plan or project of improvement, the carrying out of which must of necessity extend over several years, must therefore ignore these changes to a very great extent.

It seems to me that it is only possible and proper to adopt the general project, and to leave the ultimate definite location of the works to be determined at the time the project is put into execution. I can see no serious defect in the general plan proposed for the improvement of this entrance by Capt. Young, and believe that, with some slight modifications, it should be adopted, leaving, as before stated, the ultimate location of the jetties to be determined when the plan is put into execution.

The essential features of this plan are a south jetty, forming an artificial headland, which shall keep the channel from cutting away to the south, and a north jetty, which shall hold the sands back and prevent them from piling into the channel under the influence of the summer littoral currents from the north, the two together to concentrate the flowing waters upon the bar.

The width between the jetties should be, in my opinion, 600 feet instead of 500, as proposed by Capt. Young, as wherever the river is 600 feet wide there is ample depth, and it is bad policy to choke the entrance against the inflowing waters any more than is necessary.

[illegible] south jetty should not break away from the shore so abruptly, as shown on [illegible]. Young's plan, but should leave it with a gentle curve.

[illegible] send herewith a blue print, upon which I have indicated two possible locations [illegible] a pair of jetties.

The extension of the jetties seaward is rather problematical. I have indicated on [illegible] plan the extent to which they should go to secure the maximum benefit under [illegible] existing conditions. The building of the jetties would, however, change existing [illegible] conditions, and because of the vast volume of sands in the vicinity, and the fact that [illegible] Nehalem entrance is in a shallow bight of the coast, it is altogether probable [illegible] they will have to be extended farther on account of the accumulation of sands [illegible] front of them.

[illegible] is probable that by confining the inflowing and outflowing waters between jet[illegible] 600 feet apart a bar depth of 8 feet at low water may ordinarily be expected. [illegible] this would by no means be permanent. Exposed to the full force of the ocean [illegible], the movable sands at a depth of 8 feet or less would be stirred up at every [illegible] moderate storm, and the bar channel reduced temporarily to the ordinary depth be[illegible] any improvements were undertaken.

It is also safe to predict that there would be times when the bar would exceed 8 [illegible] temporarily.

With such an entrance as the Nehalem it is in my opinion unsafe to predict any [illegible] permanent bar depth.

Estimates.—Any estimate of the cost of the jetties based upon existing conditions [illegible] depths must be approximate and subject to change. These conditions and depths [illegible] subject to change naturally, and the construction of the jetties would cause still [illegible] marked changes.

In making the following estimates I have assumed the present bottoms, as shown [illegible] the last survey, as the basis. The jetties are planned to be rubble mounds, on [illegible] mattresses, built to full high-tide level, 10 feet wide on top, with a slope of 1 [illegible] 3 on the channel side from high to low water, and a slope of 1 on $1\frac{1}{2}$ on the side [illegible] from the channel between high and low water, and slopes of 1 on 1 on both [illegible] below the water.

In order to provide for settlement of the rubble mound into the sand, and due to [illegible] scouring in the deeper contracted channel, and to abrasion, an allowance of 6 feet [illegible] increased depth is made in all estimates except the estimate for the jetty from the [illegible] of the North Spit extending southerly and limiting the river on the west. For [illegible] portion, from A to B, an allowance of 4 feet is made.

North location.

	Feet.	
Estimate:		
South Jetty, approximate length	4,500	
Rubble required, 108,308 cubic yards, at $4		$433,232
North Jetty, approximate length	4,200	
Rubble required, 93,367 cubic yards, at $4		373,468
Total		806,700

South location.

	Feet.	
Estimate:		
South Jetty, approximate length	2,700	
South Jetty, approximate length of tramway approach	5,500	
Rubble required, 69,760 cubic yards, at $4		$279,040
North Jetty, approximate length	6,800	
Rubble required, 115,205 cubic yards, at $4		460,820
Tramway approach, 5,500 feet, at $4		22,000
Total		761,860

The estimated cost of completing the project wherever the jetties are located will [illegible] about $800,000.

The cost of the plant necessary and the expenses attendant upon the commence[illegible]ment of this work in a manner commensurate with its magnitude is $50,000.

On account of the lack of any fixed, rocky headland, and the unstable character of [illegible] sands upon and in which this work must be founded, and the great changes [illegible] which are liable to occur at any time, it is particularly necessary and desirable that, [illegible] once commenced, it be prosecuted with vigor and with ample funds.

cation for this improvement being undertaken is, as stated by Capt. the lumber business by furnishing a harbor from which the im- f lumber tributary to the Nehalem could be shipped to market. not be obtained at the Nehalem sufficient in capacity to permit the ness to be carried on profitably, the improvement seems unjustifiable, as t interests involved are comparatively insignificant.

o carry on even a coast-wise trade in lumber profitably at present prices, or prices which could confidently be expected for years to come, requires a harbor with a greater depth of water on the bar than can be hoped for at the Nehalem, and a harbor where the vessels are not liable to be bar bound for weeks at a time.

It is not possible for me to believe that such a harbor can be obtained at the Nehalem. The lumber of the Nehalem must be shipped out of the country by some other route.

I entirely coincide with the opinion expressed by Capt. Powell, that the problem of providing this district with means of transportation would be satisfactorily solved by the construction of a railroad to the Columbia River, and by the establishment of a more convenient line of communication to Tillamook Bay.

Very respectfully, your obedient servant,

THOMAS W. SYMONS,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CAS
Chief of Engineers,

Recommendations and rema roject for the improvement of the Nehalem having been defin formally decided upon, and no work of construction having horized or commenced, I refrain from making any recommend o future appropriations, or as to the amount that could b xpended upon the work during the next fiscal year.

ment.

July 1, 1891, balance unexpended	$10,000.00
June 30, 1892, amount expended during fiscal year	415.08
July 1, 1892, balance unexpended	9,584.92

COMMERCIAL STATISTICS.

The following returns, furnished by Mr. E. G. Wist, of Nehalem, are for the year ending June 30, 1892.

The number of vessels of all descriptions crossing in over the bar during the year was 16. The number crossing out was 16. Their names, registered tonnage, and draft are as follows:

Vessels arrived and cleared.

Name.	Trips.	Registered tonnage.	Draft loaded.
			Ft. In.
Steam schooner Augusta	9	87	7 9
Steam schooner W. H. Harrison	7	70	6 9

As there were no winter freshets last season and the bar channel having shifted, vessel masters were very cautious and refused to come in; only 1 vessel came in during the month of May.

Articles.	Quantity.	Value.	Articles.	Quantity.	Value.
EXPORTS.			IMPORTS.§		
ax lumber* ....tons..	255	$14,000	Two sawmill outfits .tons..	150	$25,000
Coal† ....do...	5	25	One pile-driving outfit.do..	15	2,000
Butter ....do...	15	6,000	Merchandise and logging machinery ....tons..	650	50,000
Salmon‡...............do...	8	500	Cannery supplies ....do...	200	10,000
Salmon, canned ....do...	144	20,000	Total..................	1,015	87,000
Hides and furs........do...	10	10,000			
Elkhorns and beeswax.do...	3	1,200			
Chittem bark ....do...	3	300			
Total..................	443	52,025			

* Double amount on hand, but unable to ship.
† Sample.
‡ Off year for salmon; double the amount the year previous.
§ The bar channel having shifted, vessel masters were cautious and refused to enter.

T T 8.

IMPROVEMENT OF UPPER COLUMBIA AND SNAKE RIVERS, OREGON AND WASHINGTON.

Description of original condition.—Under the above head it has been deemed proper to officially include the continuous Columbia and Snake rivers from Celilo, at the head of The Dalles, to Lewiston.

The Upper Columbia and Snake form a continuous line of navigable river, but broken by many rapids, rendering navigation difficult and dangerous.

These rapids are in nearly every instance caused by rocky bars with occasional bowlders, and the channels were crooked and narrow.

Before improvement the ruling depth at low water was 2 to 3 feet on many of these bars, some of which were practically impassable at low water.

The Columbia was navigable all the year round, except when closed by ice. The Snake was, however, only navigable during high water and for three to four months in the spring of the year.

Plan of improvement.—Previous to 1877 $120,000 had been appropriated for the work of improvement, and had been expended in survey and rock removal at the principal rapids.

In 1877 Maj. J. M. Wilson made a project for the improvement of the upper Columbia and Snake rivers, consisting of removing rock bowlders, and rocky reefs, and scraping gravel bars in the Columbia and Snake as far as Lewiston. The estimated cost of this work was $132,000.

The present project or plan of improvement consists in removal of bowlders, gravel bars, and rock ledges, and putting in such contraction works as may be necessary.

The estimated cost of the work has not been accurately determined because of the lack of continuous and full surveys, because from the nature of things it can not be, as many of the obstructions which it is necessary to remove are continually recurring.

APPROPRIATIONS.

Upper Columbia River:	
Act June 10, 1872	50,00
Act June 23, 1874	20,00
Act March 3, 1875	35,00
Total	105,00
Upper Columbia and Snake rivers:	
Act August 14, 1876	15,00
Act June 18, 1878	20,00
Act March 3, 1879	20,00
Act June 14, 1880	15,00
Act March 3, 1881	15,0
Act August 2, 1882	6,0
Act of July 5, 1884	20,0
Act August 5, 1886	10,0
Act August 11, 1888	10,
Act September 19, 1890	20,
Total	151,
Aggregate	25

The amount expended on the project to June 30, 1891, was $134,44

Results obtained to June 30, 1891.—Up to this date no work had done in the river since the report of Maj. Jones, in 1889, was wri and consequently no additional results had been obtained.

Ice and heavy freshets had brought into the river channel a nu of great bowlders, which were an additional annoyance and dang boats navigating the river.

Although the work heretofore done on the river has been very ficial to navigation by lessening its dangers, it has not increase navigable depth and capacity, particularly of the Snake River.

As stated in Maj. Jones's report, the general result of all work and of natural forces at work has been to lower the bed of the [illegible] but it is found that the water surface has also been [illegible], so that the resulting navigable depth is about the same as which formerly existed.

The amount expended during the fiscal year ending June 30, was $[illegible].

Results obtained to June 30, 1892.—During the fiscal year en June 30, 1892, a large amount of work was done in removing bed and bowlders from the river between Riparia and Lewiston. The amount of rock removed was 293 cubic yards. The removal of thi of very great benefit to navigation, permitting the boats to carry than double the loads that they could have carried without th provement and with greater safety.

Report of operations.—Mr. W. H. Wood was placed in charge o work on the Snake, and left Portland August 6, 1891, and proc to Riparia, where the drill scow constructed the previous fiscal was moored.

A crew and full outfit of tools and supplies were secured, a August 28 the work commenced.

The plan of the work was to go from point to point up the stopping long enough at each bad place to remove the worst and dangerous rocks. The drill scow was towed from point to poi the steamers plying on the river.

Capt. Baughman, who has had charge of the steamers runni the river, was engaged to designate the points where work was

›d and to buoy the rocks of which the removal was most desirable. ractical and close knowledge of the river, gained by running on it stages for many years, was of the greatest benefit to the work, ing more to be accomplished for the benefit of navigation with the expenditure of time and money than could have been accom- ›d by any other method.

› work continued until November 28, 1891, when the scow was fast in winter quarters at Selkirk's old ferry, 6 miles below Lewis-

er this several days were spent in repairing the old crib at Log Rapids, and everything about the scow was made snug, and Mr. l returned to Portland December 15, 1891.

›ommendations and remarks.—Attention is invited to my last an- report under this head (p. 3212, Report of Chief of Engineers).

› only portion of the section of river under consideration which is ;ated is the Snake, from Riparia to Lewiston. Upon this portion e river is transported a large amount of grain, and it furnishes at nt the most convenient line of travel for a great section of country. this section of the river are many rapids, swifts, and shoals, where is necessary to secure the best available water. During periods ;h water great bowlders are moved from places where they do no ge to places where they are in the way of steamers, and these lers, like snags in some rivers, require to be repeatedly removed. is work requires yearly attention. A drill scow with an equip- of tools has been provided, which will enable the work to be done ›ly and expeditiously.

sides this work of rock removal, there are three places between ·ia and Lewiston where other work is necessary. These are at Goose Island, 9 miles above Riparia; Diamond Crossing, 13 miles › Riparia, and Log Cabin Rapids, 38 miles above Riparia.

Wild Goose Island the river is very wide and a number of gravel ls have been formed, which divide the waterway into a number of nels, which at low water become very shoal, crooked, and swift. low water now steamboats are compelled to use the south chan- hown on the plat. This is crooked and shoal above the rapid. traight middle channel becomes worse than the south channel at rater and can not be used. It is proposed to overcome the diffi- by building a stone dike across the south channel, as shown on lat, this dike to extend to 2 feet above low water. This, it is be- l, will force the water through the middle channel, thereby scour- ; to greater depth, lengthening the rapid and lightening the cur-

e estimated cost of this dike is $8,068.50.

Diamond Crossing there is a long shoal extending diagonally s the river, covering a distance of a half mile in the length of the The river is wide, the current light, and there is no defined nel. The present line of steamboat channel is very hard to navi- The boats have to drift nearly across the river in very shoal :, which in windy weather makes it extremely difficult to keep being driven on the bars.

s here proposed to build a stone dike 750 feet long to a height of ; above low water from the end of the gravel bar on the south side nto the stream, and thus force the water around same. This it is ved will give a narrower and deeper channel.

e estimated cost of this dike is $9,330.75.

Log Cabin Rapids the river divides into two channels—the north and south. Steamboats use the south channel, the north one being crooked, and with the fall so concentrated as to prevent boats going up it without lining. The south channel is only 4 feet deep in places at low water, and is constantly getting shoaler. It has a current of 6 miles per hour. The channel is full of bowlders and large gravel and is so narrow and crooked that in windy weather it is hard to navigate.

It is proposed to remedy the difficulty at this point by building a stone dike 300 feet long to 2 feet above low water, closing up the north channel and thus forcing the water at low stages through the south channel, giving a greater volume, which it is believed will both deepen and widen it.

The estimated cost of this dike is $5,810.75.

At this point there is a crib work built of timber and filled with stone, the object of which is to prevent boats drifting downstream from running on the rocky shore. This crib should be extended 50 feet farther downstream to more perfectly fulfill its mission.

The estimated cost of this extension is $1,016.63.

Plans showing the three bad places above mentioned and the proposed improvements are herewith.

The amount of money recommended for the next fiscal year is as follows:

Removing bowlders, rocks, etc	$5,000.00
Building dike at Wild Goose Island	8,068.50
Building dike at Diamond Crossing	9,330.75
Building dike at Log Cabin Rapids	5,810.75
Extending crib	1,016.63
Total	29,226.63

In round numbers, $30,000.

It is further recommended that the appropriation be made available as far as Asotin, about 7 miles above Lewiston, for reasons set forth in my letter of December 21, 1891, and published in House Ex. Doc. No. 77, Fifty-second Congress, first session.

Report of Mr. W. H. Wood, the assistant engineer in personal charge of the work, is herewith:

UNITED STATES ENGINEER OFFICE,
Portland, Oregon, December 24, 1891.

CAPTAIN: I have the honor to submit the following report of the work of improving the Snake River between Riparia, Wash., and Lewiston, Idaho, during the months of August, September, October, November, and December, 1891.

According to your verbal instructions I was placed in charge of this work August 1, 1891. I left Portland August 6 and proceeded to Riparia; thence to Lewiston.

I found the work most necessary to be done was the removal of numerous rocks or bowlders which had been carried down by ice and high water and deposited on the bars and shoals, thereby obstructing navigation very much, as they invariably lay in the deepest water, thus causing the boats to leave the channel to avoid same.

The United States drill scow *Tacoma* was tied up at Riparia in charge of Capt. E. W. Baughman. The same was turned over to me August 13, at which time the water in the river was 3 feet above low water, but falling rapidly.

It was deemed advisable to delay the work some days awaiting lower water. A part of a crew of men who were hired in Pasco, Wash., arriving at Riparia August 18, were put to work repairing and equipping the scow, taking aboard provisions, wood, etc. This work continued until August 28, when, having secured a crew of 10 men and the river having fallen to 1 foot above low water, I started to tow the scow up the river.

Arrangements had previously been made with Capt. Baughman to have the steamer *Annie Faxon* tow the scow from point to point as required.

Owing to high winds the steamer was unable to tow, and the scow was landed 1 mile above Riparia, from which point it was lined to Little Goose Island, 3 miles away, which consumed four days.

The actual work of drilling began here on September 3 and progressed until September 12. Forty-two and one-half linear feet of holes 2 inches in diameter were drilled in seven bowlders. The holes were fired and the bowlders completely broken up. Several smaller bowlders were also removed by grappling tongs. A channel was thus secured 100 feet wide, with a minimum depth of 3½ feet at low water; stage of water, +0.25. (All stages of water referred to Union Pacific Railroad gauge on abutment of railway bridge at Riparia.)

September 14, towed by steamer to mouth of Deadmans Gulch, 18 miles above Riparia. Here two large bowlders lay directly in channel. Four holes, each 3 feet deep, were drilled, loaded, and fired, and the bowlders completely removed.

September 18, towed from Deadmans Gulch to a point 2 miles above Almota, and 47 miles above Riparia. One large rock lay in channel here. Four holes, each 3 feet deep, were drilled and fired and the rock completely broken up, thus giving 6 feet of water at low-water stage.

September 20 and 21, the scow was being lined from the above point to rapid at Log Cabin Island, 4 miles above, where several bowlders lay in channel, and a small gravel bar formed at the lower end of the rapid was obstructing the channel. The rock was removed by the usual process of drilling and blasting. Twenty-two feet of holes were drilled in four rocks, which, when fired, were completely removed. A number of smaller bowlders were picked up and broken or removed from the channel.

The gravel bar was blasted by driving 3-inch iron gas pipe to a depth of 5 feet in gravel, and when heavily loaded and fired the gravel was so loosened that since that time the current has washed the greater portion away.

September 24, towed from Log Cabin Island to Kelleys Bar, 23 miles below Lewiston, where one large rock, submerged 2 feet, was directly in the channel. Nine feet of holes were drilled, loaded and fired, breaking up rock and leaving a depth of 6 feet at low water.

September 25, rafted scow 4 miles down the river to Truax Landing, where one bowlder lay in channel. Two holes, each 3 feet deep, were drilled and fired, completely removing the bowlder. Owing to a slight accident caused by the parting of a line, one of the spuds on the scow was broken and we lay at Truax Landing repairing the same until October 1, when the steamer towed the scow to Little Pine Tree Rapid, 13 miles below Lewiston. Here a quantity of work was to be done. Just above the rapids the river is wide and shoal, and what small channel there was was so obstructed by submerged bowlders that it was very difficult for boats to get through.

About 80 of these bowlders were removed. One hundred and three and one-half linear feet of drilling was done in thirty-nine holes, which were fired with good results, while a number of the smaller rocks were picked up with a derrick and tongs. There now remains a clear straight channel 150 feet wide, with a least depth of 5 feet at low water, which the river boats now go through without difficulty.

October 18, in tow of the steamer, we moved to Lewiston, where from this date until November 19, our time was spent in removing bowlders in this vicinity.

A total of 194½ feet of holes were drilled and all holes fired, and 132 cubic yards of rock removed by blasting, and a large number of small rocks removed with derrick and tongs, so that at present boats can load at Lewiston with 2,500 sacks of grain, where formerly 1,000 sacks were all they could get out with.

November 21, rafted scow down river to a bar 4 miles below Lewiston, and there removed one large rock from the channel. Three holes, each 4 feet deep, were drilled and fired with good results, and there is now 8 feet of water over the rock.

A heavy wind storm of three days' duration held us here unable to move. All through this work considerable time was lost on account of the wind, which frequently blows a gale. At such times we were not able to move or work.

November 28, the scow was rafted to winter quarters at Selkirk's old ferry, now known as Evans, 6 miles below Lewiston.

Repairing crib.—At Log Cabin Island a crib had formerly been built to aid in navigating the channel at that point, but it had been damaged to some extent by high water, and according to your instructions, I was to repair the crib. I purchased sufficient lumber at Lewiston, and on November 28 I started with lumber, raft, and men to repair the same, and reached the work the same day. The Union Pacific Company allowed me the use of their scow which lay at that point to live on. The weather turned very stormy and this work was not completed until December 8.

Following is a statement of the cost of the same:

Lumber	$99.36
Labor	159.80
Iron bolts, etc	11.45
Subsistence	56.79
Total	327.40

Having completed the above work and returned to the scow at Evans, and made some needed repairs, painting roof, etc., I took an inventory of all equipment; discharged all the men December 12, and returned to Portland December 15, 1891.

Much valuable aid was given me by Ca
the river for years) in pointing out all the
might have been overlooked, and in many i
were hard to discover, and otherwise aiding

All the equipment of the scow was store
the keys left with Capt. Baughman, who n
a quantity of powder that was left at Littl

The stage of water throughout this wor
than 1 foot from zero of gauge at Riparia, 1
clearing again.

Summarized

Total expenditures:
- Labor ....
- Equipment ....
- Supplies (work) ....
- Supplies (subsistence) ....
- Repairs to boat..
- Towing boat..
- Engineering ....

Total..

Summary of work:
- Work began August 19, 1891.
- Work ended December 12, 1891.
- Labor performed ....
- Holes drilled ....
- Holes drilled ....
- Holes fired ....
- Explosives used..
- Rock removed..

Cost of rock per cubic yard, $15.43.

All labor was hired by the month and bo

Future work.—The removal of bowlders fr
have yearly attention. From the reports c
ice and high water carry down and deposit

Estimated cost of this work yearly, $5,00

Aside from the above there are three p
Lewiston that I think could be greatly in
advisable.

(1) Wild Goose Island, 9 miles above I
three channels, and shoals badly in each
now go through the south channel, whic
rapid. The middle channel is the straight
it shoals at head of rapid, which shoal a
the rapid and forming so strong a current t

I would suggest a stone dike, 900 feet lo
on the sketch, closing up the south chan
middle channel, thereby scouring it to a
lengthen the rapid and lighten the current,
which will be easy to scour.

Estimate: 2,934 cubic yards rock, at $2.75

(2) Diamond Crossing, 13 miles above R
diagonally across the river, and about a
point is wide and the current light, with lo
nel. It is here proposed to build a stone d
from the end of the gravel bar on the south
water around the same, thereby forming an
on the north side of the river, which it is l

The present line of the steamboat chann
Steamers have to drift nearly across the ri
weather makes it difficult to keep from bei

Estimate: 3,393 cubic yards rock, at $2.75

(3) Log Cabin Rapids, 38 miles above R
north and south channels. Steamboats use
so rapid as to always cause them to line,
channel is only 4 feet deep at low water
shoaler. It has about a 6-mile current.

The bottom is composed of bowlders and

* This does not include th

hore closely and is so narrow and crooked that in windy weather it is hard to te.

ıld suggest a stone dike 500 feet long, built to 2 feet above low water, closthe north channel and forcing all the water through the south channel, a greater volume of water which I believe will both deepen and widen the

ıated: 2,113 cubic yards rock, at $2.75 per yard in place, $5,810.75.

ıis place I would also recommend the extension of a crib, same as is shown on hore in sketch and used as a sheer for steamers.

needs to be extended about 50 feet on the west end. To be built of rough and filled with suitable rock.

ıated cost complete: $1,016.63.

Summary of future improvements.

ing bowlders from channel yearly	$5,000.00
ıg dike at Wild Goose Island	8,068.50
ıg dike at Diamond Crossing	9,330.75
ıg dike at Log Cabin Rapids	5,810.75
ion of crib	1,016.63
'otal	29,226.63

ıbove to include cost of plant together with placing of rock.

'ery respectfully,

W. H. WOOD,
Assistant Engineer.

'. SYMONS,
Capt., Corps of Engineers.

ure operations.—Future operations with the money available will t in placing the drill scow in commission, and removing rocks owlders. This work can only be done advantageously when the is low and the water is clear, which is from about September 1 to ıber 1 each year.

Money statement.

1891, balance unexpended	$16,557.77
), 1892, amount expended during fiscal year	8,275.04
1892, balance unexpended	8,282.73
1892, outstanding liabilities	25.00
1892, balance available	8,257.73
t appropriated by act approved July 13, 1892	15,000.00
t available for fiscal year ending June 30, 1893	23,257.73
ınt that can be profitably expended in fiscal year ending June 30, 1894	30,000.00
ıitted in compliance with requirements of sections 2 of river and ·bor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

following information is furnished by Capt. B. R. Pegram, superintendent, Lines, Union Pacific System:

ising.—Steamers operated by Union Pacific Railroad upon Snake River between ı and Lewiston and intermediate points during fiscal year July 1, 1891, to), 1892, with tonnage, draft, and amount of freight carried:

Name.	Registered tonnage.	Draft.	Freight carried.
		Inches.	*Tons.*
Annie Faxon	564	22	9,029
Spokane	531	20	5,594
Almota	395	18	4,544
tal			19,167

value about $690,000.

T T 9.

IMPRO[illegible]EN[illegible]F COLUMBIA RIVER BETWEEN HEAD OF ROCK ISLAND [illegible]AP[illegible] AND FOOT OF PRIEST RAPIDS, WASHINGTON.

Description of original condition.—The portion of the Columbia from the head of Rock Island Rapids to the foot of Priest Rapids is about 60 miles in length. The river flows generally through a deep cañon. The banks for the greater part of the way are nearly precipitous bluffs from 1,000 to 3,000 feet high, composed of columnar black basalt. The country bordering the river is rocky and sterile.

The three principal obstructions to the navigation of this portion of the river are Rock Island, Cabinet, and Priest rapids. At Rock Island Rapids the river has cut around both sides of a large island of rock. The channel, however, on each side is very much obstructed with reefs, rocks, and points shar[illegible]m the shore. The result is a waterway so much res[illegible]ges as to dam up the waters to such an extent that t[illegible] lines of very steep slope and amidst great masses [illegible]d high projecting islands. A great reef is found [illegible]e the head of the island which has caused extensi[illegible] nearly choking the channel at low water.

The river here has [illegible],000 feet, and 12½ feet in 8,000 feet, at a stage as n[illegible]scertained of 4 feet above low water.

At Cabinet Rapids a[illegible]ic rock projects from the left shore nearly two-thirds [illegible]nel of the river, deflecting the current and causing it [illegible]n the nearly vertical basaltic rocks of the right bank. [illegible] of rock exist in the channel in and about the main rapids. The fall here is 10 feet in a distance of about 8,000 feet.

At Priest Rapids there are seven principal rapids extending over a length of 10 miles of river.

The total fall in this distance is, at low water, 72 feet, and at high water about 63½ feet.

In all these rapids the river runs through and over hard, rough, and jagged basaltic rocks.

Plan of improvement.—The plan of improvement under which existing work has been carried on consists in removing obstructing rocks at Priest, Cabinet, and Rock Island rapids, and putting in at all locations where they would be convenient, iron posts and ring bolts, to which ascending boats could make fast their lines and then wind themselves up over the rapids by means of their steam capstans, with which all such boats would naturally be provided.

The estimated cost of the work proposed was $550,000.

In addition to this it was proposed to continue the survey of the Columbia from the head of Rock Island Rapids to the boundary line. This project was approved by the Secretary of War October 18, 1890.

APPROPRIATION.

Act of September 19, 1890	$70,000

Of which $10,000, or so much thereof as may be necessary, may be used in the survey of the Columbia River from the international boundary line to Rock Island Rapids.

The amount expended to end of fiscal year June 30, 1891, was $31,291.13.

For survey of river from international boundary line to Rock Island Rapids	$2,691.91
For improvement of river at Priest, Cabinet, and Rock Island rapids	28,599.22

Results obtained to June 30, 1891.—The following extract from my last annual report shows the condition of the work to June 30, 1891:

The work so far done on the river at Priest and Cabinet rapids has not produced any results of a marked nature. All rocks removed tend to the final result and would benefit and render safer navigation on the river if there was any navigation, which there is not.

The survey of the river from the international boundary line to the head of Rock Island Rapids has progressed under Mr. William Cuthbert, so that the work is nearly done from the boundary line to the mouth of the Spokane.

The total amount expended during the fiscal year ending June 30, 1892, was $28,195.29, of which there was expended for survey of river from international boundary line to Rock Island Rapids $7,227.95, and for improvement of river at Priest, Cabinet, and Rock Island rapids, $20,967.34.

Results obtained to June 30, 1892.—The work of improvement during the fiscal year has been confined to Cabinet and Rock Island rapids.

At Cabinet Rapids a number of projecting points along the right bank have been removed, and some rocky island masses near the left bank were honeycombed with drifts and drill holes, loaded with dynamite, and blasted, dividing the rock into small fragments which it is expected will be washed away at high water.

If this is the case, Cabinet Rapids will be improved to as great an extent as appears necessary in the way of rock removal.

A number of ring bolts have also been put in at various points along the river for convenience of boats in lining over the rapids, if any should attempt it.

The work at Rock Island Rapids has been conducted with the object in view of removing obstructions which existed to boats lining up along the right bank during the higher stages of the river, and which endangered boats in running down.

That which has been done at both Cabinet and Rock Island rapids would be of great benefit to navigation if any existed.

Report of operations.—At the beginning of the fiscal year the operations in progress in connection with the improvement were the taking of the drill scows up to Cabinet and Rock Island rapids. On July 17, 1891, the foot of Cabinet Rapids was reached, and on July 31 the boats had been lined over the rapids and taken to Moses Coulee Ferry, between Cabinet and Rock Island rapids. The high water continuing, work on rock removal was not commenced until September 10. Upon this latter date operations were resumed on Cabinet Rapids and continued until February 15, 1892, with an average daily force of thirty-six and one-half men.

During this time there was used at Cabinet Rapids 11,050 pounds of dynamite No. 1; there were drilled 472 2-inch holes, aggregating a length of 3,002 linear feet, and twenty-two drifts were run to a total length of 410 feet. The last blast was February 12. The result of the work was the removal and breaking up of 12,199 cubic yards of rock. That which was not fully removed it is expected will be removed by the high water.

On February 25 work was commenced on Rock Island Rapids, and continued until May 5, with an average force of fifteen men. During this time there was removed rock aggregating 1,894 cubic yards; 256 holes 2 inches in diameter were drilled to a total length of 1,414 feet.

A permanent gauge was erected at Rock Island Rapids.

On May 5 the boats were taken back to Moses Co
and left in charge of a watchman.

The tracings sent herewith show the work which
Cabinet and Rock Island rapids.

Recommendations and remarks.—I desire to invi
statements under this head in my last annual rep
Columbia from the head of Rock Island Rapids t
Rapids," and the "Upper Columbia and Snake," p
Report of Chief of Engineers, U. S. Army.

If the work on the project is to proceed, the amou
can be profitably expended the next fiscal year is $

Future operations.—As there is a practical certa
be no further appropriation at present for the im
stretch of river, no further operations of any mag
out.

With the money remaining on hand, it is expect
the plant, and if authority is granted it is expecte
and tools in the improvement of the Snake River, f
of which provision is made in the river and harbor
The report of Mr. J. G. Holcombe, in charge of th

Money statement.

July 1, 1891, balance unexpended........................
June 30, 1892, amount expended during fiscal year:
Improvements ....
Survey ....

July 1, 1892, balance unexpended........................
July 1, 1892, outstanding liabilities ....

July 1, 1892, balance available ....

REPORT OF MR. J. G. HOLCOMBE.

PORTLAND, OR

SIR: I have the honor to submit the following annual re
upon this work under your charge for the year ending June 3

At the close of last year work at Priest Rapids had been a
scows were being lined to Cabinet Rapids, 54 miles above Pri

On June 30 they had been taken to a point about 13 miles
and July 17, having reached the foot of them, I built a ma
dynamite in it. The scows were then lined through the rap
finally reached the head, having been considerably delayed d
of moving the boats from Priest Rapids by the high winds th
during the summer months.

Having reached the head of the rapids I hired the steam f
the boats to her landing at Moses Coulee, where they were to
sufficiently to permit work on Cabinet Rapids.

As there were no steamers upon this section of the river (b
inet rapids), the moving of the boats had to be by hand. H
ble, except for a short distance, because of the rough and p
the banks.

Having reached the ferry landing on July 31, I laid off 5 me
a special mail-carrier who had been employed since March 1
twice a week from Ellensburg, the nearest post-office to the r
August, after the visit of inspection by Col. Mendell and you
men, keeping 3 men to finish certain repairs to the plant.

On the 22d of August I left for Ellensburg to engage miners
river being low enough by the 10th of September to resume w

On that date the drill scows were dropped down stream to the rapids and work again commenced.

Plan of improvements.—The project upon which this work has been done was recommended by you as a modification of Maj. W. A. Jones's project, and it consisted of the removal by blasting of the worst rocks obstructing navigation and the placing of ring bolts and deadmen, to which the steamers could make fast and line themselves over by means of their steam capstans. This was recommended, not as a permanent improvement, but as an aid that would become at once available to any steamer that might desire to use this stretch of river.

Cabinet Rapids.—During the previous year a small force was sent from Priest Rapids with small boats and tools to blast away certain points and a reef along the right bank at this place. This force worked from April 15 to May 15 and succeeded in blasting at points (marked on the map) H, I, K, and the reef G. On May 15 this work had to be stopped because of the high water.

As the river fell during the year, it was found that the high water had carried away all of the débris of last year's blasting, leaving in most instances a clean rock bed at or below the low-water level.

The work of the present year was commenced by the removal of the point F, which was cut down as low as the then stage of the river would permit. After this was completed work was started upon the mass of rocky islands in the right-hand channel, and the rocks A, B, C, D, N, O, and P have been blasted down to and below the low water of this year.

The rocks B, C, D, P, and parts of A and E were blown up by the usual method of drilling 2-inch holes down to the low-water level, loading with dynamite, and firing by electricity. For the rest, parts of A, E, N, and O, drifts were driven in on the low-water level, these drifts charged and tamped, and then fired by electricity, thus shattering the rock. This method was used in every case where feasible and when the dimensions, especially in height, would allow, and proved a quick and cheap method of blasting the larger rocks.

Results.—As previously stated, the débris of last year's work here had been washed away by the high water.

During this year there have been blasted on three rapids 12,199 cubic yards of basalt rock, using 11,050 pounds of dynamite. To blast this quantity of rock, 472 2-inch holes were drilled, having a total linear measurement of 3,002 feet. There were also driven twenty-two drifts, having a total linear measurement of 410 feet, and one shaft measuring 10 feet to low water, from which three of the above drifts were driven.

The last blast at this rapid was on February 12, when the rock E, containing 6,445 cubic yards was blown up, thus completing the project of rock-blasting at these rapids.

I then had three sets of ring bolts placed at convenient points for ascending steamers to make fast to and line themselves up over these rapids.

The work at Cabinet Rapids extended during this year from September 10, 1891, to February 15, 1892, during which period 6,103 days of labor were expended upon the rock work; this includes Sundays and holidays, upon which no work was done, but which are here included because the force were all employed by the month and subsisted. This employment of labor by the month was necessary because of the comparatively short seasons of good weather in which work could be done, making it necessary to work early and late to accomplish any valuable results.

The average daily force employed during this period was 36.54 men, the largest force 43 men, the smallest force 15 men. On January 31 the force was reduced from 43 to 15 men, this being as large a force as could be conveniently employed at the then existing state of the work.

The work of drilling, etc., was carried on upon one hundred and thirty-four different days, and having a mild winter no time was lost by bad weather.

Debris.—All of the rock is broken small and it is expected that the coming high water will wash considerable of it away.

Condition of the rapids.—While this rapid has at all stages of the river rough water, still steamers, it is believed, can pass them in safety by using the channel along the left bank in high water and the channel along the right bank in medium and in low water. It has been this medium stage that has been the impassable one at this place.

Future improvements.—It is believed that the work already carried out at these rapids is all that is required for the near future, and until the surveys of the upper river are completed and a final scheme of improvement adopted no further work will be required.

Rock Island rapids.—On the completion of the operations at Cabinet Rapids, the drill scows were lined to Rock Island Rapids. We left Cabinet Rapids on February 15, and on the 25th of the same month we reached Rock Island Rapids. A slight delay was caused at the Nixon Rapid by the low stage of the river, and we lost about fe f 4½-inch line by one of the small boats swamping. Beyond this, da as e.

of i ements.—For Rock Island Rapids, the plans were the same as f Ca Rapids, but, on account of the short time before high water, I was direct to confine the work as far as possible to opening a channel through which bo could be lined on an upgoing trip.

On February 25, drilling was commenced and continued until May 5; the fi work started was the removal of rock T (see map); this was followed by the cle ing of the reef between the right bank and rock O, the blasting of a part of rock that nearly closed this channel at its head, and the blasting of the point S. Wh this work was being carried out, I received information that the steamer *City Ellensburg*, then tied up above Rock Island Rapids, was to be placed in commissi and run between Port Eaton (below Cabinet Rapids) and the Okanogan River, so 80 miles above Rock Island Rapids.

I then, at the request of the owners of the steamer, removed as much of the poi R and rock *e* as the rising river would permit, so as to give as straight channel possible for the descending steamer.

After blasting all the rock possible this season, I placed ten sets of ring bolts all feasible points for use of ascending steamers.

Results.—At Rock Island Rapids bic yards of basalt rock have be blasted using 1,325 pounds of dyn blast this quantity of rock, 256 2-in holes were drilled having a total li rement of 1,414 feet. As stated abov the work at Rock Island Rapids e n February 25 to May 5, 1892, duri which period 1,173 days' labor , including Sundays and holidays; 1 of these were employed in mo rom Cabinet Rapids.

The average daily force em work was 15 men.

Having completed all that ed before high water on May 6, 1892, dropped the drill scows back to alee Ferry Landing, where they are lie during high water.

On the 7th instant I paid off and harg l most of the force, and on the 11t having packed all tools and equi y and cleaned the boats, I paid off th rest of the force and, leaving a wat harge of the scow, I reported to you the Portland office.

Before leaving Rock Island I erected rmanent river gauge reading from lo water this year to 40 feet above.

Condition of plant.—During the last month of the work at Rock Island Rapids employed a carpenter, who was engaged in repairing and painting all the small boa used upon this work and the survey of the upper river, which had been left with m when that survey was stopped. These boats (seven in number) have been placed good order and the entire plant is in good condition, with the possible exception lines and oars, the work in the rocky channels having been the cause of breakin and losing a quantity of these articles.

Future improvements.—This rapid is still a dangerous one for boats to pass dow over. I would recommend the removal of rocks *a*, *b*, *c*, *i*, *k*, and a part of rock *o*, an U, V, and R, so as to give a safe channel for boats to descend during high and mediu water. This work can be done in a single season and would afford relief while th permanent improvements are being planned and carried out upon the upper river.

In this connection I deem it right to call attention to the fact that the Gre Northern Railroad is now building along the left bank of the river from below to point above Rock Island Rapids, where it will cross the river on its way to the P cific Ocean, thus forming an outlet to this upper country above Priest, Cabinet, a Rock Island Rapids. The only other railroad that now reaches the river bel Kettle Falls is the Northern Pacific, crossing at Pasco, but this place can not be ma available as an outlet for the upper country until such time as the improvement Priest Rapids is carried out. There is a possibility of a railroad being built fr Ellensburg, on the Northern Pacific, to Port Eaton. If this road is built it will for the purpose of developing the steamboat trade upon the upper river, and th the clearing of Rock Island Rapids becomes of vital importance and the clearing them would be for the benefit of that stretch of country that is now without a permanent connection with the marts of this coast.

This and Priest Rapids will always be a difficult place for boats to pass over un either a system of locks or boat railways are built at these places, because of the gr fall that takes place in the river profile at these points, and until such time as the o structions at the Dalles and the Cascades are overcome, the steamboat traffic up this river will be in connection with the railroads.

Priest Rapids.—During the past year no work of any sort was carried out at t place, work having stopped before the end of last year.

Commerce.—During the past year there were no steamers or other vessels navig ing this stretch of river. On the 1st of May the *City of Ellensburg* was placed commission and began to make two trips a week from above Rock Island to t Okanagon River.

It is not out of place to call attention to the fact that this boat passes over all the riffles and rapids to, and including the Methow, without the use of lines, and before this boat was overhauled she lined at six different places on the route.

The building of the Great Northern Railroad has called renewed attention to this large section of country, and settlers are coming in from all points.

During the past year the fall of the river from high to low water at Moses Coulee Ferry was 40 feet, the low water uncovering rock c, at the foot of Rock Island Rapids, which I am informed had not happened for five years.

Visits of inspection have been paid to this work by Col. Mendell, yourself, Lieut. Fitch, and Lieut. Shunk.

There were also taken during the month of September, 1891, photographic views of Cabinet and Rock Island rapids, which have been transmitted to you.

Accidents.—During the past year there has been no accident or other mishap of a serious nature.

Very respectfully, your obedient servant,

J. G. HOLCOMBE.

Capt. T. W. SYMONS,
Corps of Engineers.

SURVEY OF THE COLUMBIA RIVER FROM THE INTERNATIONAL BOUNDARY LINE TO THE HEAD OF ROCK ISLAND RAPIDS.

The amount expended on this work to June 30, 1891, was $2,691.91, with the result of nearly completing the survey from the boundary to the mouth of the Spokane River.

The amount expended during the year ending June 30, 1892, was $7,227.95, making the total amount expended on the project to the latter date, $9,919.86.

The work has been practically completed as far as the mouth of the Okanogan River. The maps, plans, and profiles of the river, as far as surveyed, are well under way, and will be completed in a short time.

Report of operations.—At the beginning of the fiscal year the party under Mr. William Cuthbert engaged on the survey, were in camp at the mouth of the Spokane, working up their notes and awaiting the subsidence of the waters.

On the 13th of July they started from camp and went back to the boundary line and commenced a line of levels which had not been taken in first traversing the river, and getting the topography, soundings, etc.

From the mouth of the Spokane down, the line of levels was run at the same time with the other survey.

Twenty-eight bench marks were cut in the solid rock, and one was marked on a cedar post where the survey terminated at the mouth of the Okanogan. (A list of these bench marks is given in Mr. Cuthbert's report.)

The latter part of August the running of the levels had been completed and the party were again in camp at the mouth of the Spokane.

It was not until September 26 that the river had fallen to a stage fitted for the work of continuing the survey. Upon this date Mr. Cuthbert with his party of eleven men started from the mouth of the Spokane and the field work of the survey continued until December 20, when the Okanogan was reached. The party then proceeded down the river, some of the men leaving at Wenatchee, until the drill scows at Rock Island Rapids, under Mr. J. G. Holcombe, were reached. Here were left the boats, camp outfit, etc., and after discharging his men, Mr. Cuthbert came on to Portland and has been at work ever since in platting his work.

In making this survey, the topography has been worked in by stadia, and connection has been made, wherever possible, with land office stakes;

the levels have been run by means of a regular Y level and the sound
ings taken in the ordinary manner with lines and poles, located by th
stadia and cross sights.

Besides the instrumental survey which forms the basis for the map,
large number of photographs have been taken all along the river from
the boundary line as far as the survey has progressed. These photo
graphs are particularly of the bad places in the river.

There were taken seventy-one views from the boundary to the Spo
kane, and forty-four from the Spokane to the Okanogan. Of these views
eighty-nine in quintuplicate were sent for exhibition at the World's Fai
at Chicago. There were also sent with these fifteen photographs i
quintuplicate, of Priest, Cabinet, and Rock Island rapids.

It is believed that a very correct idea of the river can be obtaine
from the maps, profiles, and these photographs.

At a number of places the river was gauged.

Near Marcus, which is just above Kettle Falls, the measuremen
were made at a stage of 8 feet below high water, and gave a dischar
of 196,000 cubic feet per second. By allowing for an increased heig
of 8 feet to bring the river up to high water and with the observed ra
of current, the discharge is 250,000 cubic feet per second.

At Rickeys, below Grand Rapids, the measurements were taken a
stage 6 feet above low water, and gave a discharge of 112,000 cubic fe
per second. Taking 6 feet in elevation away from the cross sectio
gives a discharge at low water of 53,000 cubic feet per second.

As the velocity at high water would undoubtedly be increased ov
the velocity measured at 8 feet below the high-water stage, and t
velocity at low water would be decreased below that observed at
stage 6 feet above low water, it may be taken as an approximate ge
eral summary that in this upper part of its course, the Columbia has
low-water flow of about 50,000 cubic feet per second, and a high-wat
flow of about 300,000 cubic feet per second.

The total length of the Columbia from the boundary line to the mou
of the Okanogan was found to be 214 miles, and in this distance t
fall was found to be 524.4 feet, being an average fall per mile of
feet. The average fall from the boundary to the Spokane is 2.2 fe
per mile and from the Spokane to the Okanogan is 2.8 feet per mi
In the stretch of possibly navigable water from the Okanogan to Ket
Falls the fall is 1.97 feet per mile, and from below Grand Rapids
the Spokane the fall per mile is 1.62 feet.

As nearly as can be ascertained the average velocity of the wa
from the boundary line to the Okanogan is 3.48 miles per hour.

The maximum velocity observed was at the upper part of the Spok
Rapids, where it was 15.38 miles per hour. There were a number
places where the velocity was found to be 10 to 12 miles per hour.
list of places where the most rapid flow was observed is given in
Cuthbert's report.

Recommendations and remarks.—It is very much to be hoped t
this work can be continued until the whole of the Columbia Rive
surveyed.

It is not probable that this river for its whole length in our territ
will ever be used as a through highway of commerce, but unquest
ably certain portions of it will be used as feeders to railroads, and t
become of great importance. The survey will enable correct con
sions to be arrived at regarding these portions, the kind of boats
essary and proper to put on, and the improvements which may
necessary to utilize the river for the greatest benefit of the people.

f the amount named in the river and harbor bill now before Con-
ss is appropriated, it will complete the survey to Rock Island Rapids,
l no more money will be required for the survey of this portion of
river.

If it does not, I would recommend an appropriation of $10,000 to
nplete the survey to Rock Island Rapids.

Report of Mr. Cuthbert is herewith:

UNITED STATES ENGINEER OFFICE,
Portland, Oregon, June 3, 1892.

CAPTAIN: I have the honor to report that in pursuance of instructions contained your letter dated June 17, 1891, "to go back to the boundary line and run a line levels down the river, * * * " and of verbal instructions received from you Spokane City on July 2, 1891, I proceeded to camp at the mouth of the Spokane ver, and the Columbia River having fallen sufficiently to allow of it, started from ere on Monday, July 13, 1891, with four men to tow one of the boats in my charge to Rickeys Landing, a distance of 55 miles.

This was accomplished by 3 p. m. on Saturday, the 18th, having made an average 10 miles per day with a loaded boat.

On Sunday, July 19, the boat and baggage was hauled by team to Meyers Siding, station on the Spokane Falls and Northern Railway, and the boat loaded onto a at car which had been previously arranged for.

On Tuesday, July 21, started from Meyer's Siding at 5:30 a. m., reaching Corbin's anding on the Columbia at 10 a. m., where the boat and baggage were transferred to the steamboat *Lytton*, and the international boundary line was reached at 12:30 .m.

Bench marks.—Twenty-eight bench marks (a list of which, giving their positions and elevations, is attached) have been cut in the solid rock. The twenty-ninth is a edar post near the mouth of the Okanogan River. I could not find any rock in that mmediate locality.

Levels.—Establishing the elevation of bench mark No. 0 at the international boundry line from the levels of the Spokane Falls and Northern Railway, which are connued from the sea level datum of the Northern Pacific Railway, as 1,356 feet above a level, I proceeded leveling down river, taking the water surface and all well deed high-water marks. The river at this time was 7 feet below the high-water age.

Connections with the levels already taken at all important places during the lowater stage were made. (A list of levels and falls is attached.)

On July 30 I got down to Little Dalles. There I had to portage the boat around, the high stage of water rendered the river unnavigable, and Marcus was reached Saturday, August 8, 1891.

Soundings.—From Marcus downwards I re-sounded the river, the depths being relare to the water-surface line of levels and a good check on the soundings of the rmer survey.

Volume of flow.—At a very favorable spot about 2 miles above Marcus, I tested the lume of flow of water. This I have done at several other places and at various ges of water.

All of these, allowing for the different heights of water, compare very well. I k out two of them, those nearest to high and low waters:

	Cubic feet per second.
Marcus:	
Eight feet below high water	195,621
Allow 8 feet higher water, but no increase in rate of current, and it will give	249,853
Rickeys Landing:	
Six feet above low water	112,149
Taking 6 feet in elevation from cross sections, but not reducing rate of current	53,528
This will give an average of	151,690

From this average the flow during the average day would be 13,106,059,200 cubic et.

Rates of flow.—With a view of ascertaining what rate of speed a steamboat to sucssfully navigate this river should be capable of, I tested the rate of surface flow in places where it is quicker than usual.

From these tests and observations of slower currents, I ascertain as nearly as posle that the average rate of surface flow from the international boundary to the mouth of the Okanogan River is 3.48 miles per hour. The particular places where the flow is most rapid are as follows:

Names of places.	Miles from boundary line.	Miles per hour.
Pingstone Rapids	31	6.21
For 2 miles above Rogers Bar	80	6
1 mile below Rogers Bar	83	6
Deer Creek	94	7.13
Upper end of Spokane Indian Reservation	97	5
Miter Rock	100	6
Spokane Rapids, upper part	105	15.39
China Rapids	109	12.7
Above Hawk Creek for 4,000 feet	110	11
Below Hawk Creek:		
For 6,000 feet	111	10
For 3,000 feet	112	12
For 3,000 feet	113	10
For 2,000 feet	114	12
Friedlander's store	124	11
Below mouth of Sans Poil River	133	9
Mammoth Spring	136	6
Cayuse Rapid	142	8
Nespilem Rapid	165	7.5
Mah-kin Rapid	175	10.21
Parsons Rapid	182	6.45
7,000 feet below Island Shoal	185	7
Long Rapids:		
First Riffle	190	9.08
Second Riffle	191	10.34
Third Riffle	191	10.58
Eagle Rapids	193	7.35
Foster Creek Rapids	201	6.23
Bend above Port Columbia	211	6

On the evening of Saturday, August 29, I had got to within 2 miles of the head of Spokane Rapids. Here I stopped until I had a full crew, to take cross soundings at frequent intervals above these rapids, so as to determine what the result to this part of the river would be were the bowlders at present causing the obstruction blasted away.

Survey resumed.—The river having fallen sufficiently to allow of the regular survey being gone on with advantage, I recommenced work with a full party of 11 men, including Mr. O. C. Yocum as photographer, on Saturday, September 26, and found that there is very deep water above the Spokane Rapid, ranging from 51 to 69 feet, with a sluggish current of about $2\frac{1}{4}$ miles per hour.

Hell Gate was reached on Sunday, October 25. At this place, the current at low water is not strong nor would it be hard to navigate; the difficult stages are at middle and high waters on account of the tortuous shape of the channel. If the middle high-water channel was blasted out to low-water level, this trouble would be very much reduced if not done away with entirely.

From this down to Mah-kin Rapid, which in character very much resembles the upper part of Spokane Rapid, the river is comparatively good. Improvements would consist of blasting away lone bowlder rocks, to straighten or widen the channel as the case may be.

Mah-kin Rapid was reached on the 6th day of November. There is a shoal 3,000 feet above it, which I imagine will render it inexpedient to clear out and thereby lower the head of the rapid, but the foot of it could be dammed so as to lengthen and ease the fall and current.

A steamboat to get up here and similar places without lining would have to be capable of making 18 miles an hour in dead water and of keeping up her steam pressure.

On November 24 I got down to the head of Long Rapids in Nespilem Cañon. The lower and narrower part of this rapid is locally known as Box Cañon, the banks on both sides being composed of perpendicular rock 60 to 100 feet in height. At high water it is full of cross currents and whirlpools, owing to the crookedness of the passage. A very large quantity of rock must be removed from the jutting out points all the way through. The low-water depth will average all of 60 feet.

Permanent snow.—Although there was a fall of snow and sleet on November 9, it did not remain. The commencement of permanent snow was on Sunday, December 6. I was then 3 miles above Foster Creek Rapids. From this on, snowstorms and dense fogs greatly impeded the work and rendered it disagreeably cold.

Creek Rapids at low water is a mass of rocks; 34 can be counted above nd there is an equal number within 3 feet of the surface.

this down to the mouth of the Okanogan River, which is 214 miles from the ional boundary line, the river is good and navigable at any stage of water.

ied work at this place on December 20, and proceeded down river with the n of sending the men to their homes from Pasco.

ed at Chelan December 22; went up the lake with Mr. Yocum the pho- r, and came down again on the 23d, having obtained sixteen views of this ent lake. I left the mouth of the Chelan River on the 26th and arrived at th of the Wenatchee December 29, with a snow storm blowing very hard up

here the Spokane men asked to be allowed to go home; so, retaining as n (four) as would enable me to handle the two boats. I let the Spokane men with the two boats got down through Rock Island Rapids to the scows in f Mr. Holcombe, at Cabinet Rapids, on January 1, 1892.

Holcombe informed me that I could not take the boats down through Priest I turned over everything I had brought down to him, discharged the four ig men, and came to this city via Ellensburg, arriving on the 6th day of , 1892.

etc.—Since my arrival here I have been engaged in preparing plans and f the part of the river surveyed. These are not yet quite completed.

of the river.—The photographic work done consisted in seventy-one views of being taken at points above the Spokane River by Mr. Warren, and forty- w the Spokane River by Mr. Yocum, besides the sixteen he took of Lake

ry respectfully, your obedient servant,

WM. CUTHBERT,
Assistant Engineer.

T. W. SYMONS,
rps of Engineers, U. S. A.

List of bench marks.

Positions.	Elevations.
	Feet.
right bank at International Boundary	1,356
left bank at Murphys Rapid	1,333.68
left bank at Steamboat Rock	1,336.56
left bank at Sheep Creek Bend	1,360.85
left bank at Little Dalles	1,335.66
right bank 21 miles from boundary	1,304.64
left bank 27 miles from boundary	1,290.52
right bank at Pingstone Rapids	1,267.58
right bank at Marcus Rapids	1,265.90
left bank at Kettle Falls	1,241.91
left bank at Grand Rapids	1,201.68
left bank at Driftwood Rock Islands	1,193.11
left bank at Giffords Rocks	1,173.16
left bank at Turtle Rapid	1,157.35
left bank at Spencers Bar	1.168.95
left bank below Rogers Bar	1,151.49
right bank below Elbow Bend	1,148.45
left bank at Miter Rock	1,126.24
left bank at Spokane Rapids	1,116.15
left bank at foot of China Rapids	1,095.69
left bank at Whitestone Rock	1,075.78
left bank at Hell Gate	1,051.24
right bank below Neahkwa Creek	1,020.70
left bank opposite Nespilem River	969.30
right bank at Wild-goose Bills Ferry	947.17
right bank at Gaviota Bend	926.84
right bank at Box Cañon	899.30
left bank at Foster Creek Rapids	853.24
left bank at Port Columbia	817.21

Memoranda of levels and falls at a

	Elevat
	Fee
International Boundary	1,30
to	
Above Kettle Falls	1,22
Below Kettle Falls	1,13
Below Grand Rapids	1,16
to	
Mouth of Spokane River	1,07
Boundary to Spokane River	......
Spokane to Okanogan River	......
Boundary to Okanogan River	......

COMMERCIAL STATIST

There is no commerce on the portion of the Colu
Rock Island Rapids and the foot of Priest Rapids.
From the head of Rock Island Rapids to the O
steamer running, and as soon as the Great Norther
will probably be others.
Although this stretch of river between the Oka
not that under improvement, it is deemed proper t
tics" of it as furnished by the Ellensburg and Oka
Steamer *City of Ellensburg*, plying on this route,
and June. Her registered tonnage is 85.15, and dr
Amount of freight carried during May and June
Okanogan River and intermediate points was 238
chandise and lumber.
On the down trip the amount of freight carried
merchandise and lumber.
Average number of passengers carried on each tr

T T 10.

IMPROVEMENT OF CHEHALIS RIV

Description of original condition.—The p
that it is possible to navigate, is about 9
quato to its mouth. This may well be con
First. From the mouth to Montesano, a
about 18 feet of water at high water, and c
portion of the river.
Second. From Montesano to Elma, 16
affected by the tides, and has in general su
boats. But navigation is obstructed by l
summer by a scarcity of water on the bars.
Third. Above Elma the river is practi
summer and fall by snags and a general l
the river is a succession of shoals and poo
the depth is reported to be only from 6 to 1
Plan of improvement.—The plan of imp
moval of snags, overhanging trees, dams, d
obstructions to navigation.

APPROPRIATIONS.

Act of—	
August 2, 1882	$3,000
July 5, 1884	2,500
August 5, 1886	2,500
August 11, 1888	2,000
September 19, 1890	3,000
Total	13,000

The amount expended to June 30, 1891, was $10,614.60.

Results obtained to June 30, 1891.—During October and November, 1890, 51 snags, 9 trees, 45 piles, 6 stumps, 4 roots, and a quantity of drift were removed from the river between Montesano and Gray Harbor. The river between these places was put into good condition for navigation.

The amount expended during fiscal year ending June 30, 1892, was $100.68.

Results obtained to June 30, 1892.—The river from Montesano to the bay has been kept open and all troublesome snags have been removed.

Report of operations.—During October, arrangements were made with Capt. Tew for the use of the steamer *Aberdeen*, and 3 troublesome snags, averaging 30 feet in length, were removed, and 5 fallen trees, averaging 90 feet in length and 6 feet in circumference, were sawed off and towed out of the channel.

Recommendations and remarks.—Above the town of Montesano there is practically no navigation on the Chehalis except the floating down of logs and an occasional trip of a steamer during high water.

The river between Montesano and the bay is now navigated without trouble by the steamers suited therefor.

A project has been submitted for the improvement of the Chehalis River to allow ocean-going craft to ascend to Montesano. A railroad has been built from Gray Harbor along the Chehalis to Olympia and to Centralia, and is now operated from Aberdeen eastward.

In view of the present good condition of the river from Montesano to the head of the bay, of the special project heretofore submitted for its deepening to permit the passage of ocean ships, and of the railroad now in operation which will still further lessen the importance as a navigable stream of the upper Chehalis, I do not recommend another appropriation for the Chehalis at present.

There is available from the last appropriation $2,284.72, which will suffice to remove any dangerous snags which may appear in the lower river another year at least.

Future operations.—With the existing appropriation it is expected to clear the river below Montesano of snags as soon as they are found to exist and be troublesome.

Money statement.

July 1, 1891, balance unexpended	$2,385.40
June 30, 1892, amount expended during fiscal year	100.68
July 1, 1892, balance unexpended	2,284.72

COMMERCIAL STATISTICS FOR GRAY HARBOR AND CHEHALIS RIVER.

The following returns relative to the commerce of Gray Harbor and the Chehalis River are furnished by Mr. W. B. Mack, secretary, Aberdeen Chamber of Commerce, and are for the fiscal year ending June 30, 1892.

Vessels arrived and cleared.—The number of vessels of all descriptions crossing over the bar during the year was 250; the number crossing out was 255.

Most of these vessels are regular traders. The maximum lumber cargo taken out 950,000 feet, and minimum 200,000 feet. Maximum draft of water, when loaded, feet 6 inches; minimum draft of water, when loaded, 12 feet.

EXPORTS.

Articles.	Quantity.	Value.	Remarks.
Lumber .... feet, B. M.	75, 682, 000	....	
Do .... tons	151, 364	$1, 097, 400	
Salmon in bulk .... do	(*)	....	Canneries not running.
Fruit .... do	(*)	....	
Hides .... do	210	31, 500	
Lath	(*)	....	Large amount shipped as breakage.
Shingles .... do	(*)	....	Do.
Total	151, 574	....	

* No record.

Lath and shingles are shipped as breakage and no record is kept. The year was a poor year for the lumber business. About 25,000,000 feet was used on harbor, besides amount shipped as above. No record kept of amount shipped by ra

Canneries did not run last year. A large amount of salmon was shipped in bu of which no record was kept.

IMPORTS.

Articles.	Quantity.	Value.	Remarks.
	Tons.		
General merchandise, machinery, pig iron, hay and feed, and live stock.	41, 000	$2, 343, 150	No record of separate articles.

The above shipments were made by steam and sailing vessels; no record avail of freight receipts by rail.

Farmers on Gray Harbor are beginning to supply the home market with prod thus reducing the incoming shipments.

Vessels built during the year.

Name.	Registered tonnage.	Dra load
		Fe
Steamer City of Aberdeen	244. 84	.....
Steamer Clan McDonald	230. 48	.....
Four-masted barkentine Chehalis	686. 00	
Four-masted barkentine Gleaner	392. 68	

CHEHALIS RIVER TRAFFIC.

Chehalis River is in the collection district of Oregon. The nearest light-hous on Toke Point at the entrance to Shoalwater Bay, 16 miles south of Gray Harl into which the river empties. Aberdeen is the subport of entry.

Number of river steamers plying upon Chehalis River to Gray Harbor, 9.

Estimated amount of freight carried by same, 20 tons per day besides lumber, e moved on scows and lighters. (Cattle and other live stock are also delivered in t way.)

Steamer *Tillie* makes regular trips to Oyehut and Damons Point.

Steamer *Aberdeen* makes regular trips from South Aberdeen to Hoquiam.

Steamer *Typhoon* makes regular trips from South Aberdeen to Petersons Point.

Steamer *Clan McDonald* makes regular trips from Montesano to Petersons Poi

Steamers *Progress*, *Jessie*, and *Chicago* make regular trips from Aberdeen to South erdeen.

The naphtha launch *Sun Beam* makes daily trips with the mail up the Wishka ver, 14 miles. These boats all touch at way landings.

One new shingle mill has recently been built and is now in operation, and six more e in course of construction at different points on the river and harbor. Two box ctories also established, one in operation, and the other about finished. At least o more sawmills will be built during the coming year. The Northern Pacific ilroad is now in operation to South Aberdeen, and lumber and shingles are being ndled over this line.

Acres under cultivation have increased about 100 per cent during the year, and a rresponding increase is anticipated during 1892.

T T II.

IPROVEMENT OF SKAGIT, STILLAGUAMISH, NOOKSACK, SNOHOMISH, AND SNOQUALMIE RIVERS, WASHINGTON.

Description of original condition.—The waters of these rivers all rise the Cascade Range and flow to the west into Puget Sound between e forty-eighth and forty-ninth parallels of latitude.

In their original condition they carried water enough for the purpose steamer navigation, but were obstructed by snags, fallen trees, and g jams. They were the great highways of the country, traveling on nd being almost impossible on account of the heavy timber, dense iderbrush, and fallen logs.

The Snoqualmie is a branch of the Snohomish.

The aggregate length of all is estimated to be about 250 miles.

Plan of improvement.—The plan of improvement contemplates the moval of snags, logs, trees, and other obstructions to navigation. r this purpose a snag boat with an outfit of tools and appliances s been provided. This boat passes from one river to another, doing rvice in each as far as the necessities of its commerce require and as e amount of the funds appropriated will admit.

With the funds that have been appropriated this snag boat and out- have been provided, and a large number of snags, jams, overhang- g trees, and other obstructions to their navigation removed. These, th the trees that from time to time fall into the rivers, will furnish nstant employment for the snag boat for an indefinite period.

APPROPRIATIONS.

t of—	
June 14, 1880	$2,500
August 2, 1882	20,000
July 5, 1884	10,000
August 5, 1886	10,000
August 11, 1888	15,000
September 19, 1890	12,000
Total	69,500

The amount expended to June 30, 1891, was $62,118.51.

Results obtained to June 30, 1891.—In this class of work no permanent sults are aimed at or obtained. The constantly recurring snags and llen trees, etc., are required to be constantly removed. The rivers ve been kept open for navigation and many of the perils of naviga- n have been removed.

The amount expended during fiscal year ending June 30, 1892, was ,377.07.

Results obtained to June 30, 1892.—The results obtained were to greatly benefit navigation.

Report of operations.—In July, 1891, the snag boat was put in commission and after receiving her supplies at Seattle proceeded to the Snohomish, where snagging operations were carried on until September 11.

On September 11 the boat started for the Skagit, stopping on the way at the Stillaguamish to do some necessary work.

Work was continued on the Skagit from September 15 to September 29, at which date the boat started for the Nooksack River.

Work was continued on the Nooksack until November 6.

On this date the boat started for its winter quarters, stopping, however, in the Skagit and Stillaguamish to do some needed work.

The boat was laid up in Deadwater Slough of the Snohomish River November 15, 1891.

During the working season 1,175 snags were removed and 144 leaning trees cut from the banks to prevent them from falling into the stream.

Capt. Jefferson's report, which is herewith, gives details of the work done.

Capt. Jefferson has been employed during the time the snag boat has been laid up on duties connected with the building of bridges and obstructions in the navigable waters of western Washington. In this connection his services have been of great value.

His report giving a summary of the work done is herewith.

Recommendations and remarks.—The minor waterways of western Washington, consisting of the tributaries of Puget Sound, are of great importance in the development and prosperity of the country, and they should be kept as free from snags and other obstructions as possible.

The snag boat is on hand and can be kept employed almost constantly to good advantage.

An appropriation of $30,000 is recommended for this work.

Future operations.—The snag boat will be put to work and kept at work to as great an extent as possible with the funds available.

Money statement.

July 1, 1891, balance unexpended	$7,381.49
June 30, 1892, amount expended during fiscal year	5,377.07
July 1, 1892, balance unexpended	2,004.42
July 1, 1892, outstanding liabilities	200.00
July 1, 1892, balance available	1,804.42
Amount appropriated by act approved July 13, 1892 *	15,000.00
Amount available for fiscal year ending June 30, 1893	16,804.42
Amount that can be profitably expended in fiscal year ending June 30, 1894 } Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	30,000.00

* This appropriation was made under the title "Improving Puget Sound and its tributary waters, Washington."

REPORTS OF MR. E. H. JEFFERSON.

(1)

SEATTLE, WASH., *June 8, 1892.*

SIR: As master of the United States snag boat *Skagit*, I have the honor to submit the following annual report of operations for the seasons of 1891 and 1892, at improvement of Skagit and other rivers, Washington:

On July 21, 1891, instructions being received, preparations were commenced for placing the boat in commission again, she having been laid up for several months.

A crew was engaged, the boat got in readiness, taken to Seattle to receive supplies, and on the 31st of same month commenced snagging operations at Clarks Bend in the Snohomish River, continuing work in that vicinity till August 8. On that date started for a trip of examination to the different rivers named in the appropriation bill, with Col. G. H. Mendell and yourself on board. The Stillaguamish, Skagit, and Nooksack rivers were visited and examined as far up as was deemed practicable.

Returned again to the Snohomish River on the evening of the 10th, and resumed snagging operations the following day, continuing on that river working between its mouth and a point about 5 miles above Snohomish City until September 11, during which period Clarks Bend, a very bad place and dreaded by steamboat men, was thoroughly cleaned of obstructions, and the remains of an old abandoned log boom, a serious obstruction at low tide, was also renoved.

September 11 departure was taken for the Skagit River, stopping at the Stillaguamish on the way, doing some necessary work there.

On the 15th of the same month commenced work on the Skagit, continuing there till the 28th, working between its mouth and the "Cut Off," a point about 35 miles up.

On the 29th of September departed for the Nooksack River, commencing work on that stream on October 1, continuing between its mouth and Lynden, the practical head of navigation, until November 6, removing many dangerous snags and pretty thoroughly clearing the channel to the point named.

November 7 passed out of the Nooksack River, bound for the Skagit. We were storm bound at Fairhaven two days, and arrived at Mt. Vernon on the Skagit on the 10th, finding the river banks full and too high for work.

November 12 worked near Skagit City, and in the evening ran over to the Stillaguamish.

November 13 worked in the south channel of Stillaguamish till high tide, then left for the Snohomish River to lay the boat up for the winter, as per orders previously received.

Laid the boat in Deadwater Slough near the town of Everett; took apart machinery, pipes, etc., properly cared for same and stowed away tools, gear, etc., finishing, and discharging the crew on the 15th of November, 1891.

Following is a summary of the snag boat's operations for the period stated:

Snags and drift removed:		
Snohomish River		528
Stillaguamish River		43
Skagit River		176
Nooksack River		428
Total		1,175
Largest diameter	feet..	8
Smallest diameter	inches..	4
Total length	feet..	25,220
Leaning trees chopped from the banks:		
Snohomish River		78
Nooksack River		66
Total		144
Largest diameter	feet..	4
Smallest diameter	inches..	3½
Total length	feet..	5,760

In addition to the above, the boat machinery, tools, gear, etc., were kept in repair.

The snag boat has undoubtedly been of great service to the navigable interests of these rivers, and the comments of the steamboat men who know what has been done are generally of a favorable character. The only regrets seem to be that the appropriations are inefficient to keep the snag boat in commission the greater part of the time.

There will always be some complaint by people living on these streams from the fact that when the water is low steamers can not reach them, and of course the Government and its representatives are held responsible, or, rather, blamed for it, notwithstanding that at some of the shoal places a canoe can scarcely navigate.

The fact is our snag boat is rather too large for the upper waters of these streams; she can not get up to these shoal places when the water is low, and when she can get up, the water is too high and swift to do any work. For these swift shoal places she should be equipped with additional appliances, such as a spud, or grouser, placed so that it could be dropped on the river bed through the deck and bottom of the boat, so as to hold her on these riffles, thus affording a chance to do work. A good hydraulic pump should also form part of her equipment, so the sand and gravel could be washed away from obstructions and thus permit them to be removed. A good heavy drag of some kind would also be useful.

Two regular steamers are kept employed on the Skagit River route from Seattle, and one locally from Mt. Vernon to "up-river" points when stage of water will permit. Occasional trips are made by other steamers.

The Nooksack River has two small steamers running from Bellingham Bay points when business demands.

On the Snohomish there are five regular steamers at present running from Tacoma and Seattle and six more that are engaged locally on it and its tributaries, the Snoqualmie and Skykomish. Tugs with lighters containing building material and machinery and steam barges with same made frequent trips to the Snohomish. In fact, there is more steamboat business done at the present time on the Snohomish and tributaries than on all the other rivers combined. Business on this stream has doubled and trebled during the year, on account of the establishment of the new town of Everett and the manufacturing enterprises connected therewith, as well as the boom given business by the construction of the Great Northern Railroad and the Everett and Monte Cristo Railroad of 61 miles to the mines of the Cascade Mountains.

Steamboat business has fallen off considerably on the other rivers, owing to the dull times and railroad competition to many river points.

Accurate commercial statistics are almost impossible to obtain for these rivers. The following, for merchandise in tons and passengers in numbers, are estimated to be nearly correct as representing the steamboat business on these rivers at the present time, and which has prevailed for the greater portion of the year. The figures given are monthly statements:

Route.	Freight.	Passengers.
	Tons.	*No.*
Skagit River	1,200	1,000
Nooksack River	300	100
Snohomish and tributaries	3,000	3,500

Very respectfully, your obedient servant,

E. H. JEFFERSON.

Capt. T. W. SYMONS,
Corps of Engineers, U. S. A.

(2.)

SEATTLE, WASH., *June 8, 1892.*

SIR: I have the honor to submit the following report of my operations in connection with the examination and inspection of the bridges and obstructions pertaining to the various rivers emptying into Puget Sound, Gray Harbor, and Willapa Bay, Washington, for the fiscal year about ending.

During the period stated the following bridges and structures have been examined, inspected, and reported upon:

A bridge over the Snohomish River at the city of Snohomish, built by the city and completed.

Bridges of the Snohomish, Skykomish and Spokane Railroad Company (now called the Everett and Monte Cristo Railroad) over the Snohomish River and Ebey Slough, completed.

Seattle and Northern Railroad Bridge over the Swinomish Slough, completed.
Valley Street Railroad Company's bridge over the Duwamish River, completed.
Northern Pacific Railroad Company's bridges over the Chehalis and Johns
, completed.
county bridge over the Snoqualmie River, not yet commenced.
county bridge over the Skagit River at Mount Vernon, not yet commenced.
county bridges over the Willapa and Bear rivers, in course of construction.
Everett Land and River Improvement Company's bridges over the Snohomish
and Ebey Slough, in course of construction.
Snohomish and Port Gardner Electric Motor Company's bridges over the Sno-
h River and Ebey Slough, in course of construction; and the Skagit County
e over Swinomish Slough, in course of construction.

eral trips have been made to the sites of some of these bridges, first, to examine
determine if they were properly located so as not to interfere with the inter-
f navigation, then to see that they were being built and completed according
plans submitted and approved.

ing the same period the following obstructions to navigation complained of
been examined and reported upon:

obstruction of the entrance to the Nooksack River by the Bellingham Bay
Company.
truction of the Wishka River by the log boom of one Frank Miller.
truction to the entrance to the Stillaguamish River by the Chinook Boom Com-

truction to Ebey Slough by the boom of Stimpson Mill Company.
obstruction of Steamboat Slough (Snohomish River) by certain parties fell-
rge trees in the stream while pursuing the work of diking land.
obstruction of free and safe navigation of the Snohomish River by the sheer
s of Pearl & Tompkins.
obstructive character of the bridges of the Seattle and Montana Railroad over
nohomish River and Steamboat Slough and a subsequent felling of trees into
boat Slough by the parties engaged in building a dike around Ebey Island.

most of these places measurements and soundings were taken.

Very respectfully, your obedient servant,

E. H. JEFFERSON.

t. T. W. SYMONS,
Corps of Engineers, U. S. A.

T T 12.

IMINARY EXAMINATION AND SURVEY OF OLYMPIA HARBOR, WASH- TON, FROM DEEP WATER IN BUDDS INLET TO FOURTH STREET IDGE, IN THE CITY OF OLYMPIA, AND SEPARATELY FROM SAID IDGE TO THE MOUTH OF THE DES CHUTES RIVER AT TUMWATER.

[Printed in House Ex. Doc. No. 32, Fifty-second Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., November 20, 1891.

R: I have the honor to submit herewith copy of report dated Janu- 12, 1891, on preliminary examination of "Olympia Harbor, Wash- n, from deep water in Budds Inlet to Fourth Street Bridge in the of Olympia, and separately from said bridge to the mouth of the Chutes River, at Tumwater," and copy of report, with map,* dated ember 19, 1891, on survey of Olympia Harbor, Washington, from water in Budds Inlet to Fourth Street Bridge, Olympia, made by

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*t reprinted; printed in House Ex. Doc. No. 32, Fifty-second Congress, first ses-

Capt. Thomas W. Symons, Corps of Engineers, in compliance wit provisions of river and harbor act approved September 19, 1890.

For the facts and reasons given in report of January 12, 1891, Ca Symons does not consider Des Chutes River above the Fourth bridge, Olympia, to Tumwater, worthy of improvement. I concur i opinion.

The proposed improvement of Olympia Harbor below the F street bridge contemplates dredging a channel from deep wa Budds Inlet to the wharves near the bridge, 12 feet deep at low wat 250 feet wide, between pile and brush bulkheads built 400 feet beyond which the dredged material is to be deposited; and the tion of a basin at the upper end of the cut, near the bridge, 12 fe at low water, with an extreme length of 1,600 feet and maximum of 500 feet, the bulkhead to be continued around the sides and the basin, so as to deflect the current of the Des Chutes River, p being made, however, to allow small boats to pass through the the bridge. The cost of this work is estimated at $275,000.

Very respectfully, your obedient servant,

THOS. LINCOLN CAS
Brig. Gen., Chief of Eng

Hon. REDFIELD PROCTOR,
Secretary of War.

PRELIMINARY EXAMINATION OF OLYMPIA HARBOR, WASH FROM DEEP WATER IN BUDDS INLET TO FOURTH STREET IN THE CITY OF OLYMPIA, AND SEPARATELY FROM SAID TO THE MOUTH OF THE DES CHUTES RIVER, AT TUMWA

UNITED STATES ENGINEER OFFI
Portland, Oregon, January 1

GENERAL: I have the honor to state that, in obedience to th tions contained in your letter of September 20, 1890, a prelin amination has been made of "Olympia Harbor, Washington, f water in Budds Inlet to Fourth street bridge, in the city of and separately from said bridge to the mouth of the Des Chu at Tumwater, and to report as to the most practical and c channel, and the most feasible, economical, and suitable plan f ing the same for navigation by the class of vessels employed Sound, and also to cause to be made an estimate of the cost such improvements."

In this connection attention is invited to the fact that in 1 C. F. Powell, Corps of Engineers, submitted a report on Olym bor with plan and estimate for its improvement, he having rep it was worthy of improvement. Captain Powell's report is co Chief of Engineers' Report, 1885, page 2413.

In order to obtain the latest information in regard to the h city, Mr. A. J. McMillan was dispatched to the locality and report which is herewith.

In my opinion Olympia Harbor from Fourth street bridge water in Budds Inlet is worthy of improvement, to make it nav the class of vessels employed on Puget Sound.

This opinion is based upon the facts set forth in Mr. McM port. These may be summarized by stating that Olympia is t of Washington and is a city of considerable commercial and turing importance, which must naturally develop rapidly now ilroads are getting there. The harbor is rendered very incon- by reason of the extensive shoaling at the head of Budds Inlet. ited States Coast and Geodetic Survey chart of Olympia Harbor he situation very well.

gard to that portion of the inlet from Fourth street bridge to ter, I do not deem it worthy of improvement for the reason set Mr. McMillan's report.

ly all the data necessary for the preparation of plans and esti- or the works of improvement recommended are available now in ice. Only data showing recent changes will have to be gathered. timated that this and the preparation of plans, estimates, and will cost $250.

Very respectfully, your obedient servant,

THOMAS W. SYMONS,
Captain, Corps of Engineers.

Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

ugh Col. G. H. Mendell, Corps of Engineers, Division Engineer, Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
San Francisco, Cal., January 17, 1891.

ectfully forwarded.

easons herein stated, Olympia Harbor is worthy of improvement e portion extending from Fourth street bridge to deep water in Inlet.

G. H. MENDELL,
Colonel, Corps of Engineers, Division Engineer.

REPORT OF MR. A. J. McMILLAN.

OCTOBER 29, 1890.

IR: I have the honor of submitting the following report of a preliminary tion of Olympia Harbor at the head of Budds Inlet, Puget Sound, State of ton, made in accordance with your instructions.

he mouth of the Des Chutes River to 4,500 feet north of Fourth Street Bridge, ty of Olympia, is bare mud flat or tide land at low water, with the water of Chutes meandering through it, in a channel not deep enough in places to at, making navigation impossible at that stage of the tide. It takes some- r quarter tide for the stern-wheel steamers to reach Fourth Street Bridge. a wharf piled out over the tide land for over a mile, but even that distance reach water deep enough for the class of steamers that come to Olympia. e people want is a channel deep enough for ocean steamers to reach the of Fourth street; and that will necessitate the dredging of about 2 miles. rial consists of fine gravel, sand, and clay, making easy dredging.

viewed several members of the Chamber of Commerce in regard to the item er and harbor bill for making a channel from Fourth Street Bridge to Tum- nd they all stated that they did not want or expect the Government to do se it would cost a large amount of money, and would be of no benefit if it .

rd to shipping, railways, manufactures, etc., I obtained the following in- n:

re nine passenger steamers making regular trips from Olympia to points on d.

nion Pacific, Northern Pacific, and the Port Townsend Southern Railway s are building their lines within the city limits. The Northern Pacific r have a dredger at work at present at the foot of Seventh street, filling in some 7 acres for depot grounds. The Union Pacific Company are going to fill in some 15 acres for the same purpose at another part of the harbor. The Port Townsend Southern Company are driving piling for coal bunkers. The coal will come from the company's large coal fields about 25 miles south of Olympia, near the Portland-Tacoma branch of the Northern Pacific Railway.

Everything points to Olympia becoming quite a railway and shipping center in the near future.

The manufactories of this place at present consists of two sawmills, one planing mill, one wooden water-pipe factory, and one foundry and machine shop. This place has until lately been without railway or shipping facilities, and there was no inducement for capitalists to invest in any kind of business.

Although Tumwater is about 2 miles from Olympia, it is practically a part of it. Tumwater has one sawmill, one sash and door factory, and one box factory. There is being built here a flouring mill of 100 barrels capacity; also a large dam for supplying power to electric-light and street-railway plants.

Tumwater has a population of about 400 and Olympia has about 6,000. Olympia has increased in population about 300 per month since last spring.

Very respectfully, your obedient servant,

A. J. McMillan.

Capt. Thomas W. Symons,
Corps of Engineers, U. S. A.

SURVEY OF OLYMPIA HARBOR, WASHINGTON, FROM DEEP WATER IN BUDDS INLET TO FOURTH STREET BRIDGE IN THE CITY OF OLYMPIA.

United States Engineer Office,
Portland, Oregon, September 19, 1891.

General: I have the honor to submit the following report upon the "improvement of Olympia Harbor":

The river and harbor bill approved September 19, 1890, contained an item for making a preliminary examination and estimate for "Olympia Harbor, Washington, from deep water in Budds Inlet to Fourth Street Bridge in the city of Olympia, and separately from said bridge to the mouth of the Des Chutes River at Tumwater, and to report as to the most practical and convenient channel and the most feasible, economical, and suitable plan for improving the same for navigation by the class of vessels employed on Puget Sound, and also to cause to be made an estimate of the cost of each of such improvements."

Being charged with the duty of making this examination and report I submitted a report thereon, under date of January 12, 1891.

Under date of January 23, 1891, I was charged with the survey of "Olympia Harbor, Washington, from deep water in Budds Inlet to Fourth Street Bridge, in the city of Olympia."

In 1885 a survey was made of Olympia Harbor, and plans and estimates for its improvement made by Capt. C. F. Powell, Corps of Engineers. The map made at this time was used as the basis of the present plans and estimates, the only changes being the necessary corrections to bring it up to date. The tracing submitted* herewith shows the plan recommended for the improvement of the harbor.

Captain Powell's report, page 2413, Report of Chief of Engineers for 1885, the preliminary report already submitted by myself, Mr. DeCourcy's report, which is herewith, and the map submitted, are, it is believed, sufficiently descriptive of the locality to need little further in this line. The situation, however, may be summarized as follows:

Olympia, the capital of the State of Washington, is situated near the head of Budds Inlet, which at this point is about 2,000 feet wide. At Olympia, and for about 4,000 feet below, the inlet is a tide flat, mostly bare at low water. The general range of the tides is about 18 to feet. At high water boats can go up to Fourth Street Bridge, but

* Not reprinted; printed in House Ex. Doc. No. 32, Fifty-second Congress, first session.

r they are compelled to land passengers and freight at the end ıg wharf about 1 mile from the city.

ın proposed for the improvement of the harbor consists in channel from deep water, so that "the class of vessels em- ı Puget Sound" can, at nearly all times, reach the wharves at Street Bridge.

interpreted the phrase "the class of vessels employed on Puget o mean those vessels which ply from port to port on the sound, distinction to the deep-draft, seagoing vessels which ply to and sound.

lowing list gives the dimensions of the principal boats of the

Name.	Length.	Beam.		Net tons.	Draft.		Description.
	Feet.	Ft.	in.		Ft.	in.	
....	261	40		1,083.20	9		Iron, side-wheel.
le	254	40		912.78	18		Iron, propeller.
ston..............................	246	33	5	866.85	12	5	Do.
....	200	42		602.00	9		Do.
;on	200	34		577.81	10		Do.
....	141	26		158.77	16		Wood, propeller.
....	107	22		92.77	10	6	Iron, propeller.
....	107	21		80.48	11		Do.
....	230	35		589.00	10		Wood, side-wheel.
....	154	30		350.00	9	8	Do.
›on	134	25		197.49	7		Do.
›..................................	166	29		345.46	9		Do.
'..................................	148	28		336.00	8	6	Do.
....	147	25		178.00	6	4	Do.
ıhington..........................	170	31		449.00	7		Wood, stern-wheel.
....	137	26		241.00	5	6	Do.
'ard	177	29		466.00	7	5	Do.
....	141	24		193.08	5	6	Do.
....	120	24		135.99	9	7	Wood, propeller.
n.................................	108	22	5	166.00	4	6	Wood, stern-wheel.
....	117	22		100.00	6	6	Do.
'..................................	108	25		209.00	4	6	Do.
....	143	28		278.00	5		Do.
....	160	30		350.00	6		Do.
s snag boat Skagit	130	31		(?)		26	Do.

› feet at lower low water was fixed upon as the proper depth en the channel, as this depth will accommodate very nearly all ls plying on the sound and more than accommodate any now Olympia. It is fair to suppose, however, that, as Olympia ›und vessels of the largest class will visit it.

h of channel of 250 feet was fixed upon, as this will permit pass each other and will allow those at present calling at Olym- rn. It is, however, deemed wise in laying out the work to or a width of 400 feet in the future, which will be desirable if nerce of Olympia shall grow as anticipated by some. This ll enable vessels to lie at each side of the channel and yet m for others to pass in and out.

idth it is proposed to provide for by putting the bulkheads, 'hich the dredged material will be deposited, 400 feet apart.

now proposed to dredge out a basin at the upper or southern e channel, in plan as shown on the accompanying map. This › an extreme length of 1,600 feet and a maximum breadth of and is designed with a view of interfering as little as possible ting wharves and docks.

›thod of construction proposed is to build a pile and brush l on the line shown, and to pump the material from the channel sit it beyond the bulkhead.

It is deemed best to keep the Des Chutes River out of this chann as it is feared that, under favoring circumstances, it would tend to fill t channel with débris from above. This deflection will be accomplish by building the bulkhead completely around the upper end and sid of the channel. Provision for passing small boats through the dr of the Fourth street bridge can be made by limiting the height of t bulkhead at the draw to just sufficient elevation to turn the waters the Des Chutes. This will enable anything that is likely to desire do so to get above the bridge.

The work of constructing the 250-foot channel with basin, as sho is estimated to cost $275,000.

ESTIMATE FOR THE IMPROVEMENT OF OLYMPIA HARBOR, WASHINGTON.

For a dredged channel 250 feet wide (bottom width) and 12 feet deep at water, bulkheads 400 feet apart, and a basin of equal depth in plan, as shown accompanying map:

70,775 linear feet of piles, at 15 cents driven	$10,61
16,705 feet, B. M., cross bracing for basin bulkhead, at $20 in place	33
9,400 feet, B. M., longitudinal bracing, bulkhead, at $20	18
3,000 cords brush, at $2.50 in place	7,50
1,000 tons stone ballast at $2, in place	2,00
1,141,575 cubic yards excavation, at 20 cents dredged	228,31
3,000 pounds iron spikes, at 10 cents in place	30
Add 10 per cent for superintendence and contingencies	24,9
	274,1
In round numbers	275,0

The following commercial statistics of Olympia have been furni by the Board of Trade of the city:

Population of Olympia, census—	
1890	4,
1889	3,
Increase in one year	1,
Gain (per cent)	
Population of Thurston County, census—	
1890	9,
1889	7,
Increase in one year	2,
Gain (per cent)	

MANUFACTURING INTERESTS OF OLYMPIA.

West Side Mill Company (lumber): Employés, 60; capacity, 50,000 feet d capacity, lath, 10,000 daily; capacity, pickets, 10,000 daily; pay roll, $4,000 month.

D. Allison & Co. (lumber): Employés, 20; capacity, 10,000 feet daily; pay $1,300 per month.

George S. Allen (lumber): Employés, 30; capacity, 25,000 feet daily; capa lath, 10,000 daily; pay roll, $2,200 per month.

Springer & White (lumber): Employés, 50; capacity, work up 2,000,000 fee year; capital, $50,000; pay roll, $3,200 per month.

T. Z. Slater (shingles): Employés, 20; capacity, 100,000 daily; pay roll, $1,20 month.

Tumwater Shingle Company: Employés, 15; capacity, 70,000 shingles daily roll, $1,000 per month.

Puget Sound Pipe Company (pipe factory): Capital, $50,000; capacity, six assorted pipes per month; employés, 50; pay roll, $4,000 per month.

Olympia Foundry and Machinery Company: Employés, 15; capacity of foun tons daily; pay roll, $1,000 per month.

Sternberg's Furniture Factory: Employés, 15; pay roll, $1,000 per month.

Miller & Springer (cigar factory): Employés, 7; pay roll, $450 per month.

Electric plant: Electric Light and Power Company. Flour mill: capacity, c barrels; 50 tons chopped feed; complete corn-meal plant; employés, 10; pay roll, 00 per month. Lighting plant: Capacity, 3 arc dynamos, operating 130 arc lights; railroad generators, 150 horse power each; 2 incandescent lights; 1 motor, 100 horse power; employés, 15; pay roll, $900 per month. They have 28 miles arc wire and miles of incandescent wire strung.

Olympia water works: Employés, 15; pay roll, $1,000 per month; capacity, 2,000,000 gallons daily; pressure, 45 pounds, both fire and domestic; reservoir holds 2,700,000 gallons.

NAVIGATION.

There are ten companies operating boats on the sound at Olympia, which are as follows, giving names of boats and their tonnage per annum for 1890:

Companies.	Names of boats.	Tonnage.
Union Pacific Railway Co	Steamer Potter Steamer Hassallo Steamer Emma Hayward Steamer Olympian Steamer North Pacific	7,000
Columbia River and Puget Sound Navigation Co	Bailey Gatzert Fleetwood	1,200
Brown's Wharf and Navigation Co	Clara Brown	6,000
Willey Steamship Co	Multnomah Willey	4,100
Puget Sound and Alaska Steamship Co	Washington W. K. Merwin	2,500
Pacific Navigation Co	State of Washington Cascade	1,100
Port Blakely Mill Co	Steamer Nellie	2,000
St. Paul and Tacoma Lumber Co	Zephyr Messenger	500
Walter Axtell	Jessie	500
H. M. Perin, agent	Steamer The Doctor	1,000
Total tonnage of all boats for 1890		25,900

The increase of tonnage on boats for year 1890 over 1889 is 30 per cent; at this rate the tonnage for 1891 will be 33,670 tons. This is a low estimate, as the Union Pacific Railroad Company has just closed one contract for receiving the material for a new court-house which amounts to over 6,000 tons.

The tonnage for the year 1890 on the Port Townsend Railroad Company was 15,000 tons.

The Northern Pacific Railroad has just completed its line to Olympia, and the Union Pacific will be completed in a few months, so a conservative estimate of the increase in railroad tonnage would be at least 200 per cent, or 45,000 tons.

Total valuation of all property, as equalized by the board of equalization.

	1889.	1890.
City of Olympia	$1,144,621	$3,296,388
County (outside of Olympia)	1,492,065	3,260,477
Thurston County	2,636,686	6,556,865
Increase in valuation in one year		3,920,179
Per cent of gain in one year		148.6

FINAL ASSESSMENT FIGURES.

The final figures for the city assessment, as equalized by the Board, show the real estate assessment to be $5,597,455, which was reduced

$40,617, leaving a total of $5,556,838. The personal assessment was $759,607, and was reduced $3,225, making a total for both real and personal of $6,319,670, on which a 6-mill tax is levied.

There is submitted herewith the report of Mr. Bolton W. DeCourcy, who made the reëxamination and survey of Olympia Harbor.

Very respectfully, your obedient servant,

THOMAS W. SYMONS,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. G. H. Mendell, Corps of Engineers, Division Engineer, Pacific Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
San Francisco, Cal., September 30, 1891.

Respectfully forwarded to the Chief of Engineers, Washington, D. C., recommended.

G. H. MENDELL,
Colonel, Corps of Engineers, Division Engineer.

REPORT OF MR. BOLTON W. DECOURCY.

PORTLAND, OREGON, *March 17, 1891.*

CAPTAIN: I have the honor to report that, in obedience to your order given February 16, 1891, I proceeded to Olympia, Wash., and made the survey as directed.

I held consultation with most of the principal citizens to ascertain their wishes and ideas of what was necessary for the improvement of the harbor; also with the city officials, the names of a few of whom I will mention:

The mayor of Olympia, Mr. Ellis, Mr. Sickles, and others of the city council; Governor Laughton, General McKenny, Hon. Thos. H. Cavanaugh, surveyor-general; Captain McMicken, Mr. Phillips, president of the First National Bank; Mr. Shannon, vice-president of the same bank; Mr. Chaplin, Mr. Gowey, Mr. Robinson, proprietor of the Olympia Daily Tribune; and Mr. Phelps, manager of the Port Townsend Southern Railroad. These gentlemen are among the heaviest tax-payers and largest property owners in Olympia.

I had conversations also with Messrs. Pease, Willey, Parker, Hennessey, and Hatch. These gentlemen command the largest steamers running between Olympia and Sound ports.

All these persons were unanimous in recommending and requesting the consideration of a channel commencing at the Fourth Street Bridge, where the draw is situated, and between the wharves owned by Mayor Horr and Mr. Ellis, and running direct in a northerly course to deep water.

The steamer masters ask that the channel be made quite straight in alignment, claiming that this would confer one of the most material benefits to be derived from an improved channel, as the fogs are frequent about Olympia and it would be difficult for them to keep their steamers from grounding should it deviate from a straight line.

The citizens advocate a depth of 16 feet at lower low water, on the expectation of, in that case, having the ocean steamships plying between San Francisco and Portland and the ports of Puget Sound come direct to Olympia to discharge any portion of their cargoes destined for that city, instead of transferring at Seattle or Tacoma, as at present.

The steamer masters mentioned above, on the other hand, say that 12 feet depth at lower low water is ample for all purposes.

I was informed that the daily arrival of steamers at the present time is nine, of which four are large ones plying from Seattle; the remainder are small, running to insignificant places on the different islands and inlets of the sound.

The different masters of these large boats do not deem a basin necessary for their convenience in turning their craft. They say they prefer backing out, taking advantage of the deep water in a northwest direction from the place where the sight post is situated, then steaming ahead into the channel and turning north. Proceeding thus, they say, saves time over making a complete turn in a basin. However, should the channel be improved to 12 feet depth it will be necessary to also excavate some in this channel.

The Bowers dredge had completed its work when I arrived, and had left for Tacoma. I ascertained, however, that the dredge had excavated and deposited inside the revetment or bulkhead for the Northern Pacific Railroad Company 250,000 cubic yards.

The dredge was brought there from Tacoma about the 10th of November. The borrow-pit is parallel with the bulkheads and distant therefrom 500 feet. It is 400 feet wide and 17 feet deep at low water. At one place, in consequence of neglecting to cut off some springs, the pile bulkhead gave way. I took advantage of this place to endeavor to obtain the natural slope of the material, which is composed of sand, silt, and small gravel. As nearly as it was possible to judge, it showed two horizontal to one perpendicular.

As to width of channel, the masters of the steamers recommend, and the citizens request the consideration of a bottom width of 250 feet. The space left between the piling of the Horr and Ellis wharves is about 95 feet; otherwise there are no improvements encroaching on the space called for by such a channel.

The Des Chutes River has not sufficient water to be useful for scows; at lower low water its channel through the mud flats is not over 20 feet wide and 2 to 3 feet deep. It will be necessary to deflect it and prevent its discharge into any artificial channel made. The river has a small channel at the west end of the Fourth Street Bridge, which will become the main channel by preventing the water from getting into that dredged. This can be done by a short bulkhead above the Fourth Street Bridge near where the channel divides.

The steam vessels plying to Olympia, with their depth of draft, are as follows:

The *T. J. Potter*, 7 feet (according to her mate and first officer) or 10 feet (as given by Mr Jefferson); the *Bailey Gatzert*, 7 feet; the *Washington*, 5½ feet; the *Multnomah*, 8 feet; the *Willie*, 4 feet; the *Nellie*, 4 feet; the *Clara Brown*, 6 feet; the *Jessie*, 4 feet; the *Colby*, 4 feet; the *Emma Hayward*, 7½ feet; the *Hassallo*, 6 feet. The first nine of the above are regular arrivals; the last two occasional. There are tugs also that put in, and sometimes a schooner. These draw from 8 to 9 feet.

The citizens of Olympia with whom I conferred all stated that the long wharf in the event of harbor improvement would be abandoned. In that case the piling might be used for revetment purposes as far as the wharf reaches, saving a good deal of new piling.

The total length of excavation required to reach 12 feet depth at lower low water will be 8,400 feet.

The steamer *Potter* is 230 feet in length, beam 35 feet, as stated by Mr. Jefferson. She is the largest steamer at present calling at Olympia.

The masters of the several steamers with whom I conversed said that when the wind was blowing hard, in order to turn they hold on to the wharf with their stern lines and swing the head round. This requires for the *Potter* about the width requested for the bottom, *i. e.*, 250 feet. A high wind would blow them onto the shallows if they endeavored to turn by backing out.

Piling can be procured at 5½ cents per linear foot.

The narrow gauge from Tenino, since it came into the hands of the Oregon Improvement Company, has been made standard gauge and extended to the coal bunkers at Brittlers Cove, and its depot established at the crossings of Fourth Street Bridge.

The Tacoma, Olympia, and Gray's Harbor Railroad, being built by the Northern Pacific, is in an advanced state, and it is expected will be finished in sixty days. The Portland and Puget Sound Railway Company has a good deal of grading done, but has suspended work for the present.

The above is the entire improvement, as far as roads in contemplation are concerned.

I have made a map and estimate, with tracings of the result of the survey.

Respectfully submitted.

BOLTON W. DECOURCY.

T T 13.

[Printed in House Ex. Doc. No. 35, Fifty-second Congress, first session.]

PRELIMINARY EXAMINATION OF TILLAMOOK BAY AND BAR, OREGON.

UNITED STATES ENGINEER OFFICE,
Portland, Oregon, December 2, 1890.

GENERAL: I have the honor to state that in accordance with the direction in your letter of September 20, 1890, a preliminary examination has been made of Tillamook Bay and Bar, Oregon, and the following report thereon is submitted:

Tillamook Bay and Bar were first examined in 1886 by Lieut. Edward Burr, under direction of Capt. C. F. Powell. In 1887 a survey was made of the interior waters under direction of Captain Powell, who in 1888 submitted a project and estimate for work to be done.

The river and harbor act of August 11, 1888, appropriated $5,200 for Tillamook Bay and Bar, and this money was expended in making a survey of the bar entrance and building a dike and revetment work, for the improvement of Dry Stocking Bar, in Hoquarton Slough.

Lieutenant Burr in 1886 and Captain Powell in 1887 and 1888 recommended that all works of improvement be confined to the inner waters, reporting that "the entrance to the bay requires no attention."

In order to obtain the most recent data with regard to the development on the bay, Mr. A. J. McMillan, assistant engineer, was dispatched to Tillamook the first part of November, 1890, to make the preliminary examination required by your orders. Mr. McMillan's report is appended hereto.

After a full consideration of all available information in regard to Tillamook Bay and Bar, I am of the opinion that the present demands of commerce do not require any work looking to the improvement of the entrance to the bay. All accounts agree that this is one of the best small bar harbors on the coast. The bar channel is straight, shifts very little and has an available depth of 10 feet and more at low water.

Tillamook City is the most important place on the bay, and seems to be situated in the best place for a local distributing point. It is desirable that the boats which regularly trade with the bay should be able to ascend to this place, and to do this it will be necessary to make improvements at Junction and Dry Stocking bars.

I am of the opinion that Tillamook Bay is worthy of improvement to the extent of improving the waters from the entrance to Tillamook City, so that vessels which can safely cross the bar can ascend thereto.

make a proper survey and prepare plans and estimates for the will cost, it is estimated, about $400.

Very respectfully, your obedient servant,

THOMAS W. SYMONS,
Captain, Corps of Engineers.

ig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

hrough Col. G. H. Mendell, Corps of Engineers, Division Engineer, fic Division.)

[First indorsement.]

WASHINGTON, D. C., *December 12, 1890.*

spectfully forwarded to the Chief of Engineers.

r reasons herein stated Tillamook Bay is worthy of improvement e extent herein recommended.

G. H. MENDELL,
Colonel, Corps of Engineers, Division Engineer.

REPORT OF MR. A. J. MCMILLAN, ASSISTANT ENGINEER.

PORTLAND, OREGON, *November 11, 1890.*

TAIN: I have the honor of submitting the following report of a preliminary ination of Tillamook Bay, made in accordance with your instructions.

entrance to Tillamook Bay is situated about 50 miles south of the mouth of the nbia River. The entrance is straight and has a depth of about 10 feet of water bar at low water. It is one of the best small bar harbors on the coast, it not subject to shifting to the north or south like many others. Steam schooners aded to 12 feet draft with lumber at the Hobsonville Mill, and pass safely t. The bay has a length of over 5 miles, and a breadth of over 3. It is very being at extreme low water an immense mud flat with a few crooked channels gh it. Any craft that can cross the bar has water enough to reach Hobson- and Bay City, but not enough to reach the head of the bay on account of shoals. orst of those shoals is the one known as Junction Bar, and is situated a short ice below where the waters of the Kilchis and Wilson rivers meet the waters e Tillamook and Trask rivers at low water. This shoal has been formed by the ent brought down by those streams. It is about 1,000 feet long, and has only 1 foot of water on it at extreme low water. I think that for the improvement is place, it would be necessary to run a low stone dike from the south side of ay to concentrate the water on this place and keep it scoured out. The next is obstruction to navigation in going up Hoquarton Slough to the town Til- ok, is Dry Stocking Bar, which is situated at the junction of the Tillamook and Hoquarton Slough. This bar has at present only a few inches of water at extreme low water. The dike that was carried away by the freshets of vinter should be replaced as soon as possible. If those two places were im- d, the schooners that now go up to the town of Tillamook, would have no dif- y in reaching there. They draw 7 and 8 feet of water and have to cross those s at high water.

town of Tillamook, the principal one on the bay, is situated at the head of ation on Hoquarton Slough, and is about 3 miles above Dry Stocking Bar. e its location is a good one in regard to the adjacent agricultural lands, it is a ne in regard to navigation. The slough at the town is less than 100 feet wide, widens out toward the bar by the addition of the Daugherty, which is a part e Wilson River that comes into it about 1 mile below town, and also by the ion of the Trask River, which enters it about 1½ miles farther down. The town population of about 300. There is a sawmill here of 15,000 feet capacity, n cuts mostly for local demand but occasionally ships some spruce lumber to and.

City is situated at the place designated as Sandstone Point on the Coast Sur- harts. It has a sawmill of 6,000 feet capacity, and cuts for local demand. own has a population of about 50 persons.

bsonville is situated at Memaluct Point. There is a sawmill here of 50,000 apacity, which cuts spruce for the San Francisco market. There is also a can- at this place, but it did not run this season.

Garibaldi is situated at Bailey Point near the entrance. There is a cannery a this place that put up about 20,000 cases of salmon this season.

The exports of the bay for this year are as follows:

	Valu
Lumber, 12,000,000 feet	$180,0
Butter, 40 tons	16,0
Apples, 3,500 boxes	1,7
Potatoes, 4,000 bushels	2,0
Hides, 600	1,2
Sheepskins, 300	2
Stock, 400 head	8,0
Total	209,1

The vessels at present entering the bay are the steam schooners *South Coa Augusta, Truckee,* and *Louis Olsen.* The *South Coast* and *Truckee* load at Hobs ville with lumber for San Francisco. The *Augusta* and *Louis Olsen* are coasti schooners and go up to Tillamook.

After a careful consideration I have come to the conclusion that the entrance this bay is in good enough condition to suit all the present demands of commer but I consider that the Government should replace the dike at Dry Stocking I and do something toward the improvement of Junction Bar.

The present routes of travel to reach this bay are by daily stage from North Ya hill, by triweekly stage from Sheridan, by trail from Astoria, and by coasti schooner from Astoria.

There is being built a wagon road from Forest Grove down Wilson River to Til mook. It will be finished by the end of next June. It will be a better road th the one from North Yamhill and have 1,400 feet less elevation on the summit of t Coast Range.

Very respectfully, your obedient servant,

A. J. McMILLAN

Capt. THOS. W. SYMONS,
Corps of Engineers, U. S. A.

SURVEY OF TILLAMOOK BAY AND BAR, OREGON.

UNITED STATES ENGINEER OFFICE,
Portland, Oregon, October 19, 1891.

GENERAL: I have the honor to submit the following report upon survey of Tillamook Bay and Bar.

The last river and harbor bill contained an item providing for the e amination and survey, if found necessary, of "Tillamook Bay and Ba

Being charged with making the preliminary examination, I submitt my report thereon under date of December 2, 1890.

Under date of December 13, 1890, I was directed to make the nec sary survey.

Mr. William H. Wood was engaged to make the survey of the inn harbor, and his report is herewith.

Tillamook Bay is situated about 50 miles south of the entrance to t Columbia River, and at high tide is about 7 miles long and 2½ mi wide; at low tide it is a great sand and mud flat cut by three channe the North, Middle, and South channels. These channels are shown the accompanying map,* which embraces all of the bay within abo three-fourths of a mile from the harbor throat.

The South Channel is unimportant, being shoal and not used for pu poses of navigation.

The Middle Channel is the through channel by which access is had the head of the bay and to Tillamook City, the principal town of t locality, which is situated on Hoquarton Slough.

The North Channel runs along the north shore of the bay from t entrance to Shell Point, about a mile above Bay City, where it ter nates.

*Not reprinted; printed in House Ex. Doc. No. 35, Fifty-second Congress, first sessi

The difficulties met with in the navigation of the bay are three in number and are as follows:

First. Boats using the North Channel can not proceed up the bay except by returning down the North Channel nearly to the entrance of the bay, and then turning and going up the Middle Channel. It is proposed to obviate this difficulty by making a connection between the Middle and North channels so that boats can go to points along the north shore and then keep right on up to the head of the bay.

Second. The second difficulty is met with at Junction Bar, a shoal bar in the Middle Channel just below where the South Channel diverges from the main or middle channel. It is reasonable to believe that this bar is due to the interference of currents, and particularly to the weakening of the ebb current in the Middle Channel due to the branching off of the South Channel.

The remedy proposed for this difficulty is to partially shut off the water and stop its running into the South Channel and to confine more effectually the currents of the Middle Channel at the bar.

Third. The third difficulty consists in a shoal at a point known as Dry Stocking Bar, at the junction of Hoquarton Slough with the Tillamook River.

This is due to the widening of Hoquarton Slough and the backwater from Tillamook River.

A marshy island divides Hoquarton Slough into two channels, and the obvious remedy for the difficulty is to close up one of these channels by a dike, compelling the channel into the other and thus causing a deeper scour to take place.

A dike was constructed at this point some years ago, but was carried away by the winter freshets.

In order to make the connection between the North and Middle channels it will be necessary to dredge a channel across the intervening sand flat; and in order to maintain this channel it will be necessary to close up the Middle Channel so as to direct the ebbing and flooding waters through the dredged channel. This it is proposed to do by a dike which should be extended across the sands separating the North and Middle channels, and for some distance upon the sands bordering the Middle Channel on the south, in order to prevent the Middle Channel from cutting in around the deflecting dike.

It is proposed to make the dredged channel 200 feet wide on the bottom and 6 feet deep at low water. This will require the dredging of 65,000 cubic yards of material. The required deflecting dike will be 2,000 feet long, and can only be put in entirely across the channel after the opening of the new channel.

This dike can be built of piles, brush, and stone, at an average cost of $12 per foot. It is proposed to leave this dike 3 feet below high-water mark.

For the removal of Junction Bar a dike 5,000 feet long will be required. This will be built of piles, brush, and stone, and is estimated to cost $5 per foot.

For the removal of Dry Stocking Bar a dike will be required 950 feet in length; the dike to be built of piles, brush, and stone, at an estimated cost of $10 per foot.

The following is the estimated cost of the work proposed:

ESTIMATE.

Connection between North and Middle channels:	
Dredging 65,000 cubic yards, at 50 cents	$32,500
2,000 feet dike, at $12	24,000

Removal of Junction Bar:	
5,000 feet dike, at $5	$25,000
Removal of Dry Stocking Bar:	
950 feet dike, at $10	9,500
	91,000
Contingencies, engineering, etc.	9,000
Total	100,000

COMMERCIAL STATISTICS.

There is given herewith the report of Mr. W. H. Wood, of date of June 16, upon the commercial statistics of Tillamook Bay.

This, together with my preliminary report and the report of Mr. A. J. McMillan accompanying it, furnish all the information available in regard to the commerce of Tillamook Bay.

TILLAMOOK CITY, *June 16, 1891.*

DEAR SIR: I have the honor to submit the following report of the commercial statistics of Tillamook Bay for the year ending June 30, 1891, as per your instructions of June 2, 1891, as follows:

Following are the separate amounts, in tons, of the exports and imports of the entire bay; the same will be found in the tabulated statement attached:

EXPORTS.

	Tons.
11,600,000 feet B. M. lumber, at 4 pounds per foot	23,2
21,000 cases canned salmon, at 72 pounds per case	7
130 barrels salt salmon, at 400 pounds per barrel	
Butter	
Wool	
Hides	
3,000 boxes apples, at 50 pounds per box	
100 cases eggs, at 50 pounds per case	
Hay	
General merchandise	

IMPORTS.

General merchandise	3,3
Agricultural implements	
Machinery	1
Flour	1
Feed	2
Shingles	1
Brick	

Making a total of 24,188½ tons exported and 4,106 imported during the year.

Besides this there were exported 1,200 head of cattle which were driven out Astoria.

VESSELS.

The number of vessels of all descriptions crossing the bar during the year was in and 60 out. Their names, registered tonnage, number of trips each, are as follow

Steam schooner.	Tonnage.	Draft.		Tri
		Ft.	*In.*	
Truckee	350	13	6	
Scotia	200	11	4	
Laguna	200	11	6	
Augusta	87	7	9	
W. H. Harrison	70	6	9	
Louis Olsen	80	7	6	
Elmore	30	8	6	

: two vessels *Truckee* and *Scotia* ply between Hobsonville and San Francisco, ing both freight and passengers. They load out with lumber from the Truckee ber Company's mill at Hobsonville for San Francisco. The *Laguna* plies be-n Hobsonville and San Francisco, loading out with lumber, but carries no pas-ers. All three of the above vessels are operated solely by the Truckee Lumber pany.

e steam schooner *Augusta* carries both freight and passengers, making irregular between Tillamook City and all points on Tillamook Bay and Astoria and land. The steam schooner *W. H. Harrison* made one trip from Portland with ral merchandise for Bay City. The steam schooner *Louis Olsen*, owned by Mr. n, of Tillamook City, made six trips from Portland to Tillamook City, bringing chandise. She is now off the bay. The steam schooner *Elmore* made four trips Astoria, bringing supplies to Mr. Elmore's cannery at Garibaldi.

here are no regular vessels plying to Tillamook City, and I am unable to learn he lines of transportation extending to points beyond San Francisco and Port- except in the case of the *Truckee*, which is loading lumber for one trip to some t in Mexico.

ere are now plying between points on Tillamook Bay the following boats:

e tugboat, *General Garfield*, 10 tons register, drawing 5 feet of water, towing afts and carrying freight. She ascends as far as tide water extends. Two l sailboats carry passengers and some freight. There is also one barge with driver outfit.

e above-mentioned boats and vessels include all that are now or have been in pon the bay during the year.

e other lines of transportation to and from Tillamook City and Bay are:

lamook City to Sheridan via Grand Ronde, 60 miles, triweekly stage. Tilla- City to North Yamhill, Oregon, 42 miles, daily stage. Tillamook City to Hob-lle, Oregon, via Bay City, 9 miles, daily stage. Garibaldi to Nehalem Bar, on, 9 miles, daily stage. All of these stage lines carry the United States mail t from Garibaldi to Nehalem.

INDUSTRIES AND RESOURCES.

e whole of Tillamook County, except a portion bordering on the Nehalem River, butary to Tillamook Bay. Its principal resources are now and will be in the e, lumber, canned salmon, farming, dairying, and stock raising. The products, ding home consumption for the year 1890-'91, are estimated as follows:

Products.	Amount.	Tons.	Value.
er .... feet, B. M.	14,230,000	28,460	$13.00 per M.
d salmon .... cases	21,000	756	4.60 per case.
lmon .... pounds	52,000	26	.02½ per pound.
r .... do	76,000	38	.25 per pound.
.... bushels	2,500	400	.55 per bushel.
....	....	5,000	8.00 per ton.
e .... pounds	5,000	2½	.15 per pound.
attle .... head	1,200	....	22.00 per head.
.... pounds	6,000	3	.06 per pound.
les	600,000	60	2.00 per M.
....	10,000	20	8.00 per M.
s .... boxes	3,000	210	2.00 per box.
.... pounds	22,000	11	.10 per pound.

ere are some other small productions, but as they are all consumed on the bay ot estimated.

CITIES AND TOWNS.

ere are four small cities and towns situated on and tributary to Tillamook Bay,

ribaldi, situated three-quarters of a mile inside the bar, with a population of It has two general stores, two hotels, and one salmon cannery. The principal stry is fishing and canning salmon, during which season the population is much ased.

bsonville, situated on the east shore of the bay, is 1½ miles south from Gari-i. It has a population of 112; 1 general store, 1 hotel, post-office, and one sal- cannery. The Truckee Lumber Company's mill is located here, which mill has shed all the export lumber to date. The principal industries are lumbering canning salmon.

y City, situated on east shore of the bay, 5 miles south of bar; population, 374; 30, 1890, the population was 80. Bay City has a newspaper, 2 general stores, post-office, 1 hotel, 1 school building, 1 church, 1 sawmill, capacity 10,000 f M. per day; 1 sash and door factory, 1 hardware store, and storage ware and wharves. About $40,000 has been expended in new buildings this ye there are now being erected 2 stores, 2 hotels, 1 barrel and stave factory, 1 s besides several dwelling houses. The available resource is lumber.

Tillamook City, county seat of Tillamook County, is situated on Ho Slough, 12 miles south of the bar of Tillamook Bay. It is the oldest settlem has a population of 650 people.

The county court-house is located at Tillamook City. It has also 1 school b 1 church, post-office, 1 sawmill with a capacity of 15,000 feet B. M. per da niture factory, 6 general stores, 1 jewelry store, 2 fruit stores, 1 boot and sh 1 agricultural implement store, 1 hardware store, 1 furniture store, 2 hotels and 2 newspapers; also 2 blacksmith shops, 2 wagon shops, 2 livery stabl storage warehouses. The industries are lumbering, agriculture, dairying, an raising. All the agricultural land is tributary to Tillamook City.

Five rivers or streams empty into Tillamook Bay from the east, each ha source in the Coast range of mountains, viz: Miami, Kilchis, Wilson, Tr Tillamook rivers. Large bodies of timber land border on the heads of these consisting of spruce, fir, larch, and cedar, a large part of which is tributa bay; it has been roughly estimated at 20,000,000,000 feet B. M.

The bottom lands are very fertile and although as yet covered with tim great extent, they are the prospective agricultural lands of the county. the timber land is as yet unsurveyed. It is being located as fast as surve some even before.

The estimated increase of population is 20 per cent for the county since 1890.

No mines or minerals have yet been discovered tributary to the bay, alt is claimed that indications of coal do exist. Coal in some quantities has be on Coal Creek, a tributary of the Nehalem River, about 30 miles north of T City, but no mining has been done.

This information has been derived from various sources; from the county records of the various vessels and merchants' books, and by general inq observation.

I have been unable to complete the table through preceding years to any e no records were kept, and the older merchants did not keep books. Many have taken place.

No records of the vessels or their cargoes have been kept, not even their and departures, and my chief source of information was from the freight books of the vessels, which are incomplete and do not extend backward m two or three years.

Hoping the above may be satisfactory, I remain,

Your obedient servant,

W. H. \

Capt. T. W. SYMONS,
Corps of Engineers.

There is also given herewith the report of Mr. W. H. Wood survey of the inner bay:

TILLAMOOK, *June 30,*

SIR: I have the honor to submit herewith the following report of surve inner harbor of Tillamook Bay, Oregon, made during June, 1891:

Tillamook Bay is situated about 50 miles south of bar of Columbia River, tude about 45° 33′ north, longitude 123° 56′ west from Greenwich.

At high tide this bay is a body of water about 7 miles long and from 2 to wide, while at low tide it consists of a great sand mud flat, cut by three channels, known as the North, Middle, and South channels. The entrance c bar is about one-half mile wide.

The South Channel diverges from the Middle Channel near Dicks Point. It in many places and is not used in navigation.

The North Channel forms near the bar and extends up past Hobsonville a City. It runs out near Shell Point.

The Hobsonville and Bay City vessels use this channel. No fresh-water of any extent flow into it above Hobsonville, and from report it is filling up ually.

The Middle Channel is the one used by vessels that ply to Tillamook City the situation now is, any vessel going to Hobsonville or Bay City, in order t Tillamook City, must back out to near the bar and take the Middle Channe at any stage of the water.

ring into the bay from the north and east are six rivers or streams, the Miami, , Wilson, Tillamook, and Trask rivers, and the Hoquarton Slough.

steam tug *General Garfield*, drawing 5 feet of water, ascends the Tillamook 3 or 4 miles, while it and the steam schooner *Augusta*, the latter drawing 7 inches, both ascend Hoquarton Slough to Tillamook City at high tide. None other streams are navigable.

obstructions to navigation in reaching Tillamook City by way of the Middle el are Junction and Dry Stocking bars, separately described as follows:

tion Bar, as shown on the accompanying map, is situated at a point where ters of the Wilson River join those of the middle channel of the bay. It is . by the debris from Wilson River lodging at this point.

nprove same it is proposed to build a dike from the shore near Dicks Point, a e of 5,000 feet. This will prevent the water from going through the south l and force the ordinary currents of both channels to flow over this bar, thus g it scoured out. The material composing this bar is sand and gravel, ap- ly very loose and easy to scour.

Stocking Bar is situated where Tillamook River joins Hoquarton Slough, and distance below where the Trask River joins the same slough. Tillamook eing situated on Hoquarton Slough about 3 miles above this point, all vessels ing there have to cross this bar.

uld recommend that a high-water dike be built at this point as shown on ength 950 feet. Sufficient strength will be required to withstand the winter s, which are very severe, as shown by driftwood and other water marks.

dike will occupy about the same position as did a pile dike that was pre- r constructed at this place, but which was too weak to withstand the floods, now almost entirely destroyed. Of the improvements previously made here, o spur dikes and revetment on south side of channel still stand and are all nt for the intended purpose. This bar is sand and mud, and by confining the l by this proposed dike, I believe it will scour out 4 or 5 feet deep. At pres- re is only 6 inches of water on it at low tide.

mpanying this report are designs for dike and excavation to change channel, ng the Middle and North channels together, providing such a change is l necessary.

uilding this dike and excavating through this sand bank it will force the ow flowing in the Middle Channel to flow out through the North Channel, y securing one direct navigable channel from the entrance to Tillamook City, ow the vessels that come to Bay City to proceed direct to Tillamook City. I recommend the dike to be left 3 feet below high water.

bar of Tillamook Bay, from all the information I could gather, is not subject h change, and is in about the same position and condition as previous reports ow.

four steam schooners that now irregularly cross the bar are the *Augusta*, *Scotia*, , and *Truckee*. Depths in water are respectively 7 feet 10 inches, 11 feet 4 11 feet 6 inches, and 13 feet 6 inches. They always await favorable winds gh tides. Soundings taken by the captains of each are reported and give depths on the bar. These soundings as reported will, reduced to lower low- level, give a mean of 12 feet. The steamer *Truckee* claimed to be bar bound nine days during April and May, 1891, but all four are going in and out at t without trouble. The bar has only one buoy to mark the channel, and the ty seems to be in keeping the channel.

COMMERCE.

commerce of Tillamook Bay is all confined to the north shore and to Tilla- City on Hoquarton Slough. It consists in canned salmon, lumber, and agri- al products, in amounts and distribution as per my report to you of date June l, of "commercial statistics," of Tillamook Bay.

commerce is capable of much increase, especially the lumber interests, large ties of timber being found on all the streams, and tributary to the bay are h canneries, one at Galibaldi and one at Hobsonville, only one of which was ed during the past year.

Truckee Lumber Company, located at Hobsonville, are the only exporters of :. Their lumber is shipped to San Francisco. Two other mills cut lumber for al market.

materials that will be needed in the construction of these several dikes can produced here, except iron bolts. Piling in any quantity can be taken out at any point, and the sawmills can furnish lumber, while brush, such as alder, k, and spruce boughs, is along all the streams and can be boated to places re- . Clay is found in the underlying strata of all the tide lands and can be con- tly placed in works.

Rock extends along the shore from Memaloose Po
200 feet high. Good and convenient quarries of sa
loaded on barges at any stage of tide.

I have examined old piling for teredos and find th
sonville.

SURVEY.

The field work of this survey was done during the
of June, being finished June 12, 1891.

The Coast Survey signals were re-located on Men
Shell points, and intermediate signals located by sex

Soundings were taken from a Columbia River fish
men doing the pulling. The position of the soundi
readings from boat to signals on shore.

In platting the map the points first given above
Coast Survey triangulation and the intermediates fr

A tide gauge was set on wharf near Easterbrook P
ing Bar. The readings of high and low water were
tion for zero obtained by comparing it with Coast S
sponding time, and from this all the soundings we
level.

The mean rise of tide at Easterbrook Point is 7.3
6.6 feet, as so compared and calculated.

It is believed that by placing dikes and excavatior
accompanying sketches, a minimum depth at low w
maintained in one continuous channel from bar of
baldi, Hobsonville, and Bay City.

Very truly, yours,

To Capt. T. W. SYMONS,
Corps of Engineers, U. S. A.

SURVEY OF TILLAMOOK

In my report on the preliminary examina
Bar there is the following in reference to the

After a full consideration of all available informat
and Bar I am of the opinion that the present demar
any work looking to the improvement of the entr
agree that this is one of the best small bar harbors o
straight, shifts very little, and has an available de
water.

I am of the opinion that Tillamook Bay is worthy
improving the waters from the entrance to Tillamool
safely cross the bar can ascend thereto.

In my project for the expenditure of the
proving harbor at Tillamook Bay" it is r
things that a survey of the bar be made.

This survey was intended to procure the
in regard to the entrance, and to determine
importance had taken place about the entra
vey of June, 1889.

The last survey was made July 6, 1891,
the steamer *Gen. H. G. Wright*. A plot
soundings reduced to the plane of the mean
sent with this report.

This survey and plot shows an excellent
11 feet at mean low water or 17½ feet at mea

At the harbor throat, between Green Hill
distance between high-water lines is 1,820 fe
curves is 500 to 600 feet. The greatest dept

The bar is about 9,000 feet from the harbo
gable passage across it of 11 feet at the mea

*Not reprinted; printed in House Ex. Doc. No. 35, Fift

The least distance across the bar between 12-foot curves is 1,100 feet, and the distance between 18-foot curves is 3,500 feet.

The survey was made in the summer and shows the location of the bar and channels during the summer, when the northerly winds prevail.

As the winter season approaches and the prevailing winds veer to southerly, the bar and entrance channels move to the northward until they occupy about the position marked on the plot. As winter recedes they return to the position shown.

A comparative chart has been made which shows the surveys of 1867, 1889, and 1891. From this it is seen that the last two surveys give practically identical results.

The survey of 1867 shows the bar and entrance channels somewhat to the north of the location existing at the time of the later surveys, and with a least depth of 15 feet at low water. This would indicate one of two things, either that the bar has shoaled in the last twenty-four years or that in shifting from south to north or north to south a deeper channel than ordinary is sometimes developed.

It is altogether probable that the latter is the case, although the difference may be due to a combination of the two.

Another fact is observed, which is that the bar occupies practically the same position in regard to the sea that it did in 1867, it having neither advanced nor receded.

Mr. John B. Savage, who made the survey of the bar and entrance, reports as follows:

* * * * * * *

I have the honor to submit the following report on the survey of the entrance to Tillamook Bay, Oregon:

Arrived off Tillamook Bay on the steamer *Gen. H. G. Wright* on the morning of Monday, the 6th of July, 1891, but found upon entering only one or two of the former signals for sounding standing, so we started in and ran a line 3,200 feet in length approximately east and west across the northern end of the sand spit, and with that for a base extended a series of triangles which sufficed to locate most of the signals which were being erected as the triangulation was done, but with two signals, viz, "South" and "Beach," it was necessary to run lines from the nearest triangulation points to locate them. About four and a half days were spent in locating and erecting nine or ten signals, most of them temporary, with usually six or seven available men. I took the precaution to erect the signals for the bar soundings first, so that we could take advantage of the prevailing favorable condition of the weather to work on the bar, which we were able to do on two days before the signals were completed.

In all the equivalent of four days were spent in working on the bar, where there were four different sets of intersecting lines run so as to furnish a reliable check on the work, as well as to develop in an expeditious manner all portions of the bar. While sounding on the bar about 780 sextant observations were taken and 3,160 casts of the lead made.

One complete day sufficed to work up the inside of the bay as far as I considered necessary, and about two days were required to locate the high and low water lines, and in each case the mean was taken.

The bar covers a very considerable area, being quite a little larger than the bar at the entrance to Yaquina Bay, and it also shows a very fair depth of water for an unimproved entrance; in the channel, at low water, the least depth being about 11 feet. At the time of writing I have not been able to put the soundings on the map, so this is only an estimate, but it is a conservative one, I think.

The men who are acquainted with this bar, mainly the captains of the vessels passing over it, tell me that during the winter months the channel is very much to the north of its present position; in fact during last winter the two beacons "West Base" and "Spit" were used as a range for the channel by the masters of the vessels crossing the bar, but during the spring the channel gradually shifted to the south until it took its present position, which it has held for about the last two or three months, and is likely, I think, to continue in the same place till fall.

As soon as we tied up in Tillamook Bay I established a tide gauge, which I had read night and day for nearly two weeks, and by a comparison with the time and height of tides as computed from the tide tables, I determined the datum of the mean of lower low waters to come on the 2-foot mark of the gauge, which was nailed facing west to a pile on the northeast corner of the Cannery Wharf at Garibaldi. The total time consumed in making this survey was two weeks.

* * * * * * *

Very respectfully, your obedient servant,

THOMAS W. SYMONS,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. G. H. Mendell, Corps of Engineers, Division Engineer, Pacific Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
San Francisco, Cal., November 11, 1891.

Respectfully forwarded, recommended.

G. H. MENDELL,
Colonel, Corps of Engineers, Division Engineer.

T T 14.

[Printed in House Ex. Doc. No. 31, Fifty-second Congress, first session.]

PRELIMINARY EXAMINATION OF SWINOMISH SLOUGH, WASHINGTON, WITH THE VIEW OF CONSTRUCTING A SHIP CHANNEL THROUGH THE SAME, CONNECTING SARATOGA PASSAGE AND SKAGIT BAY WITH PADILLA BAY.

UNITED STATES ENGINEER OFFICE,
Portland, Oregon, November 4, 1890.

GENERAL: In compliance with orders contained in your letter of September 20, 1890, I have the honor to make the following report of the preliminary examination of "Swinomish Slough, Washington, with the view of constructing a ship channel through the same, connecting Saratoga Passage Skagit Bay with Padilla Bay, and to report the most suitable and feasible plan for making such improvement, with the cost of the same."

I have lately made an examination of Swinomish Slough in connection with the subject of the bridge of the Seattle and Northern Railroad Company over this slough, and deem no further preliminary examination necessary, as this slough is in my opinion worthy of improvement.

There are three routes for boats passing from the northern portion of the great body of water known as a whole as Puget Sound, to the southern portion thereof.

One way is by keeping through Rosario Straits, through the main sound to the west of Whidby Island and through Admiralty Inlet. The second is by passing through Rosario Straits and Deception Pass into the waters of Skagit Bay, Saratoga Passage, etc.; and the third way is by taking advantage of the navigable waters of Padilla Bay, Swinomish Slough and Skagit Bay. The first two routes are dangerous for smaller boats, owing to the heavy seas which prevail at times in the main sound to the west of Whidby Island, and to the dangerous passage through Deception Pass.

The route by Swinomish Slough is the most easterly and the safest for the smaller boats which ply on the sound and the many rivers and inlets thereof, as well as the shortest. It is, however, shallow and crooked.

Swinomish Slough is especially valuable for the passage of rafts of logs and lumber from one portion of the sound to the other. It has always been an important highway of commerce, but its relative importance has been changed somewhat of late by the introduction of larger [illegible]ts on the sound, the building of railroads, and the

l by the bridge constructed by the Seattle and Northern Railroad
any across its northern end.
ides the importance of this slough as a highway for general com-
, it passes through an exceedingly fertile country, the Skagit
the greater part of which has been reclaimed by dikes and
ht under cultivation. This Skagit Delta is in many respects the
important agricultural area west of the Cascade Mountains in
ington, and its means of water communication should be carefully
ed and as far as practicable added to.
survey for a ship channel will include a length of about 13 miles
the shallow flats of Skagit and Padilla bays, and through Swi-
h Slough.
estimated that the survey for a ship channel, the preparation of
and estimates, will cost about $3,000.
Very respectfully, your obedient servant,

THOMAS W. SYMONS,
Captain, Corps of Engineers.

;. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

:ough Col. G. H. Mendell, Corps of Engineers, Division Engineer,
c Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
San Francisco, Cal., November 14, 1890.

pectfully forwarded.
reasons herein stated, Swinomish Slough is worthy of improve-

G. H. MENDELL,
Colonel, Corps of Engineers, Division Engineer.

:Y OF SWINOMISH SLOUGH, WASHINGTON, WITH THE VIEW OF
STRUCTING A SHIP CHANNEL THROUGH THE SAME, CONNECTING
ATOGA PASSAGE AND SKAGIT BAY WITH PADILLA BAY.

UNITED STATES ENGINEER OFFICE,
Portland, Oregon, December 14, 1891.

IERAL: The last river and harbor bill contained an item for the
nation and, if deemed worthy, survey of "Swinomish Slough,
the view of constructing a ship channel through the same, con-
ig Saratoga Passage Skagit Bay with Padilla Bay, and to report
ost suitable and feasible plan for making such improvement, with
st of the same."
ler date of September 19, 1890, I was directed to make the re-
l examination, and under date of November 4, 1890, I submitted
port thereon.
Department letter dated November 21, 1890, I was directed to make
quisite survey.
ow have the honor to submit the following report, with maps,*
, and estimates.
p No. 1 is a vicinity map, showing the relations of Swinomish
h to the principal cities, navigable channels and passes of Puget
l.

* reprinted; printed in House Ex. Doc. No. 31, Fifty-second Congress, first

As shown by this map, there are, in this g
as Puget Sound, three routes for boats passi
southern portion, or the reverse.

One way is by keeping in the main sound
Fidalgo islands and through Admiralty Inle
ing to the west of Fidalgo Island and then
into the waters of Skagit Bay, Saratoga P
way is by taking advantage of the navigab
Swinomish Slough, and Skagit Bay. The fi
ous for smaller boats owing to the heavy sea
the main sound to the west of Whidby Isla
passage through Deception Pass.

The route by Swinomish Slough is the m
for the smaller boats which ply on the sound
inlets thereof, as well as the shortest. It
crooked in some portions, and the approach
low flats of Padilla Bay on the north, and S

Swinomish Slough is the ordinary meeting
at times the tides run in one direction entir

The ordinary rise and fall of the tides in t

As a general thing throughout the slough
of water; opposite La Conner there is 10 to
south of La Conner this increases to 34 feet,
trance to the "Hole in the Wall" there is
water.

Where the slough widens out, and especia
been in the habit of putting fish traps, this d
is not over 2 feet at low water in any practic
nel there is, is very crooked.

At the northern end the slough opens out
southern portion of Padilla Bay in the midst

At the southern end of the slough there a
the slough with the waters of Skagit Bay.
rated by a rocky island called McGlinns Isla

The east passage is wide and shallow, hav
feet of water at low water. The west passa
Fidalgo islands is at the narrowest place 22
depth of water for all purposes.

This short and crooked passage is so situa
on either side, that one can not see through
On account of its character it has received
descriptive title of the "Hole in the Wall."

This is the passage used almost exclusivel

EXTENT OF IMPROVEM

Situated as it is, Swinomish Slough is a
local steamboats plying on the sound, for ra
small sailing craft going up the slough and
chandise and taking out the products of the

There is not at present, and I do not beli
any necessity for large sea-going vessels to p
mish Slough. These vessels, in passing fro
to the other, would naturally take the wide an
Inlet or Saratoga Passage.

In fixing upon the extent of improvement p ation has chiefly been given to the class of vessels before named, *i. e.*, local steamboats, small sailing craft, and rafts of logs and lumber.

The principal use which would be made of the slough would be by the smaller steamboats running to the Nooksack River and the Bellingham Bay towns, Whatcom, Fairhaven, and Sehome, to points in the Skagit River country, the Stillaguamish and Snohomish countries, and to Seattle and Tacoma. These boats draw ordinarily about $3\frac{1}{2}$ to 4 feet. The sailboats which might use the slough would draw probably not more than 8 to 10 feet.

In deciding upon a depth to be given the navigable pass, this has been fixed at 4 feet below mean low water.

This will give a continuously open passageway for the smaller steamboats, while boats drawing more than 4 feet could always pass through by waiting for the tide.

If in the future, commerce should justify it, this navigable depth could be increased.

The width of the dredged channel has been fixed at 100 feet in order to allow boats or a boat and a raft to pass each other.

Throughout the slough there are places where a greater depth than 4 feet at low water exists naturally, and with much greater widths than 100 feet.

In the long stretch of dredged channel from the southern entrance of the slough to the deep water of Skagit Bay, 2 miles in length, it has been deemed proper to provide a basin where boats could accumulate or lie without interfering with the passage of others. This has been made where the channel passes nearest to Goat Island, and is designed to be widened to 200 feet for 750 feet in length.

As nearly all the traffic into or through the slough will be from north to south, or the reverse, the channel designed to be dredged from the entrance of the slough to the deep water of Skagit Bay is given as much of a southerly trend as practicable. In fixing upon its position, advantage has been taken of a natural channel. The same has been done at the northern end of the slough in locating the channel across the Padilla Flats.

It is feared that if channels are dredged across the Skagit and Padilla Flats they will fill up again unless some means are taken to prevent. With the object of preventing this, a series of dikes shown on the map is proposed. These dikes consist of piles driven about 8 feet apart, and wattled with brush from the bottom to about 2 feet above low water. With the aid of the dikes as located, it is believed that currents sufficient to prevent the deposition of sediment, will be compelled through the dredged channels.

ESTIMATES.

For a channel 4 feet in depth at the mean of the lower low waters, the amount of dredging which will be required for this work in Padilla Bay is 90,000 cubic yards; in Swinomish Slough, 143,000 cubic yards, and in Skagit Bay, 180,000 cubic yards.

The material throughout is sand and mud, all of which can be readily removed by the sand-pump dredges.

The material in Skagit and Padilla bays can be disposed of by conveying it to a distance of 1,000 feet or more through pipes and depositing it upon the mud flats. Most of the material in Swinomish Slough can be disposed of by depositing it in neighboring sloughs or behind

dikes. A small amount will probably have to
erable distance and dumped. For this an inc

ESTIMATE.

Dredging:
Padilla Bay, 90,000 cubic yards, at 20 cents ......
Skagit Bay, 180,000 cubic yards, at 20 cents......
Swinomish Slough, 125,000 cubic yards, at 20 cent
Swinomish Slough, 18,000 cubic yards, at 30 cents
Diking:
Padilla Bay, 6,000 feet wattled pile dike, at $1 ...
Skagit Bay, 14,500 feet wattled pile dike, at $1 ...
Swinomish Slough, to retain wasted material, 6,00
dike, at $1..................................

Total......................................
Add 10 per cent for contingencies, superintendence, et

Total......................................

In round numbers ....

SHIP CHANNEL.

Although Swinomish Slough is not consid
ment to the extent of making through it and
dilla and Skagit bays a channel for deep sea
has been made of the cost of such a channel.
follows approximately the course of the small
large map sent herewith. It varies from it i
and in passing to the east and around Mc
through the passage known as the "Hole in
would be too tortuous and dangerous for larg

While the smaller channel could probably b
directing the tidal currents, it is more than pr
channel would require constant dredging t
great a benefit as possible from the tidal cur
channel and to guard against sediment, it wo
stronger, higher, and closer dikes.

The ship channel estimated for is planned t
at low water, to be 80 feet wide in Swinomish
in Padilla and Skagit bays.

The estimated cost is as follows:

Dredging:
Padilla Bay, 2,800,000 cubic yards, at 20 cents....
Skagit Bay, 2,300,000 cubic yards, at 20 cents.....
Swinomish Slough, including disposal of materi
yards, at 25 cents ....
Diking:
In Padilla and Skagit bays, 30,000 feet, at $4 per

Add 10 per cent for contingencies, engineering, etc ...

Total......................................

COMMERCIAL STATISTI

Swinomish Slough has been an important
the development of the Puget Sound countr
asserted without hesitation, the details regard
meager. The use of the slough has been seri

ing the past two years by the bridge of the Seattle and Northern Railroad Company across its northern end. This bridge was built at an angle of about 45 degrees with the current, with a narrow draw span and a draw rest extending almost entirely across the channel. The bridge was complained of, and by direction of the Secretary of War a new drawbridge with a span of 158 feet, giving a clear passage in the direction of the current 100 feet wide, is being built. This it is expected will be completed by January 1, 1892.

The slough has in a few places during recent years also become very shoal, rendering it necessary at all times for boats to wait for high water in order to pass through.

With the removal of the obstruction to navigation caused by the railroad bridge and the deepening of the channel as proposed in this report, there can be no doubt of the greatly-increased use of this short and safe route between the upper and lower portions of Puget Sound.

Aside from the through travel, the improvement of Swinomish Slough will be of immense benefit to the commerce of the Skagit Delta through which it passes. This Skagit Delta is mostly composed of tidal marshes which have been reclaimed by diking and which have an almost fabulous fertility. They are penetrated by several tidal sloughs opening into Swinomish Slough or into Skagit and Padilla bays, which are the principal highways for the removal of their products and the shipping in of merchandise, building material, etc.

The products of the country are chiefly hay, oats, fruits, etc., which find ready and good markets in the larger cities and the lumber camps.

La Conner, the county seat of Skagit County, is situated on Swinomish Slough and is a beautiful little town of about 1,000 inhabitants. The town is old and conservative, having been established in 1869.

The large plat sent herewith shows the slough and the work as projected.

The following statement has been furnished this office by Dr. G. V. Calhoun, ex-mayor of La Conner:

Of the practicability of dredging the Swinomish, nothing need to be said herein, as that point will be fully covered by the report of the engineering corps that made this survey last spring. The next thing to be determined is the necessity for the proposed improvement, which question involves the consideration of safety, distance, and convenience.

All traffic passing from the waters upon which are situated the towns of Padilla, Bay View, Edison, Samish, Anacortes, Guernes, and all points in Whatcom County, to Seattle, Tacoma, Olympia, Coupeville, Oak Harbor, Snohomish, Stanwood, and all other points south of Skagit Bay, is directly affected by the condition of this inside route.

All this traffic must either pass through Swinomish Channel or take the tedious and dangerous outside route west of Fidalgo Island, where it encounters, between Deception Pass and Burrows Bay, the roughest water on Puget Sound or the Straits of Fuca. There the strong tides emerging from Saratoga Passage meet opposing southwest winds, and produce seas against which even the most seaworthy craft can not contend with any degree of safety, and the craft ordinarily plying these waters are utterly unfitted for such an ordeal.

Then at Deception Pass even greater dangers are encountered. The tide, suddenly confined between walls of solid rocks within a very narrow passage, rushes through at a velocity of from 8 to 15 miles per hour, creating great whirlpools and eddies. Very few steamers can make headway against the tide when at its worst, and none can do so with safety.

In attempting the passage against the tide, all steam is necessarily pressed on, and at such a time if the vessel strikes a whirlpool and takes a sheer, only the promptest action can prevent a catastrophe. Thus far, though numerous minor accidents have occurred, the caution of pilots has prevented any very serious mishaps, though hair-breadth escapes have often been reported, and it is generally recognized as an indisputable fact that the sinking of a steamer there would result in a loss of all on board. The steamboat inspectors, comprehending this, have forbidden vessels from attempting the passage except at slack water.

The inside route, through Swinomish Slough, possesses every advantage over t outside route. It shortens the distance from Skagit Bay and Saratoga Passage Padilla Bay and the Gulf of Georgia by some 15 miles, and provides a safe shelter route of sufficient width, free from heavy seas or dangerous tides and rocks, the o obstacles being sand bars, which impede progress.

As before stated, the entire commerce between the northern and southern porti of Puget Sound, dividing on Fidalgo Island, is affected by the condition of the side route. Such traffic as does not now take this route would do so if the chan was improved to admit of low-tide navigation.

It would be impossible, without a pretty thorough investigation, to form a relia estimate of the amount of annual tonnage of receipts and shipments.

Owing to the numerous bays, inlets, rivers, and so-called "sloughs" interse ing every portion of the country, all lined with warehouses and granaries, nea every farmer, logger, and manufacturer, as well as every merchant, is a shipper.

Then, too, we must remember that for every ton of grain or produce shipped a proportionate amount of provisions, machinery, and merchandise is imported.

For the country situated in the immediate vicinity of this channel and direc tributary thereto, it is estimated that there are shipped annually 20,000 tons of o (1,250,000 bushels), 20,000 tons of hay, and other products. Over 5,000 tons of m chandise, etc., is imported.

No data is available bearing on the log and lumber shipments, but as logging even a more important industry than agriculture, some idea may be formed of t quantity of logs and lumber seeking shipment by this route.

As these figures take into consideration only a very small scope of country, p haps a better idea of the importance of this channel and the necessity of its impro ment may be gained by an enumeration of the list of steamers running here regular or occasionally, as follows:

Steamers making regular trips: Hassalo and Idaho, daily; Mary F. Perly, t weekly.

Steamers regularly engaged in the grain trade: Fanny Lake, E. W. Purdy, L. Perry (steam schooner), Utsalady (steam schooner), Maid of Oregon (steam schooner

Making frequent or occasional trips:

Wasco.	Eliza Anderson.	Glide.
Alki.	Emma Hayward.	J. B. Libby.
Cascade.	Enterprise.	James McNaught.
City of Quincy.	Gem.	Josephine.
Clara Brown.	Geo. E. Starr.	Lilly.
Daisy.	Gleaner.	Brick.
Edison.	Biz.	W. K. Merwin.
Washington.	W. F. Munroe.	Yakima.
Yukon.	Zephyr.	Fairhaven.
J. C. Brittain.	Henry Bailey.	Sehome.
Isabelle.	Margy.	Mame.
May Queen.	Messenger.	Michigan.
Nellie.	Otter.	Saranac.
Seattle.	Skagit Chief.	Susie.

The report of Mr. John R. Savage, assistant engineer, who made th survey, is herewith.

Very respectfully, your obedient servant,

THOMAS W. SYMONS,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. G. H. Mendell, Corps of Engineers, Division Enginee Pacific Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
San Francisco, Cal., December 18, 1891.

Respectfully forwarded to the Chief of Engineers, U. S. Army, reco mended.

G. H. MENDELL,
Colonel, Corps of Engineers, Division Engineer.

REPORT OF MR JOHN R. SAVAGE, ASSISTANT ENGINEER.

CAPTAIN: I have the honor to submit the following report of the survey of Swinomish Slough with a view of constructing a ship channel through the same, connecting Saratoga Passage Skagit Bay with Padilla Bay:

Swinomish Slough is the channel separating Fidalgo Island from the Swinomish flats, and joining Skagit Bay, Saratoga Passage, with Padilla Bay. This slough extends almost due north and south for about 6 miles in longitude 122° 30′ west of Greenwich and in about latitude 48° 25′ north, and affords a direct inside passage for steamers from the upper end of Puget Sound through Saratoga Passage to Bellingham Bay, thus avoiding rough water and the dangers of Deception Pass.

On the north, through Padilla Bay, Swinomish Slough has connection with the Strait of Fuca by way of Ship Harbor and Rosario Strait; and on the south, by Skagit Bay and Saratoga Passage through Deception Pass, there is also connection with the Straits; but the main commercial value of this slough is owing to the fact of its being the connecting link for direct water communication between the Bellingham Bay country and all the upper Sound points.

Fidalgo Island, which forms the west shore of Swinomish Slough, is heavily wooded generally, and in the main is more or less broken up and hilly, although towards the north end of the slough there is quite an extent of tide-flat land, from half to 1 mile in width, and about 2¼ miles long, of which a part has been reclaimed and is now cultivated by the Swinomish Indians, who own all the portion of Fidalgo Island bordering on the slough. To the east of Swinomish Slough there is a magnificent stretch of farming country, perfectly level, that was originally salt marsh, which has been reclaimed by means of dikes and is now an extremely fertile section, the special products of which are hay and oats, of which very large crops are raised.

These flats vary in width from 4 to 6 miles and extend for many miles to the north and south.

Skagit and Padilla bays are in the main mud flats bare at low water, with a number of small narrow channels running through them, but in a large part of Swinomish Slough there is a very good depth of water. There are a number of shoals or bars, however, nearly bare at low water, which were formed in all probability by the fish traps or dams built by the neighboring Indians some years ago, but these can be easily improved by dredging.

The traffic through the slough has been very light in the last two or three years on account of the Seattle and Northern Railway bridge, which has been a serious obstruction to navigation. It is now, however, being replaced by another bridge with a clear span of 100 feet.

FIELD WORK.

The town of La Conner was the center of operations for this survey, which was started April 23, 1891, with the initial point of the meander line near the lamp designated on the map as "Lamp 100." This line, known as the A line, followed the east shore of Swinomish Slough pretty closely for a distance of about 6¼ miles to the bridge and trestle of the Seattle and Northern Railway, from which place another line (the B line) was run south on the west shore of the slough a distance of nearly 2 miles to the north end of the channel known as the Hole in the Wall. These two lines were connected at various points by triangulations and the field work was thus thoroughly checked as the latitudes and departures of the lines were calculated. The location of the shore lines of the slough and the erection and location of the necessary signals for sounding were very quickly done, once the meander lines were run.

A series of triangles was extended through the Hole in the Wall, as chaining was impossible on account of the rocky and precipitous nature of its shores. Here the various signals for sounding were located with reference to the triangulation points or by cuts from two or more of these points; the prominent points of the shore line through this channel were located by sextant observations and the shore line sketched in through these points.

The A line was run 3,600 feet south of its initial point and there was also a short line run on the east shore of McGlinns Island to locate the shore line and the necessary signals for sounding.

The soundings were taken from a small rowboat at equal intervals on diagonal lines across the slough, the points on and the ends of which were located by simultaneous observations with two sextants to the signals established and located on each shore. The soundings were taken in feet and reduced to the mean of the lower low waters. The soundings shown in Skagit and Padilla bays are taken from the work of the U. S. Coast and Geodetic Survey from the survey of 1890.

TIDE GAUGES, ETC.

Tide gauges were established near each end of the slou
and read continuously for a period of about a month; c
experienced in reconciling the daily readings with the c
times computed from the tide tables for the Pacific Coa
tance of the nearest points named in the tide tables fro
stated above, the datum to which the soundings were r
observed lower low waters, which is the plane of referen
and Geodetic Survey.

The tides in Skagit Bay run rather higher than those in
and heights of high and low water are as a rule from on
an hour later than those in the latter bay, and in consequ
tide at the Padilla end of the slough begins to ebb before th
end, which causes the flow of water in the slough at about
erly direction, even after the tide has really begun to fall
The tidal currents in Swinomish Slough run with conside

BORINGS.

Borings were made with a steel rod at all the shoals in
every place where excavation is necessary. In nearly
difficulty met with in working the rod down to more th
plane of the lower low waters, and in every case the sh
which I should judge extended as far as the rod penetr
instances when the indications were that gravel was
borings however were taken at the cut near Whitney's b
an alluvial nature, and, while of course it is not so eas
cause no particular difficulty in excavating. The materi
is of about the same nature as the above, only probably a

PROJECT FOR IMPROVEMENT.

The proposed project of improvement consists of a chann
bottom, dredged to a depth of 4 feet below the mean of t
deep water on the south in Saratoga Passage through
closely the eastern shore of Fidalgo Island through the sr
Hole in the Wall, into Swinomish Slough, thence by the
peal route practicable to and through Padilla Bay to deep

The channel through Skagit Bay leads directly from th
little to the east of Goat Island, where it makes a small tu
the small shallow channel across the flats to deep water i

The channel skirting the southern shore of Fidalgo Isla
toga Passage just north of Seal Rocks could be improved
above named, but on account of its being more direct an
through the slough, the channel to the east of Goat Islan
provement.

In Padilla Bay, as shown on the map accompanying
channel will follow closely the present channel leading di
slough to deep water, although on the score of economy it
this channel more tortuous than is desirable.

Through Swinomish Slough the places where dredging
on the map by the hatched channel.

In the slough proper, I think there will be nothing to b
portions filling up again, at least not for several years, an
them, but the disposition of the material dredged from th
consideration.

In the outside bays, however, the problem of retainin
channel is proposed to be dredged is one of considerable d
material could be easily disposed of by pumping behind
dike and allowing the same to settle there.

It is believed that some sort of a training wall or wattl
tion shown on the map, will be necessary in order to retai
channels in Skagit and Padilla bays.

At the north end of the slough the material to be dred
cut off, and bar south of the Seattle and Northern Railwa
posed of by pumping it into one of the numerous sloug
west of the main channel; at the extreme southern end

excavated could be conveniently wasted behind a brush dike on the tide flat to the west and probably made use of in reclaiming this land for agricultural purposes.

In the 2 miles of the slough from La Conner north there are about 50,000 cubic yards of excavated material to be disposed of, either behind brush dikes above or below high water, or by filling up small sloughs, or by removal on scows and wasting at the nearest available place. There is a stretch of excavation about one-fourth of a mile north of La Conner and about 1,000 feet in length, amounting to nearly 6,400 cubic yards, the excavated material from which can be conveniently wasted between the small island near by, and the mainland, by joining each end of the island with the mainland by a dike to retain the excavated material.

The excavated material in the long stretches near the mouth of White Slough and north of the same could be probably best disposed of by wasting behind a brush dike, constructed along or near the low-water line on the west shore of Swinomish Slough for a distance of about 3,900 feet opposite these shoal parts of the slough.

The disposal of any excavated material in the slough could be safely counted on, not to cost more than 10 cents per cubic yard. This includes disposal by removal on scows, or wasting behind dikes, or by any of the means mentioned, and the disposal of the 18,000 cubic yards remaining out of the above 50,000 cubic yards has been estimated at this, 10 cents per yard cost, without any specified place of deposit.

This channel proposed, from Saratoga Passage to deep water in Padilla Bay, has a total length of about 10.8 miles, with a total cost of $122,000, or a cost per mile of about $11,300.

SHIP-CHANNEL PROJECT.

According to the terms of the law authorizing this survey, an estimate is to be made of the cost of a ship channel through Swinomish Slough to connect Saratoga Passage and Padilla Bay; and a cross section with a depth of 25 feet below the mean of the lower low waters, and with a bottom width of 80 feet, and side slopes of one on one and a half, has been adopted for the project through the slough.

In Padilla and Skagit bays the same depth is used, but the bottom width is enlarged to 150 feet, with the same side slopes as above.

The route chosen for the ship channel is practically the same as that for the 4-foot channel, with the exception that the former passes to the east of McGlinns Island instead of through the "Hole in the Wall;" the ship channel is more direct however, as 2,000 feet has been adopted as the smallest radius.

Through Skagit Bay the route is, as in the 4-foot channel, to the east of Goat Island, where it swings off to the east of McGlinns Island, around which it passes on a curve of 2,000 feet radius and parallels the shore on a tangent for about 2,000 feet, when it reverses on another curve of 2,000 feet radius to the rocky point southwest of La Conner, where there is another reversed curve, this time of 3,000 feet radius and swinging to the west or left, which carries it past La Conner, whence the line is nearly straight or with long tangents, connected by curves of 3,000 feet radius to Padilla Bay, where the natural channels are followed as much as possible to deep water, a distance of about 4 miles from the slough.

The nature of the traffic through Swinomish Slough and from Saratoga Passage to points north thereof will never in my opinion demand a channel of the above cross section, as this class of trade is fully satisfied by steamers of 4 and 5 feet draft, and in consequence of this the estimates for this 25-foot channel have not been prepared with the same care as those for the 4-foot channel, but still they are a close approximation of the cost of such a channel. The price of dredging has been taken at 20 cents per cubic yard, and an allowance of 5 cents per yard has been made in addition to this, to cover the disposal of the material excavated in Swinomish Slough.

The total length of the ship channel from deep water in Saratoga Passage to deep water in Padilla Bay is about 12.5 miles, and the total cost for improving the same would be about $2,134,000, or an average cost of $170,720 per mile.

ESTIMATES.

Channel of 4 feet depth at low water:

Dredging.	
Skagit Bay, 180,000 cubic yards, at 20 cents	$36,000
Swinomish Slough, 125,000 cubic yards, at 20 cents	25,000
18,000 cubic yards, at 30 cents, including disposal	5,400
Padilla Bay, 90,000 cubic yards, at 20 cents	18,000
Total dredging	84,400

Diking.
Skagit Bay, wattled dike ....
Swinomish Slough, brush dike..................
Padilla Bay, wattled dike ....

Add 10 per cent for contingencies ....

Total ....

Ship channel:
Dredging.
Skagit Bay, 2,300,000 cubic yards, at 20 cents..
Swinomish Slough, including disposal of mater
yards, at 25 cents ....
Padilla Bay, 2,800,000 cubic yards, at 20 cents..

Total dredging..................................
Diking.
In all, 30,000 linear feet, at $4 per foot........

Add 10 per cent for contingencies..............

Total ....

Very respectfully, your obedient servant,

T T 15.

REPORT OF BOARD OF ENGINEERS ON PROPOS
NECT LAKES UNION, WASHINGTON, AND S
SOUND, WASHINGTON.

[Printed in House Ex. Doc. No. 40, Fifty-second Cor

UNITED STATES E
Portland, Oreg

GENERAL: The Board appointed under the tember 19, 1890, to select and survey the most estimate the expense of construction of a ship Union, Washington, and Samamish with the having completed that duty, has the honor report:

The Board visited Seattle and carefully exa the feasible routes for the prescribed canal, a acter and extent of surveys and investigations for a complete understanding and discussion o public meeting was held at the rooms of the Seattle Chamber of ımerce, at which citizens and other interested parties expressed ly their views upon the canal and its various features.

Vritten communications received by the Board appear as appendixes the report.

The Board designated Capt. Thomas W. Symons as disbursing officer l as executive in charge of the surveys and preparation of the plans.

The services of Mr. Philip G. Eastwick, civil engineer, were secured, d he was placed in charge of the surveys, with headquarters at Frent, a suburb of Seattle. Mr. Eastwick's report is herewith.

Accompanying this report is a general map upon a scale of 1 inch 1¼ miles, showing the vicinity of Seattle with Lakes Union, Washgton, and Samamish, in their relation to Puget Sound. Upon the ne sheet is a map, illustrating in greater detail the canal survey from get Sound to Lake Washington, upon a scale of 1 inch to 400 feet, l longitudinal profiles and cross sections along the selected canal tes.

GENERAL DESCRIPTION.

The city of Seattle, the largest city of the State of Washington, is uated upon Duwamish or Elliott Bay, an indentation of the eastern re of Puget Sound, about half way between the upper or southern . and its junction with the Strait of Juan de Fuca.

n the immediate vicinity of Seattle are the three lakes, Union, shington, and Samamish, and also Salmon Bay and Smiths Cove, arms of Puget Sound situated on the line of the projected canal.

LAKE UNION.

ake Union, which is nearest to the heart of Seattle and to the ınd, is the smallest of these lakes. It has an area of 905 acres, of ich 499 acres cover a depth of 25 feet, and with a maximum observed th of 60 feet. The area of the drainage basin of this lake is 6 are miles.

'his lake receives, in addition to the supply of water from its drain- basin, a considerable supply from Lake Washington, through a al which has been cut through the divide separating the two lakes, l which is used for the passage of saw logs and small vessels.

'he outlet of Lake Union is a small stream running from its extreme tern end into Salmon Bay. The distance between the lake and the is 5,700 feet.

'he general and average elevation of the surface of the water in Lake ion is 25.5 feet above extreme low water in Puget Sound, or 7.8 feet ve extreme high water.

LAKE WASHINGTON.

ake Washington, the largest of the three lakes, lies directly east of e Union and of Seattle. It is 19 miles long, averages about 2 miles vidth, and has an area of 38.9 square miles, or 24,896 acres, of which bably 22,000 acres cover a depth of 25 feet or more.

'he depth of this lake is very great. Soundings were not made over entire area of the lake, but it is stated on apparently creditable

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Not reprinted; printed in House Ex. Doc. No. 40, Fifty-second Congress, first ion.

authority that depths of 600 feet have been observed. The deepest water observed was 150 feet, the length of the sounding line used.

The area of the drainage basin of the lake is 182 square miles. It receives, in addition, the drainage of the basin of Samamish Lake and River, the areas of which amount to 211 square miles.

The outlet of the lake is Black River, which unites with White River, 2.5 miles below the lake, forming the Duwamish River. The Duwamish River follows a tortuous course for about 14 miles and empties into Duwamish Bay. A short distance below the outlet of the lake the Cedar River joins the Black River and flows with it to the Duwamish, except in times of flood in Cedar River, when the waters of Cedar River run partly into Lake Washington, which thus acts as a safety valve to prevent excessive flooding of the Duwamish River valley.

The general elevation of the surface of the lake is 33 feet above extreme low water in Puget Sound, or 15.3 feet above the highest tides. It is 7.5 feet above that of Lake Union.

The most extensive shoals of Lake Washington, where the water has a depth of less than 25 feet, are at the head and at the foot of the lake and in Union Bay. That at the head of the lake, formed by the deposition of sediment brought down by the Samamish River, covers an area of about 300 acres. That at the foot of the lake is evidently formed by the deposition of sediment brought down Cedar River during floods, when a large volume of the waters of that river is emptied into the lake. The area of this shoal is about 300 acres.

The shoal in Union Bay covers an area of 610 acres, almost the entire area of that bay.

The localities of the remaining shoals and their areas, are as follows:

	Acres.
Juanita Bay, north of Kirkland, about	150
Three indentations, south of Houghton, about	200
Meydenbauer Bay, about	75
Mercer Slough Bay, about	200
Island Shoal, about	25
Waterworks Bay, about	25

LAKE SAMAMISH.

Lake Samamish lies to the east of Lake Washington and is separated from it by high ridges. It is about 7¼ miles long, with an average width of a little over 1 mile. The area of the lake is 8 square miles, and that of its drainage basin 102 square miles. Its outlet is through the Samamish River, which, 17 miles in length, flows through a swampy valley into Lake Washington. The observed elevation of the surface of this lake is 41.2 feet above low water in Puget Sound, or 9.6 feet above that of Lake Washington.

The fluctuations of the surfaces of these lakes are moderate and are elsewhere described.

SALMON BAY.

Salmon Bay is an estuary connecting through Shilshole Bay with Puget Sound.

In these bays the tide has a mean range of about 11 feet and an extreme range of nearly 18 feet.

At extreme high tide the level of Salmon Bay is 7.8 feet below the usual level of Lake Union.

This bay has not sufficient depth, even at high stage of tide, for the passage of vessels of considerable draft.

It will be seen hereafter that the recommended projects provide that e level of the water of Salmon Bay be raised to and maintained at e level of Lake Union, 7.8 feet above extreme high tide. This will ecessarily cause the shores of Salmon Bay to be permanently sub- erged. Part of the submerged land, particularly in the town of Bal- rd, is occupied by buildings and wharves.

While the raising of the level of Salmon Bay must, to a very large egree, increase values of riparian lands by making a deep-water har- or, yet the submergence of certain lands gives rise to damages and es, the particular dimensions of which have not been ascertained by e Board. These constitute a liability which is not embraced in the stimates.

The proper disposition of material excavated from the canal prism d from the bays and lakes by dredging, in raising these submerged nds, will be a factor in reducing considerably the measure of these amages.

CANAL TO LAKE SAMAMISH.

By its orders, the Board was directed to include in its survey and timates, a section of canal connecting Lake Washington with Lake amamish. It early became evident, however, that there was no real mand for this canal or expectation that it would be given serious nsideration. Its cost has been ascertained by survey to be much eater than the cost of the portion connecting Puget Sound with kes Union and Washington, and the advantages to be derived from are very small.

In the general consideration of the subject, therefore, the attention the Board was, for the reason above stated, more particularly con- ned to the section connecting Lakes Union and Washington with uget Sound.

ROUTES.

There are five possible routes for a canal connecting Lakes Union and 'ashington with Puget Sound.

First. By way of Duwamish Bay and the valley of the Duwamish d Black rivers to Lake Washington and across the Portage from ake Washington to Lake Union.

Second and third. By way of depressions between the southern part of ake Union and Duwamish Bay. (These routes were considered twenty ears ago by Gen. Barton S. Alexander, and are known in his report the "Mercer farm route" and the "Tramway route.") Thence from ake Union to Lake Washington by a canal through the Portage.

Fourth. By way of Shilshole Bay, Salmon Bay, the valley of the tlet of Lake Union to Lake Union, and thence between Lakes Union d Washington, by a canal through the Portage.

Fifth. By way of Smiths Cove to the upper end of Salmon Bay; ence as in the preceding route.

The first route, by the valley of the Duwamish, was soon eliminated om serious consideration by its great cost and other disadvantages.

The second and third routes were practicable twenty years ago, when eattle was a straggling village, but the land traversed by these routes now built up with business blocks and residences and the cost of the ght of way is prohibitory.

The fourth and fifth routes are entirely feasible. They have received ll consideration, and estimates of cost by both routes are submitted. These two routes coincide in alignment from Lake Washington to

Salmon Bay; they differ in that one makes the connection with Pug Sound from the head of Salmon Bay, by the lower end of Salmon B and Shilshole Bay, and the other through a low gap to Smiths Co and Duwamish Bay.

In each of the projects, by Shilshole Bay or by Smiths Cove, vessels to pass from the waters of Puget Sound to Salmon Bay throu masonry lock placed close to the Sound, having a lift varying accor to the stage of the tide.

The dimensions of the lock are as follows: Length, 400 feet; width, 50 feet; depth on the sill at extreme low stage of tide, 16.6

These dimensions have been the subject of careful considerati the way of adapting them, at a minimum cost, to present requiren of navigation and to those of the next few years.

The depth on the sill at the lowest high water is 26 feet, so that in the lowest class of tide there will be two occasions in each tw four hours when vessels of 26 feet draft may pass through the loc

As lower high waters are generally followed by higher low w which are but little lower than the preceding high water, ther generally be two or three hours at each high water during whicl sels of this draft can pass the locks. The periods for passage of sea vessels of ordinary draft (22 or 23 feet) will last from abou tide on the flood to half tide on the ebb, an interval, including tides of the day, equal to twelve to fifteen hours. During the re ing portion of the day the lock will pass only vessels of less draft 22 feet, but at all times there will be an opportunity to lock vess 16 feet draft.

This arrangement, which now appears to the Board to afford all n facility with a minimum of expense, may require to be modified further consideration of increasing commerce. The sill can be lo at any time preceding construction, and any desired degree of a modation can be secured by an increase of cost, which, being con mainly to the cost of the lock, need not be very great.

As before stated, both projects provide that Salmon Bay sha raised and maintained to the level of Lake Union.

Both projects include channels excavated through the shoals ou of the tidal locks, 300 feet wide and 26 feet deep at the lowest high that through Shilshole Bay one-half mile, and that at Smiths one-third mile long, and basins at the outlets of the locks 500 feet and 26 feet deep at extreme low tide, in which vessels may lie to lockage.

The Shilshole Bay project provides for dredging a channel thr Salmon Bay to a point common with the Smiths Cove route.

The Smiths Cove project embraces a canal 80 feet wide on the tom, 158 feet wide at the water line, and 26 feet deep through th between the outer lock and Salmon Bay, and dredging through Sa Bay to the same common point at its head.

The following features are common to both projects, viz:

A canal 6,700 feet long, 80 feet wide on the bottom, 158 feet wi the water level, and 26 feet deep, connects the head of Salmon Bay Lake Union.

This channel is extended through the shoal portions of Lake U 200 feet wide, to the portage which intervenes between Lakes U and Washington. Through this portage a canal 2,600 feet long, 8 wide on the bottom, 158 wide at the water line, and 26 feet deep nects Lake Union with Union Bay, a shoal bight in Lake Washin A lock 400 feet by 50 feet, with a lift of about $7\frac{1}{2}$ feet and depth o of 26 feet, overcomes the difference of level between the two lakes l channel 4,600 feet long through Union Bay completes the n with deep water in Lake Washington.

tion the Smiths Cove project requires a dam at the narrows ı Bay which shall serve to raise its level to the required height. imated cost of the Shilshole Bay system with masonry locks 000, and of the Smiths Cove route $3,500,000.

ilshole Bay system costs $600,000 less than that by Smiths n the other hand, the latter route possesses advantages in that ce is in the harbor of Seattle, whereas the entrance to the other es distant, and, secondly, the Smiths Cove entrance and lock xposed to bombardment by an enemy's fleet. For these reasons ıs Cove route is to be preferred.

er of these routes there will be added to the commercial fa- Seattle three fresh-water areas where timber wharves can be ed and cheaply maintained and where vessels can lie in per- et water of a constant level.

Sound at Seattle the tide has an average range of more than nd an extreme range of nearly 18 feet. These oscillations of all embarrassing to commerce, and wooden wharves are liable stroyed by the teredo in a few months. Marine insects are ructive to piling and other timber placed in the waters of und.

Bay, maintained at the level of Lake Union, will contain 35 vater area more than 25 feet deep, and an additional area of can be brought to the same depth by a moderate amount of

nion has an area of 499 acres of a depth of 25 feet, which can, le, be increased by dredging. The total area of the lake is 905

wo areas combined about equal the total area of the docks of ınd they can readily be made equal by dredging to the area of pool docks.

'ashington area contains 38.9 square miles, or about 25,000 acres, ıbout 22,000 acres are covered with a greater depth of water eet.

ssential respects the extension from Lake Washington to Lake ı conforms to the dimensions of the canal and locks below, g Lakes Washington and Union with Puget Sound.

g upon the dimensions of the canal and locks the Board has ed to provide accommodation for the present and immediately re demands of commerce, and to so leave matters that, if in e greater accommodations should be required, they can be thout interfering with the usefulness of the present proposed The locks are designed to pass the largest type of ships which et Sound. A list of this shipping, as far as could be ascer- here given.

STEAM VESSELS.

Name.	Length of keel.		Beam.		Draft.	Tonnage.
	Ft.	In.	Ft.	In.	Feet.	
....	331	3	42	2	20	3,300
....	310		40	6	21	2,800
....	310		40	6	21	2,300
....	315		39	2	21	2,300
'acific	331		38	5	22	1,800
a	320	6	38	6	23	3,000
a	198		35	3	17	1,000
blic	191	5	36	1	16	875
....	200	1	38	2	17	1,300

For extreme length, from 10 to 30 feet must be added to the leng of keel noted, and for extreme width 1 foot must be added to the bea Heights from the water line to tops of masts will range from 120 to 1 feet.

SAILING VESSELS.

Name.	Length of keel.		Beam.		Draft.
	Ft.	*In.*	*Ft.*	*In.*	*Feet.*
Spartan	207	6	40	5	22
Ivanhoe	202	3	39	3	23
Germania	170	2	36		19
Templar	155		35	2	19
Blue Jacket	193	8	45		21
Detroit	197		38	5	22
Levi G. Burgess	217	5	41	2	22
Alexander McNeil	174	4	36	6	20
Margaret	201		39	1	23
Highland Light	194	9	38	1	23
Commodore	226	9	41	8	24
Abner Coburn	225		43	2	26
Elizabeth	231	5	41	8	26
Alexander Gibson	247	5	42	6	27
J. B. Walker	247	1	42	2	27
Daniel I. Tenny	212	4	40	4	24
Undaunted	207	3	41		23
Edward O'Brien	259	1	42	2	27
T. F. Oakes	264	6	42	2	24
Gen'l Fairchild	203	4	38	8	23

For length "over all" from 30 to 45 feet must be added to the l of keel noted, and for extreme width 1 foot must be added to the Heights from the water line to top of masts will range from 150 feet. Top masts can be so lowered as to reduce this height 3(feet.

From these lists it is seen that all the steamships are readily a modated, and that all the sailing ships can be accommodated as length and width are concerned, and generally with a tug in the lockage. There are a few ships noted that when fully loaded dı feet.

As the tendency in modern ship building is toward steamship sailing vessels of smaller draft, it was not deemed necessary to p: at present for the few wooden sailing ships of excessive draft.

There are two classes of ships which can not be passed throu; proposed lock, "ocean greyhounds," similar to those plying on tl lantic, which would be debarred on account of their great length, a large first class battle-ships and protected cruisers of the Navy, would be debarred on account of their great breadth of bean these may be added the large side-wheel steamers engaged ii traffic on Puget Sound, of the type of the *Olympian*, which is 7 wide, guard to guard.

If future developments shall show the desirability of providi the passage of such shipping, other locks can be built of size suf to afford the required accommodation.

The ideal arrangement for this canal would be that laid down f Manchester Ship Canal, where three locks are planned side by one 80 by 600 feet, one 50 by 350 feet, and one 30 by 175 feet.

WATER SUPPLY.

Lake Washington furnishes an ample water supply for the ser' the canal.

As it is probable that the lower lock will be used much mo tly than the upper lock, and as the latter at each lockage passes water than the former, it is necessary to provide for the passage Lake Washington to Lake Union of the additional amount of r required for the lower lock. Proper weirs for this purpose are ided at the upper or Portage Lock. If future developments should the necessity for more water than can well be taken from Lake hington, an additional supply can be obtained by turning the r of Cedar River into the lake. This can be done at a compara- y small expense.

MODIFICATIONS.

arious modifications of the plan finally fixed upon were considered he Board of Engineers.

rincipal among these was the project of bringing Lakes Union and shington to the same level, and avoiding thereby a lock at the tage.

'hree ways of doing this are available: By lowering Lake Washing- to the level of Lake Union; by raising Lake Union to the level of te Washington, or by establishing a common intermediate level by ing one and lowering the other.

Jpon a full consideration of the advantages and disadvantages which se modifications presented, it was concluded that, owing to the dis- bance they would make in values along the shores of the lakes, and he consequent damages, the best plan would be to leave the lakes heir present levels and connect them by a lock.

nother modification consisted in putting in the outer lock at the d of Salmon Bay and dredging thence a channel through Salmon l Shilshole bays to the deep water of the Sound; but this would gely increase the excavation required, and the project would be rived of the great benefit of the fresh-water basin of Salmon Bay. s is a modification which might well be considered, however, if the stion of damages at Ballard and elsewhere along Salmon Bay can be satisfactorily solved.

f, in the Smiths Cove route, the question of damages arising from ing and maintaining permanently the waters of Salmon Bay at the l of Lake Union be not capable of satisfactory adjustment, the er part of that bay, where the greater amount of damages would rue, can be left in its present condition, and the canal be carried ugh from the outer lock to the Fremont Cut and Lake Union, and eparated from the lower part of Salmon Bay, in its passage through head of that bay, by an embankment.

modification was also considered of substituting, for masonry locks, s composed partly of masonry and partly of timber. If this were e, there would be a saving of $276,000 in the cost of the outer lock, ther situated at Smiths Cove or Shilshole Bay, and a saving of 3,000 in the cost of the lock at the portage between Lakes Union Washington.

1 the project for the section of canal connecting Lakes Washington Samamish, it is designed to carry the level of Lake Samamish ugh the canal to a lock placed near Lake Washington, to overcome difference of 10½ feet, and to make the canal partly in cut and tly in embankment. This project would have to provide for the inage of Lake Samamish through the canal. The valley of the amish River is occupied by the Seattle, Lake Shore and Eastern lway, and contains 2,180 acres of valuable land, the surface of which

Lake Washington.

The project of the Board contemplates the rai
Salmon Bay to the level of Lake Union, 7½ feet al
tide level, and permanently maintaining them at
will flood an area of 187 acres above high tide, b
of which is about the head of Salmon Bay, abov

There are some improvements about the town
be interfered with by this raising of the water, and
the necessary work required to raise the building
fered with.

It is proposed to utilize to as great an extent
rial excavated from canal and channels in fillin
level the lands overflowed.

No other provision is made for these lands, as i
great additional value given to them by the cons
basins, etc., would more than compensate the own
expense which they might be put to in raising the

It is proposed to make, as previously stated,
outer lock to deep water in the Sound, 300 feet
at the lowest high water.

No provision is made for maintaining this cha
definitely ascertained by experience whether any
will be required.

If it be found, after the canal is put in operat
shoals up, it can be maintained either by dredging
to exclude drift, or by both.

ESTIMATES.

The projects contemplate the construction of
provided with an upper and a lower lock-gate
constructed of steel, with all necessary capstans
valves, with hydraulic engines to operate them,

First, by building, instead of a double-track canal in which ships can ass each other, a single-track canal in the three portions of the canal xcavated in the uplands, namely, from the outer lock to Salmon Bay, om Salmon Bay to Lake Union, and from Lake Union to Lake Washington. The canal designed and for which the estimates are nade is 80 feet wide on the bottom and 158 feet at the water line. By educing the width at bottom to 50 feet and at the water line to 128 feet, mple provision would be made for the passage of ships from one basin o another and out to the Sound, and the additional width can be given hen demanded by the increase of commerce.

In the same manner the excavated channels in Salmon Bay, Lake Jnion, and Union Bay could be reduced from 200 feet in bottom width o 150 feet without any immediate disadvantage and the greater width e provided for when demanded by the increase of commerce.

By thus reducing the width of the canal and basin channels, a saving ı excavation of 800,000 cubic yards can be made, equivalent to 400,000, reducing the estimated cost of the work to $3,100,000.

A second way of reducing the estimated cost would be by the substiıtion of composite locks of masonry and timber for masonry locks. ı this way a saving of $529,000 could be effected, still further reducıg the cost to $2,571,000.

Shilshole Bay route.—The total estimated cost of the complete project r the ship canal from deep water in Puget Sound via Shilshole and ılmon bays and Lake Union to Lake Washington is $2,902,859.23, or round numbers $2,900,000.

As in the other case, the estimated cost of $2,900,000 can be mateally reduced in two ways.

First, by reducing the upland cuts from a bottom width of 80 feet to bottom width of 50 feet, and the dredged channel through Salmon Bay, ake Union, and Union Bay from 200 feet to 150 feet width at bottom. This would reduce the amount of excavation 670,000 cubic yards, ıuivalent to $335,000, and the total estimated cost to $2,565,000.

The second way of reducing the cost would be by substituting composite locks of masonry and timber for masonry locks. In this way a ıving of $529,000 could be effected, reducing the total estimated cost till further to $2,036,000.

The estimates for both routes include the securing of sufficient land or the full width of canal.

The following is a summary of the estimates:

miths Cove route:	
Double-track canal with masonry locks	$3,500,000
Double-track canal with composite locks	2,971,000
Single-track canal with masonry locks	3,100,000
Single-track canal with composite locks	2,571,000
hilshole Bay route:	
Double-track canal with masonry locks	2,900,000
Double-track canal with composite locks	2,371,000
Single-track canal with masonry locks	2,565,000
Single-track canal with composite locks	2,036,000

The estimated cost of the canal to connect Lakes Washington and lamamish is $4,927,230.

PHYSICAL DATA.

The following table gives in a convenient form the principal physical data connected with the project:

Elevations:		
Extreme low tide, Puget Sound	feet..	0
Mean low tide, Puget Sound	do...	3.1
Lowest high tide, Puget Sound	do...	9.4
Mean high tide, Puget Sound	do...	12.6
Extreme high tide, Puget Sound	do...	17.7
Lake Union, lowest water observed above extreme low tide of Puget Sound	feet..	25
Lake Union, highest water observed above extreme low tide of Puget Sound	feet..	26.1
Lake Washington, lowest water observed above extreme low tide of Puget Sound	feet..	31.6
Lake Washington, highest water observed above extreme low tide of Puget Sound	feet..	32.1
Lake Washington, highest water flood marks above extreme low tide of Puget Sound	feet..	34.6
Lake Sammamish, lowest water observed above extreme low tide of Puget Sound	feet..	41.5
Lake Sammamish, highest water observed above extreme low tide of Puget Sound	feet..	45.
Divide between Smiths Cove and Salmon Bay, above extreme low tide, Puget Sound	feet..	49
Portage Divide, between Lakes Union and Washington, above low water of Lake Washington	feet..	30
Divide on "Mercer Farm Route," above Lake Union	do...	108
Divide on "Tramway Route," above Lake Union	do...	105
Areas, depths, etc.:		
Salmon Bay:		
Total water area	acres..	318
25 feet and over in depth	do...	35
Less than 25 feet in depth	do...	283
Lake Union:		
Total water area	do...	90[illegible]
25 feet and over in depth	do...	49[illegible]
Less than 25 feet in depth	do...	40[illegible]
Greatest depth	feet..	6[illegible]
Lake Washington:		
Total water area (about)	acres..	21,89[illegible]
25 feet and over in depth (about)	do...	22,00[illegible]
Greatest depth (probably)	feet..	60[illegible]
Lake Sammamish:		
Total water area	acres..	5,12[illegible]
25 feet and over in depth (about)	do...	4,00[illegible]
Less than 25 feet in depth	do...	1,12[illegible]
Greatest depth (about)	feet..	100
Lake Union Drainage Basin	sq. miles..	6
Lake Washington Drainage Basin	do...	182
Sammamish River Drainage Basin	do...	109
Lake Sammamish Drainage Basin	do...	102
Distances:		
Deep water to outer lock, Shilshole Bay (from 30-foot curves)	feet...	2,400
Deep water to outer lock, Smiths Cove (from 30-foot curves)	do...	2,000
Outer lock, Shilshole Bay to head Salmon Bay	do...	12,900
Outer lock, Smiths Cove to head Salmon Bay	do...	12,000
Head Salmon Bay to Lake Union, "Fremont Cut"	do...	4,800
Through Lake Union to upper lock	do...	13,300
Upper lock through Portage Canal to Union Bay and Lake Washington	feet..	3,100
[illegible] to deep water in Lake Washington	do...	4,000
Lake Washington to Lake Sammamish	miles..	13
Sammamish River, length	do...	17
Lake Washington, down Black to Cedar River	do...	
Lake Washington, down Black to White River	do...	2
Duwamish River from junction of Black and White rivers to Duwamish Bay, length of valley	miles..	8
Duwamish River, length of river	miles..	14

ances—Continued.

Outlet Duwamish River across tide flats to deep water	do...	1¼
Diameter Union Bay	do...	1¼
Duwamish Bay to Lake Union by "Mercer Farm Route"	feet..	5,100
Duwamish Bay to Lake Union by "Tramway Route"	do...	6,310
ensions:		
Approach to outer lock, depth below lowest high water	feet ..	26
Approach to outer lock, width at bottom	do...	300
Outer lock:		
Width of gates, clear width	do...	50
Length of lock chamber, clear length	do...	400
Depth of lock, clear depth	do...	26
Lift of lock	do...	7.3-26.1
Lift of lock, average	do...	14.4
Channel in Salmon Bay, Lake Union, and Union Bay, depth	do...	26
Channel in Salmon Bay, Lake Union, and Union Bay, width at bottom	feet..	200
Canal excavated in uplands, Smiths Cove Cut, Fremont Cut, and Portage Cut, width at bottom	feet..	80
Canal excavated in uplands, Smiths Cove Cut, Fremont Cut, and Portage Cut, width at water line	feet..	158
Canal excavated in uplands, Smiths Cove Cut, Fremont Cut, and Portage Cut, depth	feet..	26
Upper lock, same dimensions as outer lock.		
Lift of upper lock, maximum	do...	8.1
Lift of upper lock, average	do...	6.6

Very respectfully, your obedient servants,

G. H. MENDELL,
Colonel, Corps of Engineers.
THOS. H. HANDBURY,
Major, Corps of Engineers.
THOMAS W. SYMONS.
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

REPORT OF MR. PHILIP G. EASTWICK.

UNITED STATES ENGINEER OFFICE,
Portland, Oregon, September 14, 1891.

r: Under your instructions I have made surveys upon which to base a project, estimates, for the construction of a canal to connect Lakes Union, Washington, Samamish with Puget Sound, as authorized by the river and harbor act of Sep-ber 19, 1890, and respectfully submit the following report:

companying this report is also submitted a sheet upon which is drawn to a scale wo-thirds of an inch to 1 mile, a general map showing the position of the lakes their surroundings with reference to Puget Sound; and a map to a larger scale ing more in detail that part of the selected canal route between Lake Washing-and Puget Sound.

the general map are shown the respective drainage basins of the three lakes of the Samamish River, the link connecting Samamish Lake with Lake Wash-n.

e following table shows the relative elevations of the surface of the water in akes and of the high and low water planes of Puget Sound, the plane of extreme water, as deduced from observations extending over six weeks, being taken as lane of reference.

		Feet.
Samamish	Highest observed	43.1
	Lowest observed	41.2
Washington	Highest flood marks	34.4
	Highest observed	33.1
	Lowest observed	31.6
Union	Highest observed	26.1
	Lowest observed	25.0
hole Bay	Extreme high tide	17.7
	Mean high tide	13.6
	Lowest high tide	9.4
	Mean low tide	3.3
	Extreme low tide	0.0

... at its north end at the head of Lake Washin
River empties into that lake. Through this ridge no avai
The only available route for a canal to connect these two
of the Samamish River.

This valley is nearly thirteen miles long as measured o
Owing, however, to the sinuosities of the river, its lengt
miles.

The upper part of the valley is broad and flat and m
all times marshy and frequently flooded. Descending
the valley narrows, and at three places, where the flankin
the low land, the thread of the valley is very abruptly d

An extension shoal at the head of Lake Washington, th
pass, will increase the total length of the canal and its a
miles.

The Samamish River at low water is a stream of small
30 feet in width with a depth generally of from 6 to 8 fee
reaches of rapid water passing over gravel bars where
feet in a narrowed channel.

Black River, the natural outlet to Lake Washington, j
distance of 2½ miles from the lake, the confluence of th
head of the Duwamish River. Black River passes gene
depression in the edge of a broad valley, receiving the w
a half-mile below the outlet of Lake Washington. It car
ington to near the junction of Cedar River, where, after r
river, it passes with a current of about 5 miles per hour
over a shoal and rocky bottom for a distance of over half
a strong current continues to the head of the Duwamish.
feet wide.

Duwamish River flows in a very sinuous course throug
head of Duwamish or Elliott Bay. On an air line betwee
Duwamish Bay the distance is about 8 miles. By the si
ever, the distance is increased to 14 miles. The floor of
and subject in most parts to overflow during freshets. T
by the deposit of sediment, raised the surface of the valle
elevation higher than that of the more distant part nea
hills, a slightly elevated river ridge having been formed.

From the outlet of Duwamish River, at the high-water
deep water of the bay, there is a distance of 1¼ miles ov
which is bare at low water.

It will thus be seen that the length of a canal from Lake
of Puget Sound will be at least 12 miles, with such inc
obstructions to direct alignment that will upon definite s

With locks so located upon the line of the canal that

nal prism, making the total excavation for a canal by this route exceed 14,-
0 cubic yards.

h of the excavation through the valley of the Black River (which, however, mall part of the entire excavation) would be of rock. The large mass, how- of the entire excavation will probably be of easy-cutting sedimentary material. e and Cedar rivers at the time of freshets carry down large amounts of , sand, and mud, which, being deposited in the lower channel, will require to riodically removed.

hout attempting to make a close estimate of the cost of a canal over this route, ving not only the excavation, but also the construction of water-tight embank- throughout nearly the entire length of the canal, of one or more locks with a lift of 34 feet, and of waste weirs, the compensation for land occupied, and r expenses incidental to the work, it may safely be assumed that the cost of truction and of maintenance will be so far in excess of that of a canal via Lake n and Salmon Bay, and the benefits to commerce less advantageous, that the her consideration of this project is not warranted.

the western shore of Lake Washington, nearly midway of its length, is an open- about 2,000 feet wide between low headlands leading into Union Bay. This bay early circular in shape and about 1¼ miles in diameter. Its extreme western mar- approaches the shore line of the eastern arm of Lake Union at a place hereto- referred to as "The Portage," where the divide is narrow and low. This place s the only remaining possible canal outlet from Lake Washington in the direc- of Puget Sound.

ion Bay is very shoal throughout nearly its entire extent, and has a bottom of ooze of considerable depth. A canal line through the bay would cut into this rial for a length of 4,600 feet.

e canal cut through "The Portage" will be 2,600 feet long, and the material, as cated by the walls of the existing canal, will be cement gravel and hardpan.

Lake Union, from the western end of "The Portage" cut, to a depth of 26 feet, distance is 5,600 feet. Near "The Portage" on this line the descent is abrupt to a h of 18 feet at a distance of 700 feet. Over the remaining distance to 26 feet h the bottom falls gradually with but little undulation.

e low-water level of Lake Washington is 6.6 feet higher than that of Lake Union. flood marks of Lake Washington indicate a level 2.8 feet higher than the low- r level.

tween Lake Union and Puget Sound is a high ridge cut by a low and wide y at the western end of the extreme western arm of the lake. Through this y the natural drainage of the lake finds its outlet to the head of Salmon Bay, rm of Puget Sound.

the extreme south end of the lake are two depressions in the ridge separating lake from Duwamish Bay. These depressions are referred to in the report of ral Alexander, dated December 15, 1871, where they are designated as possible l routes. They are in that report designated, respectively, as the "Mercer Farm e" and the "Tramway Route." The distance between the lake and bay by the er route is 5,100 feet, and by the latter route, 6,310 feet, and the maximum ele- ons 108 and 105 feet respectively.

the time of this first examination of these routes (nearly twenty years ago) land traversed by them was for the most part wild and unimproved, with an sional clearing which added but little to its value. Much of the land in the ity was then, and remained for many years later, public land subject to entry r the homestead and preëmption laws, not having sufficient value to attract the ntion of settlers. The shores of the lake and bay at the termini of these routes unimproved and unoccupied except by the cheaply constructed and temporary ings of the Seattle Coal and Transportation Company, who at that time operated mway over one of the routes in the transportation of coal, the need of which ld have been obviated upon the construction of a canal. Seattle at that time a village covering a very small area and having a population of about 1,200. as surrounded by dense forests traversed by few wagon roads and trails.

ccording to the recent census, the city of Seattle has a population of 45,953. The ovements of the city of Seattle now extend to, and far beyond, the location of canal routes. Streets have been laid out, opened, and improved; costly manu- ring establishments, stores, warehouses. and dwellings have been erected, the district changed to busy industrial adjuncts to Seattle, or to residential rbs. The water fronts on Lake Union and on Duwamish Bay are occupied by strial establishments, warehouses, and shipping wharves.

a result, the value of the land traversed by these routes has during the past twenty s increased to figures of large proportions, and the conditions which warranted onsideration of a project for the construction of a canal over either of the routes ow so radically changed that the consideration of such a project may with reason be abandoned in favor of the route via the valley of lake to the head of Salmon Bay.

The last named valley extends from Lake Union to the h tance of 6,700 feet. The floor of the valley is broad and lo per end being but a few feet higher than the low-water le below that level at, and near Salmon Bay. The entire area has been laid off into town lots upon which a few cheap and a few sawmills have been erected, the removal of some upon the construction of a canal.

To the north of this valley and of Salmon Bay the hills ri undulating plateau. To the south lies Duwamish or Ell high and broad plateau through which is a low, narrow, ing the head of Salmon Bay with Smiths Cove, an indent Duwamish Bay. Through this gap the distance is 5,000 lines and the maximum elevation, 49 feet above extreme lo in both Smiths Cove and Salmon Bay are extensive mud Through this gap the lines of the Seattle, Lake Shore an pany, and of the Seattle and Montana Railway Company, Seattle to the north and east.

From its head Salmon Bay extends in a westerly directio Puget Sound, at the inner edge of Shilshole Bay, from wh water is nearly one-half mile over a sand beach, much of of the low-tide plane.

Estimates of the cost of construction have been prepar the lakes with Puget Sound, both on the routes from Shils Cove to the head of Salmon Bay, and thence by a common "The Portage" to Lake Washington, and also from La Samamish via the valley of Samamish River. These estim in the Appendix and are stated in their totals, as follows:

TOTALS OF ESTIMATES.

A. From Puget Sound to head of Salmon Bay:
1. Via Shilshole Bay ....
2. Via Smiths Cove......................................

B. From head of Salmon Bay to Lake Union:
Via the valley of the outlet to the lake..............

C. From Lake Union to Lake Washington:
Through "The Portage" ....

D. From Lake Washington to Lake Samamish:
Via the valley of Samamish River ....

To these estimates of the cost of construction between P and Lake Union, either via Shilshole Bay or Smiths Co added the estimated cost of changing the location of t Lake Shore and Eastern and of the Seattle and Montana

And of raising mills, dwellings, stores, etc., in the town of

Detailed estimates of these are given in the Appendix.

In case of the construction of the canals by both the S Cove routes, $27,500 should be deducted from the summar the dam at the narrows in Salmon Bay, which in that case

The foregoing estimates are summed up for different com

I.—*Puget Sound to Lake Union.*

a. Via Shilshole Bay:
Puget Sound to head of Salmon Bay.................
Head of Salmon Bay to Lake Union ....
Change of railway location.........................
Raising mills, etc., in Ballard.......................

Total..

b. Via Smiths Cove:
Puget Sound to head of Salmon Bay ....
Head of Salmon Bay to Lake Union...................
Change of railway location ....
Raising mills, etc., in Ballard.......................

Total..

Via Shilshole Bay and Smiths Cove combined:

Puget Sound to head of Salmon Bay, via Shilshole Bay		$1,019,319.51
Via Smiths Cove	$1,564,721.51	
Less cost of dam	27,500.00	
		1,537,221.51
Head of Salmon Bay to Lake Union		506,000.00
Change of railway location		89,832.97
Raising mills, etc., in Ballard		165,000.00
Total		3,317,373.99

ldding to each of these estimates the estimated cost of construction between kes Union and Washington, the following estimates are obtained:

II.—*Puget Sound to Lake Washington.*

Via Shilshole Bay	$2,902,859.23
Via Smiths Cove	3,448,261.23
Via Shilshole Bay and Smiths Cove combined	4,440,080.74

d if to these last estimates the estimated cost of construction between Lakes ashington and Samamish be added, the entire cost of the canal connecting Lakes namish, Washington, and Union with Puget Sound under the different projects obtained as follows:

III.—*Puget Sound to Lake Samamish.*

Via Shilshole Bay	$7,830,089.23
Via Smiths Cove	8,375,491.23
Via Shilshole Bay and Smiths Cove combined	9,367,310.74

All estimates through the higher lands are based upon excavation of a canal sm having a cross section as shown on the accompanying map; the bottom of the ıal to be 80 feet wide and side slopes 1¼ horizontal to 1 vertical up to the tow th or lower berme, 32 feet above the bottom; the depth of water in the canal to be feet. In the deeper excavation the slopes above the towpath or lower berme to 1 horizontal to 1 vertical, with narrow bermes at each 20 feet of excavation.

Through Salmon Bay, interior to the outer locks and through the shoals in Lakes ion, Washington, and Samamish, and in Union Bay, the estimates contemplate excavation of a channel 200 feet wide carrying 26 feet depth of water. Exterior the locks of Salmon Bay and Smiths Cove the width of channel is increased to feet, with a depth of 26 feet of water at the lowest high tide.

The locks at the outlet of the canal systems both at Salmon Bay and Smiths Cove to be placed near to Puget Sound, raising the water in the canal between them 1 Lake Union to the level of the lake. Each of the locks will have a lift of 16.7 t at low high water and 26.1 feet at extreme low water.

The lock at the Portage provides for a lift of 8.1 feet, the difference of level beeen the low-water level of Lake Union and the extreme flood level of Lake Washgton. This lock is to be placed at the head of Lake Union and adjoining the exration at the Portage.

The lock between the waters of Lakes Washington and Samamish provides for a of 10¼ feet, the difference of level between the low-water level of Lake Washingı and the high-water level of Lake Samamish. Upon the excavation of the canal the Samamish River Valley, a freer outlet of the waters of Lake Samamish will offered, and the rise in that lake, which is caused by the present restricted chanl, will be reduced, thereby lessening the lift required in the lock. This lock is ated at the outlet of the river at the head of Lake Washington.

The projects contemplate the construction of masonry locks provided with an per and a lower lock gate and a guard gate constructed of steel, all necessary stans, inlet and outlet valves, and hydraulic engines to operate them, the power be supplied by turbine wheels. The locks are to have a clear width of 50 feet at gates and in the main lock prism, and a length to accommodate vessels 400 feet ıg.

ndependent estimates have been made for all locks wherein the masonry has been, far as practicable, replaced by structures of timber.

Substituting such structures, the cost of the respective locks will be reduced as lows:

	Difference in cost.
ck at outlet at Salmon Bay	$276,000
ck at outlet at Smiths Cove	276,000
ck at the Portage	253,000
ck at head of Lake Washington	271,000

In the following table are given the lengths of the several reaches of canal on the route via Shilshole Bay, including the lengths of the intermediate reaches in Lake Union and Washington, where no improvements are required.

	Miles.
From deep water of Puget Sound to head of Salmon Bay and point common with Smiths Cove Canal	2.84
Fremont Canal and approaches	1.02
Lake Union (no improvement required)	1.50
Portage Canal and approaches	2.42
Lake Washington (no improvement required)	8.25
Samamish Valley Canal and approaches	14.07

From these data the following table of lengths is deduced:

	Miles.
From Puget Sound to Lake Union	3.86
From Puget Sound to Lake Washington	7.78
From Puget Sound to Lake Samamish	30.10

The length of the reach from deep water of Puget Sound at Smiths Cove to a connection with the route via Shilshole Bay, at the head of Salmon Bay, is 2.59 miles.

No data concerning the rainfall in the immediate vicinity of the area of the drainage basins of the lakes are to be obtained. The nearest approach to such information is furnished by the continuous observations of rainfall since the beginning of 1878, made on Bainbridge Island, which lies at the west side of Puget Sound, about 12 miles due west of the middle of Lake Washington.

The following table gives the total amount of rainfall for each year at the locality named:

Year.	Rainfall.	Year.	Rainfall.
	Inches.		*Inches.*
1878	46.38	1885	43.68
1879	64.87	1886	34.92
1880	49.35	1887	40.09
1881	53.82	1888	39.97
1882	42.53	1889	27.88
1883	34.85	1890	30.26
1884	34.03		

The record for the year 1890, by months, is as follows:

Year.	Rainfall.	Year.	Rainfall.
	Inches.		*Inches.*
January	7.71	July	0.50
February	4.88	August	0.26
March	2.90	September	0.07
April	1.54	October	3.09
May	1.03	November	0.74
June	1.65	December	5.89

From the first table it will be seen that the average rainfall per annum for the thirteen years is 41.74 inches, and for the last five years, 34.62 inches.

The second table shows that the greatest precipitation occurs in December and January, when nearly 45 per cent of the whole annual rainfall is precipitated, and that the months of July, August, and September cover a dry period when the precipitation is less than 0.3 per cent of the total.

The data upon which to estimate the amount of the evaporation from the surface of the drainage basins and lakes are not obtainable, but from the fact that at all times, except when checked by a rise in the waters of Cedar and White rivers, there is an outflow from Lake Washington through Black River, it is evident that the supply from the drainage basins exceeds at all times the evaporation. The amount of this excess during the dry seasons it is impossible to determine upon any data at present available.

An examination of the tide tables for the Pacific coast, for 1891, shows that the average height of all the tides during the months of July, August, and September, referred to the plane of extreme low water, is 10.6 feet, and, as the low-water level of Lake Union, after the construction of the canal, will be 25 feet above the same plane, the average lift of the lock, either at Salmon Bay or Smiths Cove, will be 14.4 feet.

The lift of the lock at the Portage at the low-water stage in both lakes is 6.6 feet, d as the length and width of the prism of this lock are the same as those of the ks at Puget Sound, the relative amounts of water discharged in one lockage at sh lock will be in proportion to the lift. The lock at Puget Sound will consently require for the lockage of a vessel an average of nearly 2.2 the amount of ter that is required for the same work at the Portage lock.

As the supply of water from the basin of Lake Union is, during the summer months, actically nothing, all the water required for the lockage at the outer lock during at period must be drawn from Lake Washington.

With a number of lockages at the Portage equal to that at the outlet, the volume water supplied by the former lock will be less than one-half that required for the ter, and the deficiency must be supplied from Lake Washington by a channel other an that through the Portage lock. In the projects upon which the estimates have n based this is provided for, for the dry season of the year by an independent cult or channel.

During the portion of the year when the water supply to Lake Washington is such to keep the water of that lake at a higher elevation, this deficiency is provided for the overflow of a waste weir at the Portage lock, any excess not required at Puget und being disposed of by a similar waste weir at the outer lock.

t is estimated that the average time required to fill or to supply the prism of her of the locks at Puget Sound will be ten minutes, and that ten minutes more l be consumed in moving a vessel in and out of the locks and in opening and tting the gates, or that, for one complete lockage, either up or down, twenty nutes will be required.

The greatest number of vessels can be passed through either of the locks in a given e by passing them alternately up and down, and under such conditions, one lock- of water only will be used in passing one vessel each way.

Under the assumption as to the time of operating the outer lock, one vessel can passed each way through the lock in forty minutes, or thirty-six vessels each way twenty-four hours, and thirty-six lockfuls of water will be required for the work.

The following are the areas of the respective drainage basins, and of the water faces which they contain:

	Area of drainage basin.	Area of water surface.
	Sq. miles.	*Sq. miles.*
e Samamish	102	8.0
amish River	109	0.3
e Washington	182	38.9
e Union	6	1.5
Total	399	48.7

The cubic capacity, between gates, of the prism of either of the locks at Puget und, with an average lift of 14.4 feet, is 302,400 cubic feet. As the inflow to Lake shington during the dry season of the year is in excess of the evaporation from surface, any draft upon the waters of that lake for lockage at Puget Sound will in part supplied by the excess, which will be diverted from the outlet at Black ver.

Assuming, however, that there is no excess to supply this draft in part, but that of the lockage water required tends to the lowering of Lake Washington, it is nd that the level of that lake will be reduced by continuous lockages during the ee dry months to the extent of a little over nine-tenths of a foot. Any leakage water at the outer lock in excess of that required for lockage and the water essary to operate the hydraulic motors at the lock, will increase the abatement. e amount of the leakage will depend upon the construction of the gates and ves, and by care in construction can be reduced to a small amount. The water uired for power will be but a small fraction of the whole, and, until data for ser computation are afforded, may be ignored as immaterial in these approximans.

Assuming that the supply during the dry season will be furnished by the entire ter area of Lakes Samamish and Washington and Samamish River, covering an a of 47.2 square miles as against 38.9 square miles of Lake Washington alone, abatement due to the lockages during the three dry months will be three-fourths a foot.

n the computations upon which the above statements are based, no account is en of the small amount of rainfall during the three dry months, which if considd would decrease the computed abatement of the lakes.

Continuous and uninterrupted operation of one of the locks on Puget Sound during an entire year will admit of 13,140 double lockages. A rainfall of 4.35 inches during the entire year drained from the basins of Lakes Washington and Samamish and of Samamish River, having a combined area of 393 square miles, will supply all the water required for the total annual lockage.

The average current through the canal due to the water required for lockage will be less than three one-hundredths of a mile per hour.

Cedar River, entering Black River about a half a mile below the outlet of Lake Washington, is subject to annual floods, due chiefly to the melting of the snow at the head waters of that river in the Cascade Mountains. At infrequent intervals in the past, this flood has reached large proportions, overflowing for a short time the land adjacent to the outlet. The ordinary annual floods, however, do not overflow the banks of the river.

During the height of these floods the direction of the current in Black River between Lake Washington and the mouth of Cedar River is reversed, and a large volume of water is then emptied into the lake, causing a very marked elevation of its level.

In former years the Duwamish River was more obstructed by bars and drift than at present, and the low bottom lands in that valley were covered with a dense growth of brush, which impeded the flow of water when those lands were submerged. The subsequent removal of obstructions in the river and the clearing of the low lands, permitting a much freer discharge toward Puget Sound, has so materially checked this reflux into the lake that the fluctuations of its level have been reduced from about 7 feet, reported as the maximum of former years, to less than 3 feet in recent years. It is probable that the last noted rise in the level of the water may be somewhat exceeded, as there has not been in recent years any extraordinary flood corresponding to that causing this former maximum rise.

The construction of the canal will open an outlet that will carry off to Puget Sound, through Lake Union and Salmon Bay, such a volume of water that will tend to further reduce the range of fluctuation in Lake Washington, without inducing a current that will interfere with the traffic on the canal or endanger its banks. The effect in that direction of the relatively small discharge through the existing small canal at the Portage has been manifest during the past few years.

It appears probable, therefore, that upon the recurrence of one of the greater floods after the construction of the canal, the rise, by reason of the freer outlet offered to the water, will not be so excessive as to interfere with the navigation of the canal.

The fall in Black River is such as to admit of the enlargement of its channel by deepening the rock bottom so as to permit a larger outflow from Cedar River to the Duwamish River.

The following table shows the fall of the surface of the water in Black River, at the time of survey, over a distance of 8,300 feet, from the lake:

	Distance from Lake Washington.	Interval.	Elevation above datum.	Fall.	Rate of fall: foot per hundred.
	Feet.	*Feet.*	*Feet.*	*Feet.*	
Lake Washington	0	....	33.1	......	....
Head of Cedar Rapid	3,100	3,100	33.1	0.0	0.00
Mouth of Cedar Rapid	3,600	500	32.5	0.6	0.12
Foot of Cedar Rapid	4,500	900	30.8	1.7	0.19
Station 45	5,700	1,200	29.5	1.3	0.11
County road bridge	6,600	900	28.5	1.0	0.11
Railroad bridge	8,300	1,700	26.7	1.8	0.11

In the early consideration of the canal project the equalization of the levels of Lakes Washington and Union was considered: First, by lowering the level of Lake Washington to that of Lake Union; second, by raising the level of Lake Union to that of Lake Washington; and third, by bringing the levels of both lakes to one intermediate between the two.

All of these schemes dispense with the need of a lock at the Portage.

In those wherein the water of Lake Union is raised, the amount of excavation in the canal prism between that lake and the outer locks will be decreased, but the cost of the locks will be increased by reason of the greater lift required to be given to them.

The structures on the lake front are built to the present water level, and should the water materially be raised, extensive and costly changes would be required in such structures.

The raised lake level being carried through to the outer locks at Puget Sound, the lower parts of the town of Ballard and other low land adjacent to Salmon Bay, which, under the projects adopted in the estimates, are submerged, would be flooded to a greater depth, and the area of submerged land largely increased; to such an extent, indeed, as to increase the measure of damages largely in excess of that of any advantages that might be derived from such a scheme.

The lowering of the level of Lake Washington to any considerable extent would check the outflow through Black River, or stop it altogether, and draw from Cedar River, especially during its flood, a larger part of its waters. In that case an outlet for the entire water of the drainage basins of the lakes, together with a part of the waters of Cedar River largely in excess of that now emptying into the lake, would have to be provided for through the canal. This would materially interfere with the navigation of the canal, not only during the time of floods, but for some time thereafter, until the accumulated waters had passed off.

Under such a scheme, the amount of the excavation at the Portage would be very materially increased.

It is very doubtful whether it is practicable, to lower, through a canal of the standard cross-section to be cut through at the Portage, the surface of the water in Lake Washington, containing an area of 38.9 square miles, to the level of Lake Union, and that of Lake Samamish and Samamish River, containing an area of 8.3 square miles attendant upon it.

The want of reliable data of the amount of rainfall and evaporation in this district; of the duration and rate of fall during the heaviest precipitation; of the retardation of such precipitation on its way to the lakes, and of the volume of discharge through the channels of Samamish and Black rivers, under various conditions of elevation of water surface in the lakes, precludes any estimate of the effect of the inflow and outflow upon the lakes.

The ratio of the area of the larger drainage basin, containing Lakes Samamish, Washington, and the Samamish River, to the entire water area of the basin is 8.33, and to the area of Lake Washington alone 10.10. These figures represent also the ratio of rise in the lakes to depth of rainfall, if such rainfall were entirely to find its way without impediment to the lake and the outflow were at the same time prevented. As, however, the rainwater is retarded on its way to the lake and the discharge is increased as the lake rises, a rise to the extent denoted by these figures will not occur. Only in the event of a heavy rainfall continuous for a long time can there be any material rise in the surface of the water of the lakes, and upon the abatement of such excessive rainfall the lowering of the water surface will speedily follow by reason of the uninterrupted outflow. Heavy rainfalls are of rare occurrence in this country. The rainfall during the rainy season is such as to make the supply to the lakes nearly uniform.

The excavations along the lines of railroads and streets, in the small canal through the Portage and in the ditch connecting Lake Union with Salmon Bay, show that the material of the upland in the vicinity of the proposed canal is largely composed of cement gravel, and hardpan, with occasional beds of loose gravel and sand. Nowhere in the vicinity is rock exhibited except in the case of infrequent granite bowlders. The nearest rock in place is a soft sandstone ledge which crosses Lake Washington in nearly east and west direction at the south end of Mercer Island and crops out in the Duwamish Valley a short distance above the mouth of the Duwamish River. This ledge is nowhere nearer than 6 miles to the proposed canal.

In the gap between Salmon Bay and Smiths Cove the railroad excavation which has been made, has been through loose sand and gravel easily moved. It is probable that the deeper excavation required for the canal will be largely in harder material.

In Smiths Cove and Salmon Bay the bottom is of soft mud, with a substratum of hard material. The notes of pile-driving on the line of the Seattle and Montana Railroad show the depth of soft material in Smiths Cove, except near the high-water mark, to be from 30 to 50 feet, and throughout a greater part of their line across Salmon Bay to be from 20 to 30 feet deep, the hard material being below the limit of a canal excavation.

The area of deep soft mud in Salmon Bay does not probably extend beyond the wider parts of the bay. At and below the narrows, the depth of soft mud is probably less, but as the depth of excavation for the canal is much less there, than where the deeper mud occurs, the canal excavation will probably not to any extent encroach upon the harder substratum.

The bottom of Lake Union, wherever excavations will be required, is of stiff clay. In Union Bay the ooze forming the bottom is of considerable depth. The character of the substratum is not known, but it is probably of hard material similar to that exposed in the adjacent cut through the Portage.

Elsewhere along the line of the canal between Puget Sound and Lake Washington the material, with but little exception, will probably be found to be cement gravel and hardpan.

The material of the surface in the Samamish Valley is an alluvium, the depth of which is unknown except at a few places in the upper part of the valley an abrupt bends near Lake Washington, where gravel and hard material are sh

Lake Union has an area of 1¼ square miles. The length along its axis is and the length of shore line following its principal indentations is 8¼ mil greatest depth of water is 60 feet, averaging 50 feet over a large extent, excep near the head of the lake, at the Portage, where the water shoals. The sh abrupt. This lake affords good anchorage ground.

Lake Washington has an area of 38.9 square miles, and a length, measu north to south, of 18½ miles. The length of the main shore line is 50 miles, of Mercer Island 11½ miles. The greatest width is 4½ miles at the head o Island, and the average width a little more than 2 miles. Excepting at th and lower ends of the lake, and in the few small bays along the shore, no sh been discovered. The shores, except at the shoals, are abrupt and fall rap depth exceeding 20 fathoms. It is reported on credible authority that places the depth exceeds 100 fathoms.

Lake Samamish has an area of 8 square miles and a length of 7 mile length of shore line of 18 miles. The greatest width is 1¼ miles and the a little over 1 mile. The shores are generally abrupt. A depth of from 50 t is quite uniformly maintained. The shoals at the head and foot of the la small extent.

Very respectfully, your obedient servant,

PHILIP G. EA

Capt. THOMAS W. SYMONS,
Corps of Engineers, U. S. A.

APPENDIX—ESTIMATES OF COST.

A.—FROM PUGET SOUND TO HEAD OF SALMON BAY.

1.—*Via Shilshole Bay.*

Excavation:	Cubic yards.		
Shilshole Bay	302,000		
Pool below lock	161,000		
Lock pit	84,000		
Salmon Bay	324,000		
Total	871,000 at 50 cents		
Masonry lock at Salmon Bay:			
Inclosure for lock pit:			
Piles, 140, 28 feet long, 3,920 linear feet, at 8 cents		$313.60	
Driving piles, 140, at $3		420.00	
Lumber:	Feet, B. M.		
Wales, 3,400 linear feet, 8 by 8 inches	18,000		
Plank, 15,000 square feet, 3 inches	45,000		
Total	63,000 at $10.	630.00	
Iron and spikes:	Pounds.		
Drift bolts, 420, ⅝ by 20 inches	700		
Cut spikes, 6 inches	1,000		
Total	1,700 at 4 cents	68.00	
Erecting, 63,000 feet, B. M., at $10		630.00	
Embankment, spreading and packing spoil from excavation, 16,000 cubic yards, at 10 cents		1,600.00	
			$3,661.60
Masonry:	Cubic yards.		
Main lock walls	32,000		
Guard-gate recess walls	2,000		
Upper lock-gate recess walls	1,300		
Lift wall	220		
Invert under main prism	3,700		
Invert under head bay	360		
Invert under tail bay	250		
Upper miter-sill wall	60		
Double lower miter-sill wall	140		
Stepdown	25		
Counterparts	570		
Culverts	1,600		
Total	42,225		
Classified as follows:			
Granite coping, quoins, sills, etc., 300 cubic yards, at $75		22,500.00	
Wall and culvert facing, 1,700 cubic yards, at $15		25,500.00	
Concrete, 40,225 cubic yards, at $8.50		341,912.50	
			389,912.50

Steel lock gates:			
Guard gate, 26 tons, at $200	$5,200.00		
Lower lock gate, 34 tons, at $200	6,800.00		
Upper-lock gate, 16 tons, at $200	3,200.00		
Gate bearings, 6 tons, at $500	3,000.00		
Gate anchorages, 6 tons, at $500	3,000.00		
Gatepost anchor straps, 6 tons, at $500	3,000.00		
		$24,200.00	
Power house (including foundations and turbine wells)		10,000.00	
Machinery for operating locks and erecting same:			
Turbines, 56 inches diameter, 2, at $1,500	3,000.00		
Hydraulic gate engines, 6, at $500	3,000.00		
Hydraulic sluice gates and engines, 4, at $1,000	4,000.00		
Hydraulic capstans and engines, 6, at $1,000	6,000.00		
Hydraulic accumulator pumps, 2, at $1,500	3,000.00		
Accumulator reservoir	2,000.00		
Snubbing posts, 6, at $200	1,200.00		
Pipes and valves to connect engines with accumulator reservoir	3,000.00		
Supply and delivery pipes for turbines	5,000.00		
		30,200.00	
Dwelling house for gate-tenders		5,000.00	
Electric-light plant for lighting locks		4,000.00	
Removal of bulkheads		2,000.00	
			$468,974.10
Dam and embankment at Salmon Bay:			
Excavation for foundation, 3,000 cubic yards, at 50 cents		1,500.00	
Lumber, 270,000 feet B. M., at $10		2,700.00	
Iron and spikes, 26,000 pounds, at 4 cents		1,040.00	
Erecting timber structure, 270,000 feet, B. M., at $10		2,700.00	
Earth and puddle filling of dam:			
Puddle, 1,600 cubic yards, at 75 cents	1,200.00		
Earth (spoil from excavation), spreading and ramming 3,200 cubic yards, at 20 cents	640.00		
		1,840.00	
Earth embankment: To connect dam with lock walls and shore (spoil from excavation), spreading and ramming 40,000 cubic yards, at 15c		6,000.00	
Stone revetment: To protect outer slope of dam, 3,200 cubic yards, at $2		6,400.00	
			22,180.00
			926,654.10
Engineering and contingencies, 10 per cent			92,665.41
Total			1,019,319.51

2. Via Smiths Cove.

	Cubic yards.			
Excavation:				
Smiths Cove	223,000			
Pool below lock	178,000			
Lock pit	84,000			
Boulevard cut	963,000			
Salmon Bay	249,000			
Total	1,697,000, at 50 cents			$848,500.00
Masonry lock at Smiths Cove: Estimated to cost the same as that at Salmon Bay				468,974.10
Dam and embankment at the narrows in Salmon Bay				25,000.00
Wagon-road bridge, pier, and abutments, including electric motor to operate same				8,000.00
Land damages and right of way:				
21 acres at $1,000			$21,000.00	
17 acres at $3,000			51,000.00	
				72,000.00
				1,422,474.10
Engineering and contingencies, 10 per cent				142,247.41
Total				1,564,721.51

B.—FROM HEAD OF SALMON BAY TO LAKE UNION.

	Cubic yards.		
Excavation:			
Fremont Cut	701,000		
Shoal, foot of Lake Union	13,000		
Total	714,000, at 50 cents		$357,000
Wagon-road bridges, piers, and abutments, including electric motors to operate same:			
At Ross, 1 bridge		$8,000	
At Fremont, 1 bridge		8,000	
Electric wire line to connect motors at bridges with dynamo at lock, 4 miles, at $500		2,000	
			18,000

Land damages and right of way, 20 acres at $3,000	[illegible]
Removal of sawmill, dwellings, and stores at Fremont	[illegible]
	[illegible]
Engineering and contingencies, 10 per cent	[illegible]
Total	[illegible]

C.—FROM LAKE UNION TO LAKE WASHINGTON.

	Cubic yards.	
Excavation:		
Shoal, head of Lake Union	135,000	
Lock pit	67,000	
Portage cut	537,000	
Shoal, Union Bay	385,000	
Total	1,124,000, at 50 cents	[illegible]

Masonry lock at Portage:

Inclosure for lock pit, embankment (spoil from excavation), spreading, and packing, 14,000 cubic yards, at 10 cents		$1,400.00

	Cubic yards.
Masonry:	
Guard-gate recess walls	1,400
Main lock walls	24,000
Upper lock-gate recess walls	1,400
Lift wall	115
Invert under main prism	3,700
Invert under head bay	360
Invert under tail bay	250
Upper miter-sill wall	60
Double lower miter-sill wall	140
Stepdown	20
Counterparts	340
Culverts	1,600
Total	33,385

Classified as follows:		
Granite coping, quoins, sills, etc., 300 cubic yards, at $75	$22,500.00	
Wall and culvert facing, 1,500 cubic yards, at $15	22,500.00	
Concrete, 31,585 cubic yards, at $8.50	268,472.50	
		313,472.50
Steel lock gates:		
Guard gate, 16 tons, at $200	3,200.00	
Lower lock gate, 13 tons, at $200	2,600.00	
Upper lock gate, 18 tons, at $200	3,600.00	
Gate bearings, 6 tons, at $500	3,000.00	
Gate anchorages, 6 tons, at $500	3,000.00	
Gatepost anchor straps, 6 tons, at $500	3,000.00	
		18,400.00
Power house, including foundations and turbine wells		10,000.00
Machinery for operating locks and erecting same:		
Turbines, 56 inches diameter, 2, at $1,500	3,000.00	
Hydraulic gate engines, 6, at $500	3,000.00	
Hydraulic sluice gates and engines, 4, at $1,000	4,000.00	
Hydraulic capstans and engines, 6, at $1,000	6,000.00	
Hydraulic accumulator pumps, 2, at $1,500	3,000.00	
Accumulating reservoir	2,000.00	
Snubbing posts, 6, at $200	1,200.00	
Pipes and valves to connect engines with accumulator reservoir	3,000.00	
Supply and delivery pipes for turbines	5,000.00	
		30,200.00
Dwelling house for gate-tenders		5,000.00
Electric-light plant for lighting locks		4,000.00
Removal of bulkheads		2,000.00

Dam and embankment at Portage:

Excavation for foundation, 3,000 cubic yards, at 50 cents		1,500.00
Lumber, 170,000 feet B. M., at $10		1,700.00
Iron and spikes, 15,000 pounds, at 4 cents		600.00
Erecting timber structure, 170,000 feet, B. M., at $10		1,700.00
Earth and puddle filling of dam:		
Puddle, 800 cubic yards, at 75c	600.00	
Earth (spoil from excavation) spreading and ramming 1,600 cubic yards at 20c	320.00	
		920.00
Earth embankment to connect dam with lock walls and shore (spoil from excavation) spreading and ramming 10,000 cubic yards at 15c		1,500.00
Stone revetment to protect outer slope of dam, 2,000 cubic yards at $2		4,000.00

'ortage to supply water for outer lock during the		$5,000.00
idges, piers, and abutments, including electric mo-te same:		
one bridge	$8,000.00	
rtage, one bridge	12,500.00	
re line to connect motors at bridges with dynamo ½ miles, at $500	750.00	
		21,250.00
and right of way, 12 acres, at $500		6,000.00
it of existing canal rights		80,000.00
		1,020,642.50
id contingencies, 10 per cent		102,064.25
....		1,122,706.75

D.—FROM LAKE WASHINGTON TO LAKE SAMAMISH.

:anal prism:	Cubic yards.	
of Lake Washington	455,000	
....	50,000	
Valley cut	6,770,000	
....	7,275,000 at 50 cents..	$3,637,500.00
rainage ditches at sides of canal, 504,000 cubic yards at 50 cents		252,000.00
it Lake Washington, complete		410,000.00
nkment at Lake Washington		15,000.00
dges, piers, abutments and approaches, 9 bridges at $8,000		72,000.00
es, piers and abutments, 4 bridges at $10,000		40,000.00
adjustment of Seattle, Lake Shore and Eastern Railway		10,000.00
and right of way, 428 acres at $100		42,800.00
		4,479,300.00
id contingencies, 10 per cent		447,930.00
....		4,927,230.00

Change of railway locations at and near Salmon Bay.

ESTIMATE OF COST.

000 cubic yards, at 30 cents		$9,600.00
(spoil from excavation) spreading 104,000 cubic yards, at 15 cents		15,600.00
restle, 1,300 linear feet, at $9		11,700.00
estle, 1,100 linear feet, at $6		6,600.00
combined rail and wagon roads, including piers, abutments, and electric rate same		15,000.00
adjusting old track two-thirds of a mile, at $400		266.67
idoned track 3⅛ miles, at $400		1,250.00
or excess of new location over old location, new rails, 60 pounds per yard,)	$760.00	
00 pounds, at 4 cents	88.00	
, 300 pounds, at 5 cents	15.00	
), at 25 cents	2,250.00	
, 18,000 pounds, at 4 cents	720.00	
		3,833.00
ck, 3⅓ miles at $800		2,666.67
0 cubic yards, at 75 cents		6,150.00
acres, at $1,500		9,000.00
		81,666.34
d contingencies, 10 per cent		8,166.63
....		89,832.97

ION OF MR. WESLEY WILSON, MANAGER SEATTLE COAL AND IRON COMPANY.

SEATTLE, WASH., *March 24, 1891.*

N: Having been advised of your being in this city for the purpose of the ground of the proposed route of said canal, and obtaining such as to the necessity of, and needs to, commerce and the probable advan- erived therefrom, I would, on behalf of the Seattle Coal and Iron Com- submit the following for your information:

are located at Gilman, King County, Wash., about 3 miles distant from Samamish Lake.

[illegible]

[illegible] to be derived from [illegible]

[illegible] spoken [illegible]

Sound with Lake Washington. After reading, we would be pleased to have ·ward it, with other matter which you are having prepared bearing upon the t, to the War Department.

statement has been compiled as suggested by you when here.

Yours respectfully,

J. FURTH, *President.*

G. H. MENDELL.

MENT OF COMMITTEE OF CHAMBER OF COMMERCE, SEATTLE, WASHINGTON.

survey authorized by Congress of the proposed ship canal to connect Lake ington with Puget Sound at Seattle having been completed, the attention of norable Secretary of War is respectfully invited to the following, presenting of the reasons why this canal should be promptly constructed: The city of le is situated almost in the center of the Puget Sound region and has a frontage lt water of more than 6 miles. Lake Washington lies abreast of the city to stward parallel with the Sound, and stretches north and south 25 miles. Deeply yed by a cordon of mountains, its surface is always smooth and safe; its shores old but not rocky; its waters of ample depth, soundings showing in places 100 ms. Its width near its central section is 4 miles and the average nearly 3, ing ample room for handling vessels of the largest size. The absence of tides urrents renders its waters always tranquil and of even stage, and preserves nks without washing. Its outlet by an easy channel, enters the sound almost n the present city limits.

dered with fertile lands, backed with inexhaustible forests of finest timber, and se fields of coal, iron, and the precious minerals, the situation of this lake has iled to attract the attention of every one versed in the ways of business or com- who has visited the region.

ther such body of fresh water lying within 2 miles of a noble ocean road- with which it may easily be joined, capable of being converted into anchorage d for the fleets of the world, does not exist elsewhere; it would seem to have provided by nature as a complement to our harbor system which it will make t in its every feature.

et Sound having been for many years marked as the seat of coming great com- al expansion has become within the last decade the focus of enterprise looking realization of its future—four great transcontinental railway lines for the i of their systems. Already two of them are establishing ocean steamship lines a and the oriental islands.

m all parts of the world come fleets of vessels to this inland sea to compete for rgoes which lie close at hand or arrive as freights of railways spanning the ent. The tide of progress in trade and commerce is so rapid as to run ahead facilities provided, and such is likely to be the case for years to come. The f the industrial world are set this way.

rsory glance at the resources of the State shows good reasons for faith in its .

wheat yield of 1890 was about 20,000,000 bushels; that for the current year is ted at over 25,000,000 bushels. The capacity of the natural wheat fields of ate is conservatively placed at 200,000,000 bushels per year. Oats, barley, hay, of all kinds, and every farm crop reward the husbandman with prodigious s.

lumber cut of the State for 1890 was 1,222,830,042 feet, an increase of 538,617,042 er the preceding year; nearly 100 per cent. This does not include the lumber to laths, pickets, etc., estimated at 174,186,800 feet.

coal output of the State for 1890 was 1,319,773 tons, an increase of 438,246 tons, ut 50 per cent for the year.

coal measures are practically limitless in extent, and the business of shipping in its infancy. The amount of coal mined hereafter, will be limited only by mand for it.

ores of the best quality, fit for steel making, cover an immense field. Works manufacture are in course of construction at several points.

precious metals are distributed over a wide area and promise enormous de- nent of wealth. Gold, silver, lead, copper, tin, asbestos, graphite, limestone, , granite, and sandstone are to be added to iron and coal. All these combined h an opulence of mineral resources rarely encountered in a single field.

ate possessing unrivaled agricultural advantages, and having superadded to uch incomparable wealth in timber and minerals, can not fail to develop manu- ing interests on a gigantic scale. Such development is already entered upon. h the completion of the railroads now speeding to their terminals at this point, ate will have an enjoyment of transportation lines greater and more perfect than any one State has hitherto equipped. She will be prepared to handl[illegible] almost dispatch the traffic which throngs at her gates.

Great as the outlook for domestic trade may appear, it does not exceed t[illegible] scope for foreign commerce.

The trade of China alone is conservatively estimated at $150,000,000 annually[illegible] country has but just begun to make use of American products in large a[illegible] Every year she adds to her demands for timber, flour, and manufactured good[illegible] the special field for expansion of trade is in manufactures of iron and steel. [illegible]

A country without railways, her manifest destiny is to develop on a scale [illegible] ing enormous consumption of iron and steel, these modern means of improvi[illegible] lization. Asiatic Russia has already entered upon this work in her possessio[illegible] of China.

Australia is opening wide doors to American trade, and cargoes to her p[illegible] tiply yearly in astonishing ratio.

Japan and the coast countries are adding steadily to the volume of co[illegible] business with our people. In South American countries, several of them p[illegible] immense timberless savannas, the lumber of Puget Sound finds a profit[illegible] growing market. This trade is apparently only in its incipiency, and is b[illegible] menting constantly.

Machinery, domestic utensils, manufactures of iron and wood, every pr[illegible] our workshops, whether made on the Pacific or coming by rail from eas[illegible] tors, are now to be added to the list of articles for trade with the South [illegible] States, a people rich in resources but possessing meager manufactures. [illegible] cargoes of sugars, coffee, spices, precious woods, dyestuffs, gums, tropical f[illegible] nitrates will seek these waters for their distribution by the railways [illegible] points.

The Nicaragua Canal, a necessity of the times and certain now of speedy [illegible] tion, will open the door to a vast tide of commerce from the Atlantic seabo[illegible] ports both of the United States and South America. It will reduce by one [illegible] distance to European ports and bring a mighty current of traffic from that [illegible]

Thus from Asia, the greater island of the southern ocean, the rich East In[illegible] the immense stretch of the Atlantic seaboard, the fruitful lands of western [illegible] a rising volume of commercial business is sweeping this way and must be [illegible] and cared for in Puget Sound or else surrendered to our active and determi[illegible] petitors to the north of us.

It is not too much to assert that a commercial expansion equal to that n[illegible] ing at the port of New York is impending for these waters. A far greater sl[illegible] than that port has will be essential for the proper accommodation of the d[illegible] [illegible] that nearly the entire shipping of th[illegible] [illegible] at a few ports embracing Puget Sound, S[illegible] [illegible] Columbia River, whereas many good harbors [illegible] [illegible] of New York.

[illegible] nearer to Puget Sound than to Englan[illegible] [illegible] makes the halfway point. Japan and all n[illegible] [illegible] to us than to London. Our commerce [illegible] [illegible] coast of China. Statistics show that N[illegible] [illegible] miles nearer to Canton than is Liverpool, an[illegible] [illegible]

[illegible] advantage in distance to Asiatic points over Sa[illegible] [illegible] distances culled from Prof. Ruffer's interestin[illegible] [illegible] presents significant data upon the nearness o[illegible] Sound to points [illegible] vantage ground:

Seattle to—
- [illegible] ....
- [illegible] ....
- [illegible] ....
- [illegible] ....
- [illegible] ....
- [illegible] ....

San Francisco to—
- Vladivostock ....
- Shanghai ....
- Canton ....
- Singapore ....
- Southwest point of Australia ....
- Calcutta ....

Liverpool to—
- Mouth of Amoor River ....
- Vladivostock ....
- Shanghai ....

...rpool to—	Miles.
Canton	10,900
Southwest point of Australia	10,750
Singapore	9,300
Calcutta	8,700
...York to—	
Canton via Puget Sound	9,500
Shanghai via Puget Sound	8,000

...is well known that the carrying trade of the world is being transferred by ...d stages from wooden bottoms to hulls of iron and steel. So fast is the transfer ...ng made that wooden-ship yards are constantly going out of commission. Ves...s of war are no longer thought of as made of wood. Iron and steel rule the ship...g of all seas.

...is also well known that iron and steel bottoms are subjected in salt water to ...rine growths which adhere to them and greatly impair the efficiency of the ves...s. The speed of an iron ship is often reduced one-half by the presence of grass and ...rnacles adhering to the bottom, and the cost of maintaining such vessels is greatly ...hanced by the necessity of frequent docking to remove these accretions. Fresh ...ter destroys marine growths and prevents their formation. Barnacles and grass, ...hich cover a vessel's bottom in salt water to the weight of many tons, are killed by ...w days in fresh water and will drop off, or may be removed easily with scrapers. ...advantageous to iron shipping is an accessible body of fresh water that masters ...f vessels regard it as of importance next to cheap fuel at ports of arrival from sea ...yages. One of the material advantages named in favor of building the Nicaragua ...nal is the fact that a fresh-water lake lies midway of the canal route, and that ...ips will pass through it in their progress from ocean to ocean, and may avail them...elves of its waters for freeing their bottoms from marine accretions. Puget Sound ...ossesses cheap fuel for coaling vessels; it has abundant cargoes; a canal to Lake ...ashington will add immensely to its present advantages.

The most ample and perfect facilities are of paramount importance to the great ...anscontinental railway lines which converge here. If these railways are impor...ant and necessary from a military point of view, if they tend to bind together and ...nify the distant sections of the Republic, and hence possess national importance ...eyond their value as transportation lines, then certainly they should have com...lete terminals to enable them the more efficiently to aid in the work of developing ...nd building up the material resources of the country. In this connection the fact is ...ot to be lost sight of that our neighbor, the Dominion of Canada, spares no expense ...nd loses no opportunity to make perfect her transcontinental railway facilities, ...nd that she is preparing to contest with us most strenuously for the ocean carrying ...rade.

With a ship canal joining the waters of Lake Washington with Puget Sound our ...dvantages for shipping would be ideal in character and superior to those of all ...ther ports on the Pacific coast. Indeed this unique advantage would make Seat...le preëminent in facilities for shipping amongst the ports of the world. A vessel ...ould come to her dock in fresh water undisturbed by tidal flow, and while dis...harging cargo her bottom would be cleared of its burden of barnacles and grass ...ithout the delay and expense of docking. She would thus save two or three days' ...ime as well as considerable expense. The demurrage alone thus avoided would ...ggregate for the tonnage entering the port a large sum each year.

But a desideratum of the most practical importance is the increase of shore line ...vailable for wharves and docks which this improvement involves. Lake Wash...ngton would add more than 50 miles to the dock front of Seattle, increasing her ...arbor capacity tenfold and giving here transcendant advantages in this regard.

The maintenance of wharves and docks in the salt water of the sound is now very ...xpensive by reason of the ravages of the teredo, which often destroys piling within ...a single year after driving, so that the wharf goes down with loss of its entire stores, ...nd sometimes with loss of life. In the fresh water of the lake, piling will last prac...tically without limit. The saving in the cost of maintaining docks and wharves ...lone would far more than repay the cost of constructing the canal.

Manufactures already seek Lake Washington; its fresh water for making steam, ...ts nearness to the coal and iron mines, its cheap wharf facilities, and the ample ...oom which it affords, counterbalancing the expense of rehandling the manu...factured product when shipped foreign. Three railway lines, the Northern Pacific, ...he Great Northern, and the Seattle, Lake Shore and Eastern, have already estab...ished themselves on the lake and its outlet, recognizing its great commercial impor...ance. The Northern Pacific Company has built a road along the whole eastern front ...f the lake. But notwithstanding the railway facilities, many industrial enterprises ...re precluded from locating here while the canal is not built, such as flouring mills,

grain elevators and warehouses, lumber mills, e
largely by water.

Every foot of the shore line of this lake would c
accommodation of shipping and manufactures, were

The timber of the coast and bordering upon the
nearly used up, so that the vast forests of the inter
supplying the demand. Twenty million acres of t
rail. An enormous timber product will come to La
sawed and shipped hence, when the proposed connec

Wheat warehouses, elevators, and flouring mills,
the immense yield of grain which the wheat fields
amounts largely increasing every year, await est
time as the canal to the Sound is completed.

A comprehensive plant for the reduction of iron
is in course of construction at Kirkland, a manufac
east side of Lake Washington. This blast furnace
the Denny iron mines, situated about 30 miles east
in another place) compares favorably with the
pioneers ranking as the best upon the continent.
this ore will also bring superior coking coal from th
30 miles east of Kirkland. This will be coked and
banks of the lake.

Smelting works for ores of the precious metals w
where coals will be convenient, the ores coming by
mines.

A great city placed at the focal point where the
ocean carriage will beget an infinite number and
while the wondrous progress of the age will in it
not yet known to the inventor. The unmistakable
a great manufacturing and industrial center.

Congress is increasing the Navy of the United St
begun. The position of Puget Sound demands here
dock has been provided for already, to be followe
necessary.

A ship canal into Lake Washington would affor
pable advantages for naval vessels of any in the Un
tary reason for endowing the Pacific railways and
there is a still stronger military reason for Govern
and removing it from the control of private person
government would be the link connecting the milita
pool of great strength available for naval protection

While commercial development would be greatly
of manufactures accelerated by reason of the propo
wharfage and dockage, the handling of cargoes, th
freights, if not the cost of all the various charges
ever nature, would be materially lessened, as a resu
fresh and salt anchorage provided for the city of S

Not only for commercial reasons, but for reasons
nature, the Government should provide, control, an
as one of prime national importance.

The cost of the work is but a bagatelle in view o
and the results certain of attainment.

C

COMMUNICATION OF MR. I. W. DODGE, SECRETARY C
WASHINGTON.

THE
Se

DEAR SIR: Since reading and forwarding to you
committee of the Chamber bearing upon the Lake W
occurred to me that some points of importance in d
character of locks, etc., were not mentioned. I ther
your attention to a few points that present themselv
probable amounts of coal tonnage. At the present
tary to Lake Washington in operation; one develop

are in process of development. The names and daily capacity of the mines in operation, also the prospective capacity of each in the event of proper shipping facilities being afforded, are below given:

Name.	Present daily capacity.	Prospective daily capacity.
[illegible]	600	2,000
[illegible]castle	1,000	2,000
[illegible]r River	200	500
[illegible] Diamond	1,000	2,000
[illegible]klin	500	1,000
Total	3,300	7,500

The next feature that occurs is the amount of lumber that would be shipped from Lake Washington were facilities afforded.

There has been during the past year cut and floated on Lake Washington, for the use of mills located on Lakes Union and Washington, about 9,000,000 feet of logs, and there is being handled at the present time about 300,000 per working day. This would be but a small portion, comparatively speaking, of the amount that would be handled were there direct shipping facilities from the lake. It is estimated that there are 16,000,000,000 feet of timber now standing in King County. Over one-half of this, and an equal amount in Snohomish County, is directly tributary to Lake Washington. Western Washington is destined to be a heavy producer of metals, both base and precious, and while it would be impossible to estimate the extent of shipments of the various classes it is but proper that attention should be called to the fact that extensive iron and steel works are now under construction; that a company has recently been formed for the purpose of smelting and refining precious metals, the extent and value of which are each day becoming more apparent.

The size and character of vessels which would frequent these waters in case the canal was constructed would also be a matter of importance to you in determining the size of locks and depth and width of basins. From the best information I am able to gather from vessel owners, it is apparent that there is a decided tendency to increase the tonnage capacity. Bearing in mind that the freight would consist chiefly of coal, coke, grain, lumber, furniture, machinery, iron products and other metals, the canal and locks should be capable of handling vessels of large capacity. Vessel owners here are of the opinion that the prevailing type will be of about the following average: 2,000 tons register, 350 feet in length, drawing 26¼ feet water, 43 feet beam. Grain merchants seem to think that vessels similar to the *John R. Kelly*, which has net tonnage of 2254, and length of 256.9 feet, breadth of 45 feet and depth 27.8 feet, will represent the style of grain carrier. The fact that the new steel barges, which are now in use to a limited extent on the Great Lakes, will also soon be plying these waters, should also be borne in mind. No estimate has been made of the probable amount of grain shipments, for the reason that our experience in this line has been for so limited a period (the first elevator shipments from this port being made in August, last year) that we can not with any degree of accuracy estimate it. The elevator, which was completed and commenced business last August, has handled under adverse circumstances about 1,000,000 bushels during the past ten months, all received from one line of road. With the completion of the great Northern and Union Pacific and the extension of other roads now in prospect, which will pass through large areas of grain-producing land, the amount of tonnage that can and will be handled under favorable conditions is beyond estimate. Bulletins issued by the Agricultural Department show that Washington outranks all States of the Union in the yield per acre of wheat, oats, barley, and potatoes. The yield of wheat in the State for the past year has been estimated at 20,000,000 bushels. Bearing in mind the immense area of as yet uncultivated lands adapted to the production of this and kindred grains, the future of that branch of business can not be estimated.

Yours respectfully,

J. W. DODGE, *Secretary.*

Col. G. H. MENDELL.

REASONS WHY CONGRESS SHOULD CONSTRUCT A SHIP CANAL INTO LAKES UNION AND WASHINGTON, IN AID OF COMMERCE.

The advantages of a fresh-water harbor are so well known and have been so voluminously set forth by engineer officers of the Government at various times heretofore, that it is hardly necessary to give any further reasons why a fresh-water harbor should be preferred to salt water. If, therefore, it can be shown that the commerce of the State of Washington is so extensive that the sa wharves, in deterioration of ships and vessels of all kinds, are reduced, or reduced to such an extent that the sav not only to ship owners, but in lessening the cost of tr charges upon the handling of the grain and other pro hardly necessary to say that Congress will be justified in priation to build a canal into these waters. This wou saving would be sufficient to pay a large interest upon th canal. It is a well-known fact that the ravages of the ter Sound, and, in fact, in all the waters of the Pacific Oce tremendous tax upon commerce. All the wharves in the on an average of less than two years. It is safe to say t could be constructed in Lake Washington for the accomm commerce of the State at one-fourth the first cost that woul such wharves in the waters of Puget Sound or the Pacific and warehouses would last at least ten times as long, an in the fresh waters of the lake would be an infinitesima what they are in the salt water.

Again, the cost of handling ships at the wharves and th rail to ship would be but a small fraction of what it is up be so because of the level in the lakes being the same at al were once in the lake they would be absolutely safe from

If a canal were constructed into Lake Washington it i nearly all of the wheat and coal shipments of the State This would be so because of the very small cost of ha the reasons above stated, and because it is easier for all c the waters of the lake than it is to reach the waters of the

As a matter of fact all of the existing railroads in t themselves or by rail, direct contact with the shores of coal shipped now from the Sound, mainly from King and neighborhood of 2,000,000 tons per annum. These shipme not unlikely to be more than doubled. The wheat produc 1890 was nearly 30,000,000 bushels and it is safe to say that w product will be nearly 100,000,000 bushels. The eastern p all the wheat lands are cultivated, is capable of producing per annum, or say one-fourth of the present entire whe States. The saving in cost to the farmer and the mercha product by the lake instead of by salt water, would amou

In addition to the coal and wheat products the amount from the lake would be very large.

There are also within 30 miles of the lake some of the b in the world. Already transportation has been nearly pr and these deposits, and extensive works for the reductio being built upon the shores of the lake, and it is expected mines will be in operation within one year from this time.

Summing up, it may be said that there is not a coal mi the State of Washington that can not more readily ship it ington than to the Sound. Neither is there any iron dep not be more readily shipped from the lake. As a site for very extensive manufactures that will be required on the point that begins to possess the advantages of Lake Washi by superior natural location but because of the inexhausti If the construction of a canal were begun at once, it could the developments in iron mining and manufacturing and wheat product, would more than justify the small expendi

THE CHAMBER OF C
By E. O. GRAVES, *Vice-*
J. W. DODGE, *Secret*

COMMUNICATION OF MR. C. J. SMITH, GENERA

PORTLAND,

DEAR SIR: In relation to the business which this com transact upon the shores of Lake Washington in case a ca the waters of Puget Sound to Lake Washington, I would s

This company is the owner of the Columbia and Puget S gauge road extending south and east of Seattle to the New miles, and from the junction at Renton to Franklin Mine, a distance of 34 miles m Seattle.

here is located upon this road, coal mines belonging to this company, known as Newcastle Mine and Franklin Mine. In addition to these there is located upon line of this railroad the Black Diamond and Cedar Mountain Mine. The entire put of these mines would find a shipping point upon Lake Washington in case a al was cut through. The output of the mines is as follows:

	Tons.
1888, Newcastle Mine	84,000
Franklin Mine	177,000
1889, Newcastle Mine	67,000
Franklin Mine	90,000
1890, Newcastle Mine	130,000
Franklin Mine	74,000

'arious causes have contributed to keeping the output of these mines very conerably below their average capacity. In 1888 there was a fire in both the Newtle and Franklin mines, and in 1889 and 1890 the Newcastle Mine, owing to kes, was shut down two months and the Franklin Mine four months. The estited output of these mines, barring strikes, fires, or accidents, would be as follows:

	Tons.
wcastle Mine	200,000
nklin Mine	150,000
ck Diamond Mine	200,000
lar Mountain Mine	60,000
Total	610,000

ll the output of these mines is transported over the railroad of this company and pped from the coal bunkers of this company at Seattle, with the exception of the ount used for domestic purposes at Seattle. The amount of coal so used at Seattle uld be about 75,000 tons per annum, leaving 535,000 tons for shipment. Owing the difficulty with the teredo at Seattle, it is necessary to build these bunkers h copper-covered piles, and the shipments of the above mines are now made from l bunkers which cost this company $168,000. Bunkers sufficient to enable this npany to handle this product from fresh water at Lake Washington could be ilt for $50,000, and could be maintained much more cheaply than the bunkers at ttle.

he class of vessels transporting this coal are steamers ranging from 1,000 to 2,500 s capacity, with an average draft, loaded, of 19 feet. In addition to the coal pped in steamers, it has been the custom of both this company and the Black mond Coal Company to charter sailing vessels ranging in capacity from 1,000 to 00 tons, with draft, loaded, of about 21 feet. This company owns or controls a t on the Pacific coast of about twenty steamers, ranging in capacity from 1,000 2,500 tons, and are now engaged in the coastwise business, with routes from Portd to Puget Sound points, and from Puget Sound points to Alaska. They have a parture of vessels averaging every four days, and in addition to the coal carried, a very large merchandise and passenger business. It is probable that a considerle portion of this business would be done at the wharves on Lake Washington uld this canal be cut through.

The Newcastle Mine of this company is located only a mile from the shores of Lake shington, the Cedar Mountain Mine about 8 miles, the Black Diamond Mine about miles, and the Franklin Mine about 18 miles. There would be a saving in distance the carriage of coal to Lake Washington from Newcastle Mine of nearly 20 miles; m Cedar Mountain Mine of about 10 miles; from Black Diamond Mine of about 18 les, and from Franklin Mine of about 14 over the carriage of coal to Seattle.

In addition to the mines already opened and developed, there are a number of ospects in this same region that would be opened and developed to a working output the cost of transportation and wharfage charges were cheapened to the extent excted by the opening of service on the shores of Lake Washington.

Trusting the above information may be of use and benefit to you, I am

Yours, truly,

C. J. SMITH,
General Manager.

THOMAS W. SYMONS,
Captain, U. S. Corps of Engineers.

T T 16.

ESTABLISHMENT OF HARBOR LINES IN OLYMPIA HARBOR, VANCOU HARBOR (COLUMBIA RIVER AT VANCOUVER), AND BELLINGHAM (AT NEW WHATCOM AND FAIRHAVEN), WASHINGTON.

WASHINGTON, D. C., *March 1, 18*

SIR: On behalf of the harbor line commission of the State of W ington I have the honor very respectfully to submit herewith c projects or preliminary plans for the improvement of the harb Olympia, Vancouver, and Bellingham Bay, in that State, and t your approval of the same.

Before any further explanation is made of these plans—her presented upon the accompanying maps*—and in order that the which has heretofore been taken by the State of Washington wi erence to its harbors and navigable waters may be more fully u stood, I beg leave to present the following statement in relation th The magnificence and unsurpassed advantages of these harbors long been recognized by the entire civilized world. For beaut variety, for safety, extent, convenience of access, and unlimited ca for usefulness in the interests of commerce and navigation, th not only far superior to any other harbors or waters of the kind Pacific coast between the Arctic Circle and Cape Horn, but th not surpassed on the surface of the globe. They are surrounded country rich in every natural production required for the buildi of great centers of wealth and population, and more particula those things which contribute to the growth of commerce, ma tures, and the industrial arts. A description of its resources of ti coal, iron, mineral, agricultural, and other products would fill a vo while its climate is of that temperate and salubrious character conduces in the highest degree to the physical development and t dustrial activity of the human family. Every transcontinental rai across the North American continent has already secured or is ing to obtain terminal facilities on the shores of these harbors. Canadian Pacific, the Great Northern, the Northern Pacific, an Union Pacific Railroad companies all have terminal facilities of gr or less extent already in their possession, while every railroad com which is extending its track in the direction of the Pacific co hoping sooner or later to reach the waters of Puget Sound. Th traordinary growth of the commerce of Washington Territory i well known to require at this time anything more than passing refer The figures are to be found in the commercial statistics of the cou The people of the State of Washington, upon their admission int Union, realized these facts and determined to utilize to the gre possible advantage the grand commercial facilities with which n had provided them. For this purpose they adopted a line of p which would enable them not only to preserve, maintain, and im these commercial facilities, but also determined to retain the posse and control of the water front in its numerous harbors, in order they might regulate tolls and charges of all descriptions thereon, they might make these charges reliably and permanently cheap keep these commercial facilities convenient and accessible to the ge public for all time to come. Therefore when their constitution framed and adopted it contained among others the following provis

* Not printed.

ARTICLE XV.—HARBORS AND TIDE WATERS.

CTION 1. The legislature shall provide for the appointment of a commission se duty it shall be to locate and establish harbor lines in the navigable waters ll harbors, estuaries, bays, and inlets of this State, wherever such navigable rs lie within or in front of the corporate limits of any city or within one mile eof upon either side. The State shall never give, sell, or lease to any private on, corporation, or association, any rights whatever in the waters beyond such or lines, nor shall any of the area lying between any harbor line and the line of nary high tide, and within not less than 50 feet nor more than 600 feet of such or line (as the commissioners shall determine), be sold or granted by the State, ts right to control the same relinquished, but such area shall be forever re- d for landings, wharves, streets, and other conveniences of navigation and com- e.

c. 2. The legislature shall provide general laws for the leasing of the right to l and maintain wharves, docks, and other structures upon the areas mentioned ction one of this article, but no lease shall be made for any term longer than y years, or the legislature may provide by general laws for the building and taining upon such areas, wharves, docks, and other structures.

c. 3. Municipal corporations shall have the right to extend their streets over vening tide lands to and across the area reserved as herein provided.

ı order that these provisions of the constitution might be carried effect, and in further pursuance of the same line of policy, the fol- ng laws were subsequently enacted by the State legislature:

ARTICLE XVII (OF THE CONSTITUTION).—TIDE LANDS.

CTION 1. The State of Washington asserts its ownership to the beds and shores l navigable waters in the State up to and including the line of ordinary high in waters where the tide ebbs and flows, and up to and including the line of or- ry high water within the banks of all navigable rivers and lakes: *Provided*, , this section shall not be construed so as to debar any person from asserting his a to vested rights in the courts of the State.

c. 2. The State of Washington disclaims all title in and claim to all tide, swamp, overflowed lands patented by the United States: *Provided*, The same is not im- hed for fraud.

HARBOR LINE COMMISSIONERS, STATE OF WASHINGTON.

[Laws of 1889-1890, page 239.]

ACT to create a board of harbor line commissioners, prescribing their duties and compensation.

it enacted by the legislature of the State of Washington: SECTION 1. There is hereby ted a board of harbor line commissioners, to consist of five disinterested persons e appointed by the governor.

c. 2. The said commissioners shall hold office until the 15th day of January, . Should a vacancy or vacancies occur in said board, by resignation or other- , the same shall be filled by appointment by the governor.

c. 3. The duties of the said harbor line commissioners shall be to locate and estab- harbor lines in the navigable waters of all harbors, estuaries, bays, and inlets of State, wherever such navigable waters lie within or in front of the corporate ts of any city or within one mile thereof upon either side, and to perform all r duties provided and prescribed in article 15 of the constitution of the State of hington, and all such other duties as the law may prescribe, and wherever and never said board of harbor line commissioners shall have established the lines erein provided, in any of the navigable waters of the harbors, estuaries, bays, inlets of this State, they shall file the plat thereof in the office of the secretary tate, and a duplicate thereof in the office of the clerk of the city or town where or lines shall have been located, and from and after the filing of said plat, the or lines established as herein designated and displayed shall be, and the same are ared to be, the harbor line of that portion of the navigable waters of this State.

c. 4. The board of harbor line commissioners hereby created shall begin opera- s as soon as may be practicable, and are hereby authorized to employ a clerk, a petent surveyor, and such assistance as may be necessary, and to purchase such erial and supplies as may be necessary to carry out the full intent and purpose

of this act, at such rates of compensation a
into effect the provisions of this act the sur
thereof as may be necessary, is hereby approp
State treasury not otherwise appropriated.

SEC. 5. Each of the board of harbor line c
($5.00) per day for each and every day employ
actual traveling expenses.

SEC. 6. The board of harbor line commissio
incurred in the discharge of the duties provi
tion of the proper vouchers so allowed the S
warrant on the State treasury for the seve
treasurer is hereby authorized to pay said wa
appropriated for this purpose: *Provided*, Tha
payment of which no appropriation shall ha

SEC. 7. The board of harbor line commissi
all expenses incurred, and report the same to

Approved March 28, 1890.

PUBLIC WAYS ACROSS TIDE

[Laws, 1889-1890,

AN ACT to establish and define public ways for wat
and for a mile either way from, all incorporated ci

Be it enacted by the legislature of the State
be established one or more public ways acros
within or in front of any incorporated city o
from any incorporated city or town within t

SEC. 2. The public ways provided for in s
than fifty nor more than one thousand feet w
deep-water end, in not less than twenty feet
inland across the State's tide lands.

SEC. 3. The public ways above provided
near as is practicable, within their bounds,
the tide flats in which they are located, an
sary for the present or future convenience o

SEC. 4. All public ways established under
defined by posts not less than 8 inches in dia
and of sufficient length so that they will p
less than four feet, and such posts shall not
such public ways shall be correctly surveye
with the Government surveys, or such othe
lasting record, and a correct plat of all pu
one copy of which shall be filed with the se
missioner of public lands of the State, one
chairman of the board of harbor line comm
nished with a correct plat of all such publ
and such plats shall be filed as city or town
county records.

SEC. 5. All the public ways that may be
act are, and shall forever be, reserved fro
crafts.

SEC. 6. Where the words "tide flat or tid
be construed to mean all lands over which t
at low tide; and where the words ordinary
strued to mean boats, barges, and other wat
and over of water.

SEC. 7. The board of harbor line commi
structed to carry out the provisions of this
soon as practicable after the passage and ap
authorized to employ such assistance and pr
to carry out the full intent and purpose of
same shall be such reasonable amount as sa

SEC. 8. All bills incurred in carrying out t
and paid in the same manner as is provided
missioners, for the payment of bills incurre

Approved March 28, 1890.

IMPROVEMENT OF HARBORS AND WATERWAYS.

[Laws 1891, page 405.]

AN ACT relating to the improvement of harbors and waterways in the State of Washington, and providing funds therefor.

Be it enacted by the legislature of the State of Washington: SECTION 1. That seventy-five (75) per cent of the proceeds derived by the State from the sale of tide lands within the limits of any incorporated city or town in the State of Washington, or within one mile on either side thereof, shall be, and the same is hereby, appropriated, and the same shall be set apart as a special fund by the State treasurer for the construction and maintenance of a system of permanent and substantial improvements in aid of commerce and navigation in and for the harbor of such city or town wherein such tide lands may be sold, and the remaining twenty-five (25) per cent shall be paid into the general tide-land fund of the State.

SEC. 2. Wherever harbor lines are now, or may hereafter be, located and established within or in front of any incorporated city or town in the State of Washington, the harbor line commission is hereby authorized and directed to approve and adopt, subject to the approval of the Secretary of War, or an advisory board created by the Secretary of War, as soon as may be practicable, such a system of harbor improvements, within the harbor line strip of each harbor wherein such lines may be located and established, as will conform as nearly as practicable to any permanent improvements constructed or under construction therein as in their judgment, and upon the available advice of competent engineers, shall be best calculated to promote the permanent commercial welfare thereof; and all funds appropriated for the purpose of harbor improvements under the foregoing section of this act, or otherwise, shall be expended under the direction, supervision, and control of the harbor line commission of the State of Washington, and the State auditor is hereby directed, upon the filing of vouchers approved by the harbor line commission, to draw warrants on the State treasurer, payable out of the several harbor-improvement funds, and the State treasurer shall pay all said warrants out of said funds.

SEC. 3. In keeping the account of this fund the State treasurer is directed to credit each harbor with the amount received for sale of tide lands, as provided in section one of this act, and debit each harbor for warrants drawn for improvements therein.

SEC. 4. All acts or parts of acts inconsistent with the provisions of this act are hereby repealed.

Approved March 10, 1891.

The declaration in the constitution that the State of Washington asserts its ownership to the "beds and shores of all navigable waters in the State up to and including the line of ordinary high tide in waters where the tide ebbs and flows, and up to and including the line of ordinary high water within the banks of all navigable rivers and lakes," is simply the statement of a fact, and in nowise adds to the actual validity of the title by which the State owns this property. That the State of Washington, by virtue of its sovereignty, and not by virtue of any act of the General Government, is the absolute owner of these tide lands and lands under the navigable waters of the State, is a principle of law now so thoroughly established by repeated decisions of the Supreme Court of the United States, that it is no longer questioned by any lawyer or layman, court or judge, who has investigated the subject. As the original thirteen colonies came into the Union the proprietors of their tide lands by virtue of the sovereignty which they had inherited from the British Crown, and which they never relinquished, and as all the States in the Union which were subsequently admitted, were admitted upon precisely the same footing as the original thirteen States, so all of the States of the Union, Washington included, are the absolute owners of the tide lands within their limits, and can make any disposition of them which may be deemed advisable or expedient, subject only to the jurisdiction of the United States over the navigable waters of these States in the interests of commerce. Each State has a perfect right to decide for itself what disposition it will make of these lands, and the

Supreme Court of the United States l
is no power which can interfere with th
proper to give these lands or any inter
it has an absolute right to do so. I
which was determined by the Suprem
its October term, 1890, the court said:

With regard to grants of the Government f
been distinctly settled that they only extend
to the shore and lands under water in front
within which they are situated, if a State ha
Such title to the shore and lands under wate
eignty of the State, a portion of the royaltie
the public purpose of navigation and fishery
to individuals by the United States. (*Poll*
Kibbe, 9 How., 471; *Weber v. Harbor Commiss*
in the State, the lands are subject to State r
tion, however, of not interfering with the re
gress with regard to public navigation and c
of the usufruct of such lands, as is frequent
and granting fisheries in particular localities
flats, and the erection of wharves and piers r
Sometimes large areas so reclaimed are occup
lic or private purposes, State control and ow
only to the paramount authority of Congre
and in subjecting the lands to the necessities
ter v. Massachusetts, 139 U. S. R., 240; *Smith*
Virginia, 94 U. S. R., 391; *Martin v. Waddell*,
426.)

This right of the States to regulate and co
land under them is the same as that which
In this country the same rule has been exten
are treated as inland seas; and also in some
Mississippi, the Missouri, the Ohio, and, in P
of the State; but it depends on the law of e
extent this prerogative of the State over the

Space will not permit of further e
court or of further notice of the larg
the same decision or of extracts from
acter. It may be sufficient to say t
held that each State has the undispu
lands within its limits as to it may
Washington has given to the riparia
chasing tide lands, for sixty days, bet
deep water, it is only as an act of gra
gerated and ill-founded public sentin
and not because the riparian owner
either to the possession of tide lands
sition shall be made of them by the S

After the location of the harbor li
by the State in the interests of com
areas of tide land not available for th
manner provided by law. Not less t
posed of by the State of Washingt
waterways are located. It is desirabl
sold as speedily as practicable, becau
pal cities of the State are large areas
ing purposes, and especially for fact
industrial enterprises, which are most
ducted upon the water front or within
The laws of Washington require that
shall be located as speedily as practica

may be sold and made available for business purposes. The growth of most of the larger cities in Washington is now hampered and retarded because of the delay which has unavoidably been incurred in the location of these harbor lines. Beyond question the State of Washington has a perfect and absolute right to locate these harbor lines and waterways and to construct within these lines such improvements as may be deemed advisable in the interests of commerce and navigation. The object of the location of these lines is to mark out such areas to be reserved from sale as shall be considered necessary for streets, landings, wharves, and other conveniences of commerce and navigation. The areas to be reserved within these harbor lines for these purposes are from 50 to 600 feet in width, in the discretion of the harbor-line commission. They are now and are to be forever reserved as the property of the State and retained under its control, to the end that the commercial facilities thereon provided shall be made cheap and free of access to the general public, and may not fall into the hands of private persons or corporations whose exactions might prove a heavy burden upon the commerce of the State and nation.

The State has already appropriated 75 per cent of the proceeds of the sale of tide lands within its harbors for their improvement, and will probably expend many millions of dollars in the construction of sea walls, bulkhead lines, wharves, streets, and other conveniences of commerce upon the water front of its harbors within the near future. The jurisdiction of the United States over the navigable waters of the State of Washington is for the promotion of the commercial interests of the country. The legislation of that State is actively engaged in the same direction and for the same purpose. Whilst the commerce of that State is rapidly assuming large proportions, and is not only of a national but of an international character, yet the State is more deeply interested, more vitally concerned, in the increase, in the encouragement, and in the good management of that commerce than anyone else can be, because its interest is direct, and every other interest is of an indirect or secondary character. Therefore it seeks and desires to act in harmony with the General Government in all plans and measures which have for their object the care, protection, and improvement of these great and growing commercial interests. It desires to coöperate with all agencies, whether local and municipal or State and national, in the work of securing, constructing, and maintaining a comprehensive system of harbor improvements commensurate with the enormous national and international commerce which will in the years to come be carried on in the ports of Washington.

In addition to the work of locating harbor lines and waterways, with which the Harbor Line Commission of the State of Washington is charged, we are also required by law to prepare and adopt plans for the permanent and substantial improvement of these harbors, subject to the approval of the Secretary of War. We are well aware of the fact that no action of the legislature of the State of Washington would be binding upon the Secretary of War, yet we have thought it not unreasonable to suppose that men who are charged with the care of great commercial interests, whether representing the General Government or the State of Washington, might agree upon some general plan or plans for harbor improvement, in accordance with which the sums appropriated or expended by each should be disbursed, either jointly or severally, but in such a manner that the greatest amount of benefit might be derived therefrom in carrying out the plans which might be found acceptable to both the State and the General Government. We hope

for appropriations by Congress to assist in th
bors, and should expect that appropriations so
under the direction of the officers of the Ger
also expect large sums to be expended by the
all efforts made and moneys used for this pur
the construction of a comprehensive system
ments which shall produce the best results f
State and Nation. We are aware of the fact
act of Congress approved September 19, 18
provision:

Where it is made manifest to the Secretary of War
bar lines is essential to the preservation and protect
hereby authorized, to cause such lines to be estab
wharves, bulkheads, or other works shall be extended
such regulations as may be prescribed from time to tim
shall willfully violate the provisions of this section, o
by the Secretary of War in pursuance of this sectio
misdemeanor, and on conviction thereof shall be pu
$1,000, or imprisonment not exceeding one year, at the
offense.

But we believe that in making this provisi
bor lines by the Secretary of War it was n
Congress to impose this duty upon that o
taken with reference thereto by the proper S
such action, if taken, was an injury to navig
contingency shall be shown to exist, it was
Congress not to interfere with measures whic
bor improvements by the several States with
and this is further evidenced by the fact that
act an exception is made in favor of "b
wharves, and similar structures erected for b
exception is clearly intended to cover the pre
pose to erect upon the areas within the harb
locating. We desire most earnestly, however
only no cause for controversy, real or appar
tween the General Government and the Sta
your active and cordial coöperation in the d
and responsible duties which have been devol
of Washington.

We therefore submit for your consideration
of the following projects or preliminary plans
as set forth on the maps which are herewith p

1. For the harbor of Olympia. This consi
including bulkhead and pierhead lines, which
a careful survey of the harbor, and with the b
skill, with reference to the interests of comme
these lines there has been incorporated a pro
dredged from deep water to the head of navi
which surveys have been made and plans, spe
prepared and submitted by Capt. Thomas W
States Engineer Corps, at Portland, Oregon.
by us is identically the same as that suggest
cept that its lines have been slightly modified
conform to the harbor lines we have establish

(2) For the harbor of Vancouver. This co
of a plain suggested by Maj. T. H. Handbury
tions, and estimates prepared by him for the c

a slough or channel at the head of Hayden Island, to which we have ided a project for dredging a channel 400 feet in width on the north de of the Columbia River, from the harbor of Vancouver to the deep ater near the mouth of the Willamette River. It was the opinion of aj. Handbury that the closing of the channel at the head of Hayden land, thereby increasing the force and action of the current below the arbor of Vancouver, would open a channel through the bar which has rmed below that harbor, but we are anxious to open a channel across is bar as soon as practicable, without waiting for the slow process of e river currents. With the exception of this channel the plan for hich we ask your approval is identically that suggested by Maj. Handury after a thorough and careful survey of the Columbia River in ont of the city of Vancouver, and between that place and the mouth, the Willamette River, from which point to the ocean there is usually ample supply of water for at least ships of medium size or capacity.

(3) For Bellingham Bay. This project consists simply of the location f harbor lines, including bulkhead and pierhead lines, which have een established after a careful survey and with special reference to the nterests to the navigation in front of the city of New Whatcom. In onnection therewith we desire your approval for the restoration of the raters of the Nooksack River to their original channel through the Lummi Indian Reservation, by which they formerly flowed into the Gulf of Georgia. A collection of driftwood and débris of all kinds at the head of the old channel, as exhibited on the accompanying map, caused a deflection of the channel into Bellingham Bay, and enormous masses of sediment, sand, and alluvial deposit are being carried into that bay, and, unless diverted elsewhere, will before many years entirely ruin the navigation of the harbor of New Whatcom, which includes the upper part of Bellingham Bay. The people of that locality are willing to do this work at their own expense and return the river to its old channel if you will approve of the project.

The people of Olympia and Vancouver are also anxious, at their own expense and without waiting for the action of Congress, to begin the work of improving their harbors, as outlined in this letter, if the plans herein suggested shall meet with your approval. The rapidly growing needs of commerce in these localities make it important that the more urgent needs of better commercial facilities shall be provided at the earliest practicable moment.

Hoping that the importance of the subject may be a sufficient apology for the length of this communication, and that you may favor us with an early, and if possible with a favorable, consideration of the requests therein made,

I have the honor to be, very respectfully,

WM. F. PROSSER,
Chairman, Harbor Line Commission,
State of Washington.

Hon. STEPHEN B. ELKINS,
Secretary of War.

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
March 5, 1892.

Respectfully returned to the Secretary of War.

ENG 92——176

... harbor lines ... section 11 of the act of September 19, 18...
... of War authority to cause the esta...
... made manifest to him that such ...
for the preservation and protection of harbo...
... this section. It is recommended that a Bo...
... Col. G. H. Mendell, Maj. Thomas H. Ha...
W. Symons, Corps of Engineers, be constitu...
upon the subject of harbor lines for the harb...
and Bellingham Bay, and that the maps an...
harbor line commission be referred to such b...

With the approval of the Secretary the o...
will be issued from this office.

Tho...
Brigadier-Gen...

[Third indorsement.]

War Depar...

Approved as recommended by the Chief o...
By order of the Secretary of War.

[Fourth indorsement.]

Office Chief ...

Respectfully referred to Col. G. H. Mend...
... of the Board of Engineers ...
... Corps of Engine...
... the Board ... be limite...

[Fifth indorsement.]

U. S. ENGINEER OFFICE,
San Francisco, Cal., May 23, 1892.

ectfully returned to the Chief of Engineers.
report of the Board is found in three tracings* containing both
l and graphic description of harbor lines recommended by the
for the respective harbors of Vancouver, Olympia, and Belling-
ay, sent in a separate package.

G. H. MENDALL,
Colonel, Corps of Engineers, Senior Member.

[Sixth indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
May 31, 1892.

ectfully returned to the Secretary of War.
Board of Engineers appointed under authority of the Secretary
: (see second and third indorsements hereon), by Special Orders
Headquarters Corps of Engineers, March 12, 1892, to consider
port upon the subject of harbor lines for the harbors of Olympia,
iver, and Bellingham Bay, Washington, under the provisions of
12 of the river and harbor act of September 19, 1890, recom-
for the approval of the Secretary of War the harbor lines de-
d and described upon the accompanying charts.
recommended that the line selected be approved, and that the
ry place his approval upon the tracings submitted.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

WAR DEPARTMENT, *June 3, 1892.*

harbor lines selected by the Board are approved.

S. B. ELKINS,
Secretary of War.

PTIONS OF THE HARBOR LINES (TAKEN FROM THE MAPS SUBMITTED).

HARBOR LINES IN OLYMPIA HARBOR.

e harbor line: Beginning at a point on the line between townships 18 and 19
ange 2 west, 328.1 feet west from the meander corner to sections 2 and 35,
oint is in latitude 47° 5′ 00″.44, and in longitude 122° 54′ 4″.669; thence west
t; thence south 14° 46′ west, 2,156.3 feet; thence south 16° 56′ east, 11,250
2,996.9 feet on this line is the northwest and at 3,046.9 feet the southwest
the line bounding the east side waterway); thence south 42° west, 350.2 feet;
orth 16° 56′ west, 5,176.4 feet; thence south 84° 6′ west, 1,401.9 feet (at 725
line just touches the northeast corner of the Main Street Wharf); thence
54′ east, 5,240 feet; thence south 84° 6′ west, 1,000 feet (at 19.8 feet on this
e northeast, and at 119.8 feet the northwest angle of the line bounding the
waterway, also the last 245.2 feet are coincident with the line bounding the
tes waterway); thence north 5° 54′ west, 5,240 feet (the first 188.5 feet of this
coincident with the line bounding the Des Chutes waterway); thence north
, 4,060 feet (the first 52.2 feet of this line are coincident with the line bound-
west side waterway); thence north 30° 52′ west, 4,000 feet; thence north

---

* Not printed.

[illegible]

surveys of the Pattle and Morrison donation claims; thence west 731.72 feet; nce south 34° 55′ west, 748.91 feet; thence south 50° 51′ west, 987.67 feet; thence h 32° 4′ west, 1,473.81 feet; thence south 6° 35′ west, 847.24 feet; thence south st, 752.33 feet; thence south 15° 14′ west, 404.38 feet; thence south 58° 50′ west, feet; thence south 86° 33′ west, 1,185.33 feet; thence south 36° 51′ west, 3,247.48 ; thence south 23° 7′ east, 1,726.92 feet; thence south 48° 46′ east, 904.4 feet; nce south 5° 32′ west, 750.54 feet; thence south 13° 26′ east, 1,467.54 feet; thence h 34° west, 252.13 feet; thence south 12° 20′ west, 825.63 feet; thence south 43° st, 783.01 feet; thence south 12° 23′ east, 945.9 feet; thence south 26° 55′ east, .84 feet; thence south 29° 11′ east, 2,011.67 feet; thence east 702.94 feet; thence h 2° 16′ east, 751 feet; thence east 31.85 feet; thence south 23° 41′ east, 208.69 ; thence south 28′ west, 200.06 feet; thence south 17° 26′ east, 714.01 feet; thence 845.64 feet; thence north 10° 21′ east, 884.11 feet; thence north 4° 22′ west, 3 feet; thence north 31° 43′ west, 850.95 feet; thence north 9° 49′ west, 703.22 ; thence east 980.95 feet; thence south 41° 40′ east, 1,305.52 feet; thence south 0′ east, 2,090.76 feet; thence south 12° 47′ east, 2,498.5 feet; thence east 307.62 to a point near high-water mark on or about the quarter-section line of sec- 24.

APPENDIX U U.

ROVEMENT OF WILLAMETTE RIVER, OREGON, AND OF LOWER CO-MBIA RIVER AND ITS TRIBUTARIES, OREGON AND WASHINGTON.

ORT OF MAJOR THOMAS H. HANDBURY, CORPS OF ENGINEERS, OFFI-'R IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892, WITH 'HER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

outh of Columbia River, Oregon and Washington.
onstruction of canal at the Cascades, Columbia River, Oregon.
olumbia and Lower Willamette rivers below Portland, Oregon.
4. Willamette River above Portland, Oregon.
5. Cowlitz River, Washington.
6. Youngs and Klaskuine rivers, Oregon.
7. Gauging waters of Columbia River, Oregon and Washington.

EXAMINATIONS AND SURVEYS.

Villamette River, Oregon, at Clackamas Rapids, Ross Island, and Corvallis.
ower Willamette and Columbia rivers below Portland, Oregon.
'olumbia River near Vancouver, Washington.

HARBOR LINES.

stablishment of harbor lines in Willamette River at Portland, Oregon.

UNITED STATES ENGINEER OFFICE,
Portland, Oregon, July 12, 1892.

ENERAL: I have the honor to submit herewith annual report for fiscal year ending June 30, 1892, upon the work of river and harbor rovement in my charge.

*   *   *   *   *   *   *

Very respectfully, your obedient servant,

THOS. H. HANDBURY,
Major, Corps of Engineers.

rig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

U U 1.

[illegible] MOUTH OF COLUMBIA RIVER, OREGON AND WASHINGTON.

[illegible] which this work is being carried on was adopted [illegible] providing a channel across the Columbia [illegible] depth of 30 feet at mean low tide. This is to be [illegible] water flowing over the bar and increas[illegible] currents to such a degree as to procure the desired [illegible] for accomplishing this end must be more or less [illegible]. The work which is now in progress is the [illegible] jetty, starting from Fort Stevens, on the South [illegible] in a westerly direction, with a slight curve to the [illegible] Clatsop Spit, for a distance of 4½ miles, more or less, [illegible] may require, to a point about 3 miles south of Cape [illegible]. The jetty is constructed of stone, resting upon a [illegible] about 40 feet wide and from 2½ to 5 feet thick. [illegible] a level of 4 feet above mean lower low water. The [illegible] has been placed in position from a jetty tramway [illegible] driven along the line of the jetty and about 24 [illegible] level of low tide. The tramway is a double-track 3-foot [illegible] the tracks being 13 feet between centers, and 28 feet [illegible] mean low water. The material is landed at the [illegible] transported to places over these tracks, which are built in [illegible] work.

[illegible] commencement of this work the channel or channels over [illegible] very capricious in location and variable in depth. The [illegible] 19 to 21 feet and the channels varied in num[illegible] location through nearly 180° from Cape Disap[illegible].

[illegible] already constructed are very marked in the [illegible] and in the effects produced by the concen[illegible] bar. There is now a straight out-and-in [illegible] with a depth nowhere less than 2[illegible] a depth of 27 feet. At the end of last [illegible] distance from the 30-foot curve on the outside [illegible] of the bar was 5,000 feet. This distance is [illegible]. These depths refer to the plane of the mean [illegible].

[illegible] this improvement was made in the river [illegible] July 5, 1884. The total amount appropriated [illegible] fiscal year for carrying out the project is [illegible] expended, including outstanding liabilities, [illegible] balance of $24,331.12 applicable to the further [illegible].

[illegible] last fiscal year the jetty tramway was at station [illegible] work at station 235 + 40. Station 25 + 8[illegible] beginning of the jetty proper. During the [illegible] tramway was extended 1,088 feet. Station 250 + 2[illegible] of the jetty. This is 4½ miles from the beginning [illegible]. From this station east to the end of the prese[illegible] is 1,080 feet, making the distance from the end [illegible] to the outer end of the jetty a little over 4.8 miles.

[illegible] the results obtained by the jetty at the end of last fisc[al] [illegible] as shown by the sounding taken at that time on the bar, it wa[s] leemed advisable to stop the construction of the jetty when it arrived at a point 4½ miles from its inner end and await further developments, which would be shown by the sounding to be taken during June of this year. To give to the outer end of the jetty extra strength to resist the action of the waves in that locality, the tramway was widened for 300 feet back from the end so far as to permit of a third track being laid 13 feet south of the south tract. This arrangement permitted the laying of a foundation of mattresses 80 feet wide; on this rock was piled to a level of mean high water. The piles used in this locality were 65 feet long; they were driven into the sand from 25 to 30 feet. The action of the waves and tides would scour the sand down from 10 to 15 feet before the mattress could be put in place. When this was done it would fill back again and as rock was put on keep piling up against it. Extra precautions were taken to double driftbolt and strap the caps and stringers to the piles and put in additional braces from the end back for a distance for 6,000 feet. In the distance of 300 feet at the widened portion of the jetty 30,000 tons of rock were dumped.

Since the commencement of the work in 1884 there has been used in the construction of the tramway and its repairs 377,660 lineal feet of piling and 2,223,580 feet B. M. of lumber. The cost of the tramway has been approximately $6.50 per lineal foot. There has been used 18,414 cords of fascines. The mattress work in place has cost $4.50 per lineal foot.

Under the contract dated January 22, 1891, in force with Joseph E. Smith, 150,500 tons of rock were received during the year. The total amount of rock received from all sources since the commencement of the work is 478,890 tons.

About 25,000 tons of this rock was used in securing the root of the jetty and in protecting the buildings and railway between that point and the wharf. The balance has been distributed along the line of the jetty. From the end of the jetty back for a distance of 2,500 feet the rock is raised to a level of 4 feet above datum, for 13,000 feet it is at datum, for 5,200 feet it will average 4 feet above, for the remaining distance it will run from this level to high water. Near the inner end of the jetty it was found to be necessary to pile the rock well up toward the high-water line to protect the piling of the tramway from the heavy drift brought down by the river during the winter and spring. At places along the line of the jetty it was observed that there was a decided tendency during the last of the flood tides and the first of the ebb for the water to flow across the jetty in great volume and with considerable velocity. Where this was the case the sand would not deposit in the vicinity, but would be scoured out, increasing the area of the waterway. At these places rock was dumped in until this action ceased. It was found that when the jetty reached the height of about feet above the mean level of low water the flow during both ebb and flood was under control. The sand was deposited to the level of low water and above, in many instances, on both sides of the jetty.

Under the contract entered into with Richard Hoyt, April 20, 1891, ,768 cords of fascines and 3,528 poles were received. These were used in making the mattresses placed under the last 1,000 feet of the jetty.

The piles used during the year were purchased in open market at the rate of 9½ cents per lineal foot delivered at Astoria. The lumber was purchased in open market also, at $10 per 1,000 feet delivered at Fort Stevens.

On account of inclement weather and to give opportunity for general repairs that were needed to the tramway, the barges, towboats, and rolling stock of the railway, the delivery of rock was suspended f the 20th of December to the first of March. It was necessary to m extensive repairs to four of the oldest barges belonging to the plan order to keep them in anything like serviceable condition. This done by written agreement with the lowest bidder after soliciting posals for the work, at a cost of $1,750 each. The other repairs made by the regular employés upon the work.

On June 9, 10, and 11 surveys were made upon the bar at the m of the Columbia River with the view to developing the present co tion of the channel in that locality. The conditions were favorabl this work and the results make a very satisfactory showing. soundings were reduced to the plane of the mean of lowest low wa and are shown upon the sheet herewith. The general outline of low-water line as it now exists in the vicinity of the jetty is also sh This survey shows an increase in the depth of the water over the to the northward of the deepest water of last year. The 27-foot c nel is now about 1 mile wide and the 25-foot channel about 2 m This tendency of the body of the water to pass out more to the n ward can be attributed, I think, to the southerly storms that pr during the winter and spring.

What was the old south channel when the work commenced is gr ally shoaling up on a line with the end of the jetty. In this vici where there was at that time from 19 to 30 and 35 feet, there is now about 17 feet. To the southward this channel is holding at the s depth as formerly. The north channel of that time is closing up, w the middle sands, with but 10 feet of water upon them, have ent disappeared, and where this minimum depth was there is now 34 These sands have been pushed out into the deeper water of the oc and now there is from 26 to 29 feet of water where they were. matter of course shoaling has taken place in this deeper water in f of the fore slope of the old bar, where this was deposited, but no such an extent as to interfere with navigation. The indications this survey are all favorable to a permanent depth of channel o least 30 feet. The shortest distance between the curves of this d on the two sides of the bar is now but 1,200 feet.

This improvement is already having a very marked effect upon foreign commerce of the river. The commercial statistics herewit dicate an increase in the number and tonnage of these vessels. indications for the coming season are that there will be a still gre increase.

Estimates for the year ending June 30, 1894.—It is estimated $525,000 will be required to finish this work. Should $350,000 of be appropriated for the fiscal year ending June 30, 1893, it is rec mended that the balance, $175,000, be made available for the fi year ending June 30, 1894.

The original estimate for the construction of this work was $3,710, of this amount there has already been appropriated to June 30, 1 $1,337,500. There was a balance on hand at that date of $24,33 exclusive of outstanding liabilities.

It is proposed to expend this and future sums appropriated in rai the jetty to a height of 4 feet above low water in those places tha not yet at that height, and in further strengthening the jetty. T is now about 13,000 feet that is at the level of mean low water. E rience has shown that it will not be safe to leave the jetty at this he The first half of the tides flowing across the jetty, either ebb or f take the sand with them and scour channels. Especially is this case where there are low places in the jetty. It is only by building up the jetty that this cross-flow can be prevented. About 4 feet above low water seems to be the height required. The jetty towards the outer end will need to be well protected with large rocks to resist heavy seas. During the year Mr. G. B. Hegardt has continued to render intelligent and zealous service in local charge of this work. His report is herewith appended, to which attention is invited for further details pertaining to the work done.

APPROPRIATIONS.

July 5, 1884	$100,000
August 5, 1886	187,500
August 11, 1888	500,000
February 22, 1890	75,000
September 19, 1890	475,000
Total	1,337,500

Money statement.

July 1, 1891, balance unexpended	$274,710.46
June 30, 1892, amount expended during fiscal year	220,913.69
July 1, 1892, balance unexpended	53,796.77
July 1, 1892, amount covered by uncompleted contracts	29,465.65
July 1, 1892, balance available	24,331.12
Amount appropriated by act approved July 13, 1892	350,000.00
Amount available for fiscal year ending June 30, 1893	374,331.12
Amount (estimated) required for completion of existing project	175,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	175,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

REPORT OF MR. G. B. HEGARDT, ASSISTANT ENGINEER.

OFFICE OF UNITED STATES ASSISTANT ENGINEER,
Fort Stevens, Oregon, July 1, 1892.

MAJOR: I have the honor to submit the following report of operations on the improvement of the mouth of Columbia River, Oregon and Washington, for the fiscal year ending June 30, 1892:

JETTY TRAMWAY.

At the end of last fiscal year the end of the tramway was at station 239+52 and the bracing carried to station 232+64.

The construction of the tramway was completed in July.

The extension during the year was 1,088 feet, which brings the end of the tramway and jetty to station 250+40. The bracing of the tramway was secured from station 232+64 to the end, a distance of 1,776 feet.

For the purpose of better securing the end of the tramway and the jetty, a spur track was put in at the end, joining the south track 300 feet from the end and having 13-foot centers. Each bent in the spur track was secured to the main bents in the tramway, thus forming a connected structure.

Sixty-five-foot piles were used for the tramway, with the exception of the last six bents, where 70-foot piles were driven.

The mean depth of water in which piles were driven was 12 feet, but before the mats could be sunk the sand would scour away to a depth of from 20 to 24 feet, the bottom generally seeking its level at about 22 feet below low water.

A few bents back from the end a cluster of four 75-foot piles were driven and allowed to stick up about 20 feet above the tracks. Between these four piles another pile, about 40 feet long and resting on the cap of the tracks, was secured with screw bolts and guys. On top of this pile was placed a ball beacon, 8 feet in diameter and [illegible] entering the river. The top of the beacon [illegible]

[illegible] and repairing the tramway had to be done [illegible] and January were a succession of violent [illegible] not damaged in any particular place, still [illegible] piles, caps, and stringers would work loose [illegible] over the spits. Several piles were [illegible] tramway, but principally in the last 300 [illegible]

[illegible] stringers through every pile from the [illegible] of about [illegible] feet, and iron straps [illegible] the two south piles from the end and [illegible] the two north piles from the end [illegible]

[illegible] were put in from pile to pile, between [illegible] and the rock dumped into the [illegible] tracks in good running order.

[illegible] south side of the jetty run so close [illegible] experienced in keeping up the repairs [illegible]

[illegible] the piles on the south side were [illegible] pile-driver had to be run out [illegible] new piles.

[illegible] part of the tramway, having been [illegible] to a great extent, and during the last [illegible] keep the tracks in good condition [illegible] where the most decay has taken place [illegible] new piles were driven [illegible] for nearly the whole [illegible] put in a condition to [illegible] most.

[illegible] expensive and difficult [illegible] in the jetty. It would probably [illegible] alongside the present [illegible] and probably was, by the rock being washed off by the sea. Part of the :eived has been placed where the settlement or washing off has taken place, it to raise the level of the rock to about 4 feet above low water, but the it towards the end of the jetty. The following approximate amounts were between the different stations: On the shore-protection spur 900 tons; sta-+44, 1,200; 44+100, 28,000; 100+170, 15,000; 170+200, 2,000; and from station he end the remainder, or 103,000 tons.

the end of the jetty and back to station 225, a distance of 2,500 feet, the rock n raised to a level of about 4 feet above low water, and from station 96 to 44, a distance of 5,200 feet, to a height of from 3 to 5 feet above low water. n stations 225 and 96 the rock is on an average up to low-water level.

ouring away of sand has taken place at the end of the jetty. There has, on trary, been a filling in of sand on top of the mats of about 12 feet. The mats .nk in 25 feet of water at low water, and the water is only from 12 to 14 feet ere now. From the survey of the bar, made June 9 to 11 will be seen that the the westward of the end of the jetty are getting shoaler; and also to be g out toward the sea. On the progress sheet accompanying this report are the sand spits that are dry at extreme low water in the vicinity of the jetty. ange is very marked from that of last year, and especially so on the south

ie drawing showing the soundings taken on the bar in June this year the ent of the main spits on the south side of the jetty are shown. The extreme imits of these spits were located by sextants from the surf-boat of the life-station here, the boat following the line of breakers as close as possible. tline of the main spit was also located by the use of sextants, from the spit it-a run-out of 2 feet below mean lower low water.

south of the end of the jetty, where there is a break in the line of soundings, ter must be shoal, as it was breaking too heavy there to take any soundings ime we were out in the surfboat.

nain portion of the main spit on the south side of the jetty is from 3 to 4½ feet nean low water. The spit on the north side opposite the main one on the south about 2 feet above mean lower low water.

other sands shown as bare at extreme low water are from 1 foot above to 1 foot mean lower low water.

ery of rock was suspended December 21 and again resumed March 1. An at-was made by the contractor to get rock for the jetty at Bugby Hole quarry. k proved to be very brittle, and could not be gotten out except in small pieces, empt was given up. The rock has been furnished from the Willamette River s as last year. All the towing of barges has been done by Government boats, re.

racing of the waves along the line of the jetty has almost entirely ceased, and place only after very severe storms.

trestle.—In September, about 200 cords of fascines were placed under the between stations 21 and 25, just back of the rock dumped in front of the tracks. out 300 tons of small rock placed on top of it, to prevent the undermining of k in front of the tracks. When heavy sea rolls in, the waves break over the here, and the water, when receding, cuts away the sand from between the d under the rock. Since the above work was done no trouble has been ex-ed at this place.

ng the severe storms we had in December a great deal of rock in front of the restle tracks between stations 22 and 26 washed off, and it was necessary to about 600 tons of rock here to bring it up to the same level it was before the

shore trestle tracks have been subject to decay as much as the first part of the ay tracks, and required repairing to put them in good condition.

year nearly all the piles had to be renewed, and this year the ties and some stringers had to be replaced.

een stations 23 and 30 the tracks were torn up and new ties put in for both cks for the whole distance. From the first old wharf, station 4 to station 23, number of new ties were put in. The rails of the north track between sta-3 and 30 were so corroded that it was deemed best to take them up. This was nd rails that were in the wharf tracks taken up and put down in the shore track, those from the shore trestle being laid on the wharf instead, the dan-ere not being so great. This work was done in February during suspension delivery. All the switches were taken up to allow new ties to be put down.

rves.—The severe storms experienced during the winter months, accompanied h tides and heavy swells, did considerable damage to the wharf tracks. In ber fifteen piles were washed out from under the wharf approach tracks. were replaced at the time by new ones being dug in and blocked up. Shortly elivery of rock had been suspended, in the early part of January, after another

. 5—the repairs to this were comparatively small, the locomotive being only a ar old.

The boilers of all the locomotives were tested, as were also the steam gauges.

Derricks.—Three new derricks were made and put up in place of those in use, hich were about two years old.

An additional derrick, complete, was made and is kept in reserve in case of break-wn.

Pile-driver.—After the repairs to the tramway the driver was laid up and wood-rk painted. The iron work of the trucks has been scraped and given two coats red lead.

Tug.—The deck of the *Mendell* was calked in September.

January 15 the *Mendell* was laid up for repairs, which were completed on the 29th. e repairs consisted of overhauling the high and low pressure cylinders and pis-s, the valves, cross-heads, crank pins, and main journals, the condenser cleaned, culating pump overhauled, boiler scaled and cleaned out. Indicator pipes were t in, capstan engines repaired, canvass put under pilot-house to prevent leakage, l bunkers repaired, etc. The hull below water line was given one coat of cop-r paint and the hull and other woodwork painted.

Barges.—All the barges were more or less repaired while engaged in carrying rock m the quarry, the repairs being mostly made to the guards and sheathing.

Chafing plates for the anchors were put on all the barges.

Four additional hatches were cut in each barge to increase the circulation of air. e four oldest barges were taken to Portland for repairs, these being too extensive be attended to here. The six other barges were taken to Youngs River for the nter, and there repaired by carpenters from here. These repairs consisted of re-iring and renewing guards, chocks, bitts, towposts, sheathing, etc. Roofs of uses and hulls above water line were painted.

Shop.—The machinery in the shop has been increased by the addition of 12-inch aper, the machinery and engine overhauled and scraped, and the tubes of the boiler panded.

Miscellaneous work done.—One old Dow pump, badly damaged, was repaired by hav-g a new yoke put in, cylinders bored out, and new piston rods made. Two Worth-gton and one wind-mill pump were also put in good repair.

One of the boiler feed pumps on the steamer *Cascades* was thoroughly overhauled, ving the cylinders bored out, new pins made for the cross head, valves and valve ats reseated, etc.

For the improvement of Coos Bay, Oregon, the following work was done: Eleven ared, self-righting dump cars were made, completing the construction of the twenty ilt here.

Two matcars, used here in the construction of the jetty, were shipped to Coos y, there being no further use for them here.

Sixty-four hooks, for suspending inside mats while being made, were also sent at e same time.

Surveys.—June 9, 10, and 11 a series of lines of soundings were taken on the bar develop the channel. These soundings show a straight-out channel about one-arter of a mile wide, with a least depth of 29 feet, referred to the plane of the erage of the lowest low waters. Last year's survey showed a 27-foot channel ree-quarters of a mile wide and the 24-foot channel about 2 miles wide.

This year's soundings give the 27-foot channel a width of 1¼ miles, the 24-foot annel having the same width as before, or 2 miles. The scouring away of sand the 27-foot channel of this year has all been to the northern or in a more straight-t course. Scarcely any change has taken place in the 24-foot channel, the contour es being practically where they were last year. The 29-foot channel is about in e same place where the 27-foot channel was last year. Where the 29-foot channel sses through the crest of the bar the distance between the 30-foot curves has been creased about one-quarter of a mile.

The spit ahead of the jetty is shown to have moved outward, and shoaler sound-gs were found between the 24-foot curve and the end of the jetty than was the se last year.

The results obtained by the jetty are certainly very gratifying, and it may not be o much to expect that, after the freshet in the Columbia River is over, there will a 30-foot channel over the bar.

Miscellaneous.—Accompanying this report are the following drawings:

Plan and profile showing extent of jetty constructed June 30, 1892.

Survey of the mouth of the river made June 9, 10, and 11.

In closing this report, I wish to acknowledge the efficient and faithful assistance ven me in my work by Mr. J. W. Stoneman, overseer.

Very respectfully, your obedient servant,

G. B. HEGARDT,
Assistant Engineer.

aj. THOS. H. HANDBURY,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

The following commercial statistics bearing upon the improvement of the m[illegible] of the Columbia River were collected from the sources indicated, and are the m[illegible] reliable that can be obtained.

Arrivals and clearances of vessels at Portland, Oregon, during the year ending June 30, 1[illegible]

[From collector of customs Portland, Oregon.]

Vessels.	Coastwise.		Foreign ports. American.		Foreign ports. Foreign.		Total.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	[illegible]
Arrived in 1891 and 1892	183	228,444	7	4,838	99	129,707	289	[illegible]
Cleared in 1891 and 1892	137	163,504	35	25,096	106	137,450	278	[illegible]

Commerce, July 1, 1891, to June 30, 1892.

Exports	$8,[illegible]
Imports, entered for consumption	1,[illegible]
Imports, entered for transportation to other ports in the United States	[illegible]
Imports, entered for transit through the United States	[illegible]
Total value of exports and imports	8,[illegible]
Receipts from duties collected	[illegible]
Receipts from other sources	
Total receipts	[illegible]

Arrivals and clearances of vessels and commerce at Astoria, Oregon, during the year [illegible] June 30, 1892.

[From collector of customs, Astoria, Oregon.]

Vessels.	Coastwise.		Foreign ports. American.		Foreign ports. Foreign.		Total.
	No.	Tons.	No.	Tons.	No.	Tons.	No.
Arrived in 1891 and 1892	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cleared in 1891 and 1892	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Commerce, July 1, 1891, to June 30, 1892.

Exports	$1,2[illegible]
Imports	1[illegible]
Duties collected	1[illegible]
Total receipts	$[illegible]

[illegible] tonnage passing in and out over Columbia River Bar, as rep[illegible] collectors of customs at Portland and Astoria, is 2,019,467 tons.

FROM RECORDS OF THE MERCHANTS' EXCHANGE, PORTLAND, OREGON.

ed tonnage inward over Columbia River Bar from June 30, 1891, to June 30, 1892.

1.	Deep-sea vessels. American. No.	Deep-sea vessels. American. Tons.	British. No.	British. Tons.	German, etc. No.	German, etc. Tons.	Steam. American. No.	Steam. American. Tons.	Other flags. No.	Other flags. Tons.	Coasters, American. No.	Coasters, American. Tons.	Total. No.	Total. Tons.
....	....	....	1	1,205	....	....	31	26,736	2	2,482	6	2,056	40	32,479
....	1	1,462	3	3,714	....	....	27	20,006	4	4,135	3	868	38	30,185
er ..	2	3,385	4	6,808	....	....	25	19,520	2	2,533	6	1,841	39	33,487
....	....	....	10	10,940	4	4,694	26	21,267	2	1,742	8	3,253	50	41,896
er ..	....	....	21	29,943	1	1,007	25	23,383	2	2,491	2	793	51	57,617
r ...	1	1,036	11	15,736	....	....	20	19,059	3	3,782	4	1,330	39	40,943
....	1	1,469	21	28,809	2	2,248	21	15,994	3	3,404	4	1,773	52	53,697
y ...	1	1,931	3	3,781	....	....	22	18,233	1	871	6	4,693	33	29,509
....	1	1,746	3	3,693	....	....	19	15,108	1	1,565	4	1,984	28	24,096
....	....	....	1	1,399	....	....	25	18,905	1	1,062	5	1,288	32	23,254
....	4	6,574	2	3,244	....	....	27	17,679	....	....	6	2,658	39	30,155
....	....	....	4	5,121	....	....	23	16,564	....	....	2	729	29	22,414
tal .	11	17,603	84	113,793	7	7,949	291	232,454	21	24,667	56	23,266	470	419,732
us	9	12,393	73	97,954	3	3,989	307	301,360	22	21,448	69	22,103	483	459,247

ed tonnage outward over Columbia River Bar from June 30, 1891, to June 30, 1892

1.	Deep-sea vessels. American. No.	Deep-sea vessels. American. Tons.	British. No.	British. Tons.	German, etc. No.	German, etc. Tons.	Steam. American. No.	Steam. American. Tons.	Other flags. No.	Other flags. Tons.	Coasters, American. No.	Coasters, American. Tons.	Total. No.	Total. Tons.
....	....	....	4	4,724	....	....	27	25,560	3	4,064	8	2,188	42	36,536
....	....	....	1	1,312	....	....	29	20,443	4	4,206	3	1,647	37	27,608
er ..	....	....	2	1,977	....	....	26	20,343	3	3,282	5	1,622	36	27,224
....	2	3,359	7	9,842	1	1,256	24	21,138	2	2,533	6	2,469	42	40,597
er ..	1	1,488	9	9,717	3	3,438	26	22,630	3	3,362	6	2,649	48	43,284
r ..	....	....	3	4,904	....	....	20	21,308	2	2,430	....	....	25	28,648
....	1	1,036	24	33,499	1	1,007	19	15,226	2	2,533	8	2,531	55	55,832
y ...	....	....	20	27,787	....	....	24	17,974	2	2,217	2	856	48	48,834
....	1	1,469	3	5,138	2	2,248	16	14,897	2	2,436	5	2,399	29	28,589
....	....	....	4	4,786	....	....	27	19,158	1	1,062	6	3,198	38	28,804
....	1	1,589	3	3,712	....	....	29	18,842	....	....	4	1,484	37	25,627
....	1	1,553	2	1,988	....	....	22	15,160	....	....	3	1,194	28	19,895
l ...	7	10,494	82	109,386	7	7,949	269	232,679	24	28,731	56	22,237	465	411,478
us	9	12,393	67	90,683	4	4,963	287	298,845	21	18,807	70	23,218	458	448,909

Comparative statement of principal exports for the past ten seasons.

WHEAT.

	Foreign. Centals.	Foreign. Value.	Domestic. Centals.	Domestic. Value.	Total. Centals.	Total. Value.
nding July 31—						
....	1,761,754	$2,918,458	362,709	$560,338	2,124,463	$3,487,796
....	2,276,809	3,712,253	311,941	477,725	2,588,750	4,189,978
....	3,147,902	3,720,378	521,834	598,828	3,669,796	4,319,203
....	3,971,756	4,979,841	1,349,740	1,602,805	5,321,486	5,582,646
....	3,042,316	3,889,499	711,872	988,936	3,754,188	4,878,435
....	3,203,108	3,783,208	1,259,263	1,485,189	4,462,371	5,268,397
....	2,689,686	3,779,644	559,953	741,642	3,249,639	4,521,286
....	1,752,879	2,210,950	343,690	420,151	2,096,569	2,631,101
1890, to June 30, 1891.	2,786,633	3,814,020	1,235,833	1,536,410	4,022,466	5,350,430
1891, to June 30, 1892.	3,563,562	5,713,710	977,677	1,503,310	4,541,230	7,217,020

Comparative statement of principal exports for the past ten seasons—Continued.

FLOUR.

	Foreign.		Domestic.		Total.
	Barrels.	Value.	Barrels.	Value.	Barrels.
[illegible]	[illegible]	$1,684,919	130,471	$708,854	[illegible]
[illegible]	[illegible]	[illegible]	218,846	945,857	[illegible]
[illegible]	[illegible]	[illegible]	152,516	650,485	[illegible]
[illegible]	[illegible]	[illegible]	187,736	689,708	[illegible]
[illegible]	[illegible]	1,412,[illegible]	137,908	548,447	[illegible]
[illegible]	[illegible]	[illegible]	158,015	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	144,184	584,186	[illegible]
[illegible]	[illegible]	[illegible]	111,681	447,275	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

SALMON.

	Foreign.		Domestic.		Total.
	Cases.	Value.	Cases.	Value.	Cases.
[illegible]	[illegible]	[illegible]	[illegible]	$1,460,151	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	1,494,315	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	1,795,904	[illegible]
[illegible]	[illegible]	[illegible]	372,112	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	2,241,281	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] for the last ten seasons.

Comparative statement of deep-sea tonnage for the past eight seasons—Continued.

OUTWARD.

Flag.	1884–'85.		1885–'86.		1886–'87.		1887–'88.		1888–'89.		1889–'90.		1890–'91.		1891–'92.	
	No	*Tons.*	*No*	*Tons.*	*No*	*Tons.*	*No*	*Tons.*	*No*	*Tons.*	*No*	*Tons.*	*No*	*Tons.*	*No*	*Tons.*
American	20	24,790	14	19,323	7	9,280	3	3,857	12	16,611	5	8,050	9	12,388	7	10,494
British	97	92,555	119	124,073	111	119,716	98	122,344	75	89,731	52	67,428	67	90,683	82	109,386
Norwegian	...	....	1	901	...	....	2	2,137	2	1,744	...	....	...	....	...	....
German, etc ...	4	3,618	3	2,622	1	851	2	2,350	4	3,976	1	974	4	4,968	7	7,949
Total	121	120,963	137	146,910	119	120,847	105	130,688	93	112,062	58	76,452	80	108,039	96	127,829

NOTE.—From 1884 to 1890 the season begins on July 31; from 1890 the period covered is from June 30.

U U 2.

CONSTRUCTION OF CANAL AT THE CASCADES, COLUMBIA RIVER, OREGON.

The general scope of the improvement which it is desired to effect at the Cascades of the Columbia River includes a reach of about 4½ miles, where the river rushes through a narrow gorge in the Cascade Mountains. The fall in the distance is about 45 feet at high water and 36 feet at low water. The principal obstruction to navigation occurs at the upper end of the reach known as Upper Cascades. The project for the improvement contemplates that the river should be improved below the Upper Cascades by removing bowlders and projecting points in the bed and banks so as to give good navigable water from its lowest up to a 20-foot stage. The fall at the Upper Cascades is to be overcome by digging a canal of 3,000 feet in length across the neck of a low, projecting spur, around which the river is forced at the entrance to the gorge, and placing in this a lock and other suitable structures, which would permit of the passage of boats up to a 20-foot stage of water in the river, this lock and canal to be so arranged that, should the future necessities of commerce so demand, additional structures may be added which will permit of navigation at much higher stages.

The first part of this project, that of improving the river below the foot of the Upper Cascades, is essentially finished.

The difference of level between the head and foot of the canal as now established is 15 feet at high water and 24 feet at low water, and difference in height between high and low water at the foot is 54 feet, and at the head 45 feet. The plan on which the future work in the canal, with its lock and accessories, is to be prosecuted, has for its object to make this portion of the river available for navigation to a stage up to 20 feet at the earliest possible moment, with the funds that are from time to time appropriated for the purpose.

At the commencement of the present fiscal year there was available for the prosecution of the work $204,691.71. At that time the principal work in progress was cutting stone, there being about fifty cutters employed. Other operations, excepting current repairs, were suspended on account of high water in the Columbia River. By the 1st of August the water had receded sufficiently to permit the lock pit to be pumped out. On the evening of the 7th the water was practically all out of this. Preparations were at once made for resuming the work of placing concrete and setting stone in the north wall of the masonry of the lower lock and guard gate. Quarrying stone was resumed about the 20th of July. Concreting and stone setting was resumed August 20. Work was pushed forward actively until December 5, when it became necessary to suspend the making of concrete and stone setting. On

[illegible]

[illegible] were [illegible]

[illegible] walls, [illegible]

[illegible] yards [illegible]

[illegible] were

[illegible] made and placed

[illegible] used in this [illegible]

[illegible] yards gravel

[illegible] were made.

[illegible] yards of

[illegible] the year amounted to [illegible]

[illegible] was used in filling in beh[illegible]

[illegible] removed from the

[illegible] the concrete, [illegible]

[illegible] the masonry [illegible]

[illegible] the year [illegible]

[illegible]

pper canal walls are nearly completed from the site of the upper guard te to the upper bulkhead; the slope outside of the berm on the north de of the canal has been paved from the lower bulkhead to beyond e center of the lock chamber a distance, approximately 800 feet, and m the upper bulkhead down a distance of 300 feet; on the south de of the canal the slope has been paved from the lower bulkhead to e lower lock gate, a distance of about 600 feet, and from the upper lkhead nearly to the upper guard gate a distance of about 500 feet; e excavation of the lower canal from the lower bulkhead to the lower ard gate has been practically completed; the excavation in the lock mber has been completed, except 2 feet left on the bottom to be re-oved just before putting down the concrete floor; the excavation for e abutments of the upper lock gate has been partially completed; d from the site of this gate to the upper bulkhead also partially mpleted. In addition to this a large amount of necessary incidental rk has been done, in the way of constructing temporary protection rks, quarters, shops, etc., and the establishment of a complete plant r carrying on the work rapidly and economically.

The principal work yet to be done is approximately as follows:

cavation:		
Earth and loose rock	cubic yards..	285,757
Bed rock	do....	57,782
Total	do....	343,539
sonry construction:		
Granite	do....	1,210
Basalt dimension stone	do....	4,287
Basalt face stone	do....	4,277
Concrete	do....	46,311
Side wall at entrance	do....	31,311
Paving slopes	do....	19,800
Total	do....	107,196

The gates, valves, pumps, engines, and other maneuvering machinry are to be provided. There is also a large amount of filling in and rading to be done. A general idea of the masonry work constructed nd yet to be constructed can be had from the tracing herewith, showg work completed and proposed.

There are on hand, June 30, approximately, 3,000 cubic yards of cut tone of various kinds and 457 cubic yards of rough basalt stone ready r cutting.

The buildings and plant are now in a good state of repair and everying is in readiness to push the work forward as rapidly as the funds vailable and other circumstances will permit.

In my last annual report mention is made of the fact that the agents f the State of Oregon were permitted to enter upon the Government rounds at the Cascades and had commenced the construction of a portge railway thereon, this road with its two inclines was finished about he middle of September. The first boat to reach the upper incline from The Dalles arrived September 15; the first boat to reach the lower inline from Portland arrived September 20. These two boats ran reguarly from September 22 to January 12 of this year, their freight and assengers being transported over the portage railway. On this last ate the service was discontinued on account of cold, stormy weather, nd ice in the river between the Cascades and The Dalles. The boats egan their regular trips again February 14 and continued until May 6, when the lower boat was taken off on account of high water, the

REPORT OF LIEUTENANT HARRY TAYLOR, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Cascades Locks, Oregon, June 30, 1892.

I have the honor to submit the following report of operations for "Improving mbia River at Cascades, Oregon," for the year ending June 30, 1892.

sumed local charge of the work on November 14, 1891, relieving First Lieut. Ed. Burr, Corps of Engineers, on that date. At the time I assumed charge it was the end of the working season, but the work was in full progress, with every-g running smoothly and systematically.

river and harbor act approved September 19, 1890, appropriated $435,000 for ing this improvement, and the approved project for the expenditure of this priation calls for the completion of the masonry of the lower lock and guard s, and the building of the lock wall and the masonry of the upper lock gates on land side to the height of about 26 feet, with allowance for necessary additional avation, and for plant, operating, and incidental expenses; the work to be done hired labor and the purchase of material.

uring the winter and early spring of 1891 work had been carried on under the ap-oved project, and up to the end of June, 1891, the work had been the construction the south wall of the masonry of the lower lock and guard gates, together with necessary excavation, stone cutting, preparation and repair of plant, and all other rations incidental to this work. Preparation had also been made for commencing north wall masonry for these gates, including the cleaning up of the foundation shifting tracks and derricks, both in the pit and overhead. The work was in gress when the annual rise in the Columbia River caused a suspension of all work he pit on May 4, 1891.

t the beginning of July then there was no work in progress except stone-cutting, overhauling and repairing plant.

he river commenced to fall in the early part of July, and preparations were made paratory to pumping out the pit as soon as the water should be low enough. The er having fallen sufficiently the pumps were started on August 1, and the water s practically out of the pit by the evening of the 7th; but on account of the leak the bulkhead the water was troublesome for about two weeks, until the river had len some 5 feet or more, to about 85 on gauge No. 2.

s soon as the water was out of the pit (August 8) preparations were begun for uming the work of concreting and stone-setting in the north wall of the masonry the lower lock and guard gates. Concreting was commenced August 19, and stone-ting August 22.

The quarrying had been commenced on July 17th and work in the sand pit on gust 14, so that on August 22 the work was in full progress again.

From August 22 until October 16 the work of concreting and stone-setting was afined to the north wall of the masonry of the lower lock and guard gates. This ll was practically completed on October 16, and the shifting of the derricks, en-nes, and tracks to their positions for work on the south (or land side) wall of the k chamber commenced. These changes were completed on the 19th, and concre-g and stone-setting were commenced in the south wall on the 19th and 21st, respec-ely. A length of about 300 feet was put under construction and completed to ference 108, both concrete and stone, on December 5, 1891.

As soon as the wall was finished the laying up of the plant commenced. Engines d derricks were taken out of the pit, the pump stand moved into position for mping after the next high water and weighted down, the inclined trestle and ack in the pit weighted and the work suspended for the winter.

The excavation for the extension of the south wall of the lock-chamber wall was mmenced on October 30 and carried on until December 16.

The excavation was not quite completed, but as all other work was stopped and e weather very unfavorable it was not considered advantageous to finish the exca-ation at that time.

The work in the sand pit was suspended December 5, in the quarry November 16, d stone-cutting December 11, 1891.

The office force was moved to Portland December 19, and the work left in charge the overseer and the necessary watchmen.

The office force was employed in Portland in the preparation of the reports and timates of the last season's work, in the preparation of the detailed drawings of the asonry of the upper lock and guard gates, and of the shop drawings of the lower ck and guard gates, until April 4, 1892, when it was again moved to Cascade ocks.

As soon as the weather was favorable in the spring, 1892, preparations were made r the resumption of quarrying and stone-cutting. No attempt was made to lay ncrete, as the funds remaining from the last appropriation would have been com-letely exhausted in about a month by the force necessary to carry on that work.

Quarrying and stone-cutting were both resumed on April 8, 1892, and have
carried on continuously since. The stone-cutting during the spring has been m
on the dimension stone for the masonry of the upper guard gate.

The work then, for the year ending June 30, 1892, has been the construction
north abutment of the lower lock and guard gates, the construction of about 3
of the south wall of the lock chamber, the excavation necessary to complet
wall, quarrying and cutting stone, the repairs of plant, and all other operation
dental to this work.

The condition of the work on June 30, 1892, is, in general terms, as follows:

The lower canal walls have been completed to reference 90 from the abutm
the lower guard gates nearly to the lower bulkhead, the completed length
south wall being 238 feet and the north wall 275 feet, the abutments of the
lock and guard gates have been completed to reference 108 on both sides of the
the south (land side) wall of the lock chamber has been completed to referen
for a length of about 345 feet; the south wing wall of the upper guard gates ha
completed to reference 124 for a length of about 97 feet; the upper canal wall
been nearly completed from the site of the upper guard gates to the upper bulk
the slope outside the berm on the north side of the canal has been paved fro
lower bulkhead to beyond the center of the lock chamber, a distance of, ap
mately, 800 feet, and from the upper bulkhead down a distance of a little les
300 feet; on the south side of the canal the slope has been paved from the lower
head to the lower lock gates a distance of about 600 feet, and from the upper
head nearly to the upper guard gates, a distance of about 500 feet; the excavat
the lower canal from the lower bulkhead to the lower guard gates has been p
ually completed; the excavation in the lock chamber has been completed, ex
feet left on the bottom to be removed just before putting down the concrete floo
excavation for the abutments of the upper lock gates has been partially comp
and from the site of the upper guard gates to the upper bulkhead the bulk c
excavation has been completed.

The work already accomplished, exclusive of all incidentals, such as the con
tion of temporary protection works, quarters, shops, etc., and the establishme
a complete plant for carrying on the work rapidly and economically, is app
mately as follows:

Excavation:		
Earth and loose rock	cubic yards..	16
Bed rock (conglomerate)	do....	23
Total	do....	40
Masonry construction:		
Granite	cubic yards..	
Basalt dimension stone	do....	1
Basalt face stone	do....	2
Concrete	do....	32
Side walls at entrances (cut basalt facing, rubble backing)	do....	16
Paving slopes (dry rubble)	do....	9
Protection wall on right	do....	24
Total	do....	77,

The work still to be done is approximately as follows:

Excavation:		
Earth and loose rock	cubic yards..	285,
Bed rock	do....	57,
Total	do....	343
Masonry construction:		
Granite	cubic yards..	1
Basalt dimension stone	do....	4
Basalt face stone	do....	4
Concrete	do....	46
Side walls at entrances	do....	31
Paving slopes	do....	19
Total cubic yards		107

materials used during the past year, for both concrete and stone masonry, were me as during the last three months of last year. The character of these materials, roportions, and the plant and methods used in incorporating the concrete, and idling the concrete and stone were so fully and minutely described in Lieut. annual report dated June 30, 1891, that any further description is unnecessary. nly important piece of plant purchased was a pumping outfit, consisting of a centrifugal pump and engine, to replace a similar outfit which had become out by long and continuous use. The only change of any note was made in the ead traveler in the stone yard. In this the power had been communicated from gine to the driving wheels which gave the motion up and down the length of the hrough a worm gearing. The speed was slow and the worm gearing had given trouble, heating and breaking and causing much delay. The worm gearing aken out and replaced by pinions and wheels. The speed up and down the yard a little more than three times what it was before, it takes less steam, and it un without a hitch. The increased speed of the traveler will allow more cut-o be worked under the sheds than has heretofore been possible.

amount of concrete made and placed during the year was 17,899 cubic yards. was all mixed by machinery and placed by chute. Of this amount 836 cubic were placed in the south wing wall of the upper guard gates, and the remainder abutments of the lower lock and guard gates and the lock chamber walls. ost of the concrete in the wing wall was somewhat greater than the average f the whole, due to the greater distance of the wall from the mixers, requiring labor to transfer the concrete from the point of manufacture to the point of use. roportions varied from 1 of cement, 2 of sand, and 4 gravel or broken stone, to ement, 4 of sand, and 8 of gravel or broken stone, depending on the final dis-on of the concrete. The proportion 1:2:4 was used in the foundations of the and in the bottom of the canal in stopping leaks in the bed rock; the propor-.:3:6 for the lower 14 feet of the lock walls and lower 10 feet of the abutments, ear the top of the walls the proportion was reduced to 1:4:8.

naking 17,899 cubic yards of concrete there were used 15,720 barrels of Port-ement, 8,457 cubic yards of sand, 13,984 cubic yards of gravel, and 1,001 cubic of broken stone. The average product was 1.14 cubic yards of concrete per l of cement and 1.19 cubic yards per yard of gravel and broken stone. The ge materials used per cubic yard of concrete were 0.878 barrels of cement, 0.473 yards of sand, 0.781 cubic yards of gravel, and 0.056 cubic yards of broken stone. ement includes such as was used dry, amounting to 136 barrels.

onnection with the concrete, the manufacturing of the culvert pipe was con-d. The pipe was made in sections 3 feet long, 39 inches internal diameter, with 6 inches thick. The concrete was made in the proportion 1:2:4, and the gravel assed through a half-inch screen.

enty-seven sections of this pipe were made, containing 51 cubic yards of concrete. otal cost was $654.51, and the cost per linear foot was $2.83. The cost of set-he pipes is included in the cost of setting stone.

sand and gravel for the concrete were obtained from the same pit as last year. roportions of the two materials varied somewhat at times, but as a rule the rtion of gravel ran higher than it did when the pit was first opened. This was vantage, as it required proportionally less crushed stone, and the gravel, as 1 in previous reports, makes a better and cheaper concrete than the broken

estimated quantity of 15,457 cubic yards (in place) of material was taken from it. After washing and separating there were obtained from this material 8,712 yards of sand, and 13,984 cubic yards of gravel, which were used in the manu-re of the concrete or for making mortar; and in addition 1,035 cubic yards of es were rejected by the screens and used for filling behind the lock walls. The ge cost of sand and gravel in the bins, after washing, was 71 cents per cubic

hand, June 30, 1,403.0 cubic yards of cut stone, 457.2 cubic yards of rough basalt, and 1,688.2 cubic yards of stone similar to that which was recut.

Cost in detail of stone laid.

Items.	Granite.		Dimension.		Face.		Culvert.		Canal.		Total.
		Cubic yds.		*Cubic yds.*		*Cubic yds.*		*Cubic yds.*		*Cubic yds.*	
Transporting	$181.03	.542	$352.84	.542	$1,085.68	.542	$36.31	.542	$140.92	.542	$1,796.78
Setting	755.77	2.263	1,473.07	2.263	4,532.56	2.263	151.61	2.263	588.33	2.263	7,501.34
Cement and sand	230.83	.691	449.93	.691	1,384.38	.691	46.31	.691	25.50	.698	2,136.95
Stone	24,644.28	73.780	17,583.09	27.009	39,276.41	19.607	......	......	704.50	2.710	82,208.28
Other materials	499.33	1.495	973.25	1.495	2,994.65	1.495	100.17	1.495	388.70	1.495	4,956.10
Total	26,311.24	78.771	20,832.18	32.000	49,273.68	24.598	334.40	4.991	1,847.95	7.108	98,599.45
Plant dropped	346.53	1.038	274.55	.422	649.40	.325	4.42	.066	24.42	.094	1,299.32
Engineering and superintendence	583.85	1.748	462.57	.710	1,094.14	.546	7.44	.111	41.15	.159	2,189.15
Incidentals	4,548.19	13.621	3,603.42	5.535	8,523.39	4.255	57.98	.866	320.61	1.231	17,053.59
Aggregate	31,789.81	94.138	25,172.72	38.667	59,540.61	29.724	404.24	6.034	2,234.13	8.592	119,141.51

Stonecutting was in progress at the beginning of July, 1891, and was continued until December 11, with as large a force as could be advantageously worked. Work was then suspended until April 8, 1892, when cutting was again resumed. The work since then has been carried on with about two-thirds the number of cutters that could be worked with the present facilities.

The stonecutters had also been at work during May and June, 1891, while other work was suspended on account of high water. Stone setting did not begin until August 22, but even with nearly four months' cutting ahead, the setting progressed so rapidly that at the beginning of December the masons had very nearly caught up with the cutters. The cutters were also helped by using some of the stone which had been cut in previous years, for use in the side walls of the entrances. The stone selected was of the proper rise and the beds and joints were already cut, but the face had been left rough. All the cutting necessary to fit this stone for use was to cut the face down to rough punched.

Nearly all the stone for the lower lock and guard gate abutments had been cut previous to July, 1891, so that the cutting of last fall was confined principally to face and dimension stone for the lock-chamber walls.

Since the work was resumed in April the cutting had been confined, as far as possible, to the dimension stone for the abutments of the upper lock gate. The dimension stones for one abutment are now almost all cut ready for laying.

The character of the stone and of the cutting were the same as last year.

The following summary gives the details of the cutting for the year, both as to quantities and cost:

	Granite.	Dimension basalt.	Basalt face.	Total.
Stone cut ... number	76	1,486	2,647	4,209
Stone cut ... cubic feet	2,073.8	27,116.8	50,019.3	79,209.9
Stone cut ... square feet	4,262.4	53,575.9	83,689.4	141,527.7
Stonecutters' labor ... hours	2,770	29,964	29,669	62,403
Average per hour ... cubic feet	.75	.91	1.69	
Average per hour ... square feet	1.54	1.82	2.82	
Cost for cutting ... per square foot	$0.50	$0.44	$0.30	
Cost for cutting ... per cubic foot	1.03	.86	.45	
Cost for stone ... do	1.36	.32	.29	
Total cost ... do	2.39	1.18	.74	
Total cost of stone cut	4,949.37	32,208.37	33,895.99	$71,053.73

The quarry work was carried on to supply the basalt required for face and dimension stone. The quarrying during the year has been done on the land adjoining the canal grounds on the east, the privilege for which was obtained last year. During the year there were obtained 2,110.5 cubic yards of dimension stone and 603.9 cubic yards of rubble. No rubble was hauled in from the quarry during the last six months as the storage ground for this stone had become very crowded and it will be cheaper to leave it at the quarry until such time as it may be needed than to haul in saw and rehandle it, as much as would be necessary. As the rubble split out inc dentally with quarrying, the dimension stone during the spring was not hauled from the quarry, no account is made of it. This increased the cost of the dimensi stone somewhat as all the charge for quarrying went to that while heretofore it h been divided between the dimension stone and the rubble.

The total cost of quarrying during the year, including the 14 cents per cubic ya for the quarry right, was $16,505.89. The average cost per cubic yard was $6.08; t cost per cubic yard for dimension stone was $7.25, and per cubic yard for rubble, These items include the cost of transporting the stone to the yards.

The excavation for the year amounted to 8,033 yards. This includes the 2 fe removed under the wall just before putting down the concrete, and the bed rock r moved east of the part of the south wall under construction in preparation for t completion of this wall and the south abutment of the upper lock gate. As the hi water of 1891 did not cover the guard fence at the lower entrance no sediment w found in the canal when it was pumped out. The total cost of the work w $10,087.40, which is $1.26 per cubic yard. The cost here given includes excavati and dumping.

All of the excavated material was used in filling behind the walls. The cobbl which were rejected by the sand washers, to the amount of 1,035 cubic yards, we also used as filling, and in addition strippings from the sand pit to the amount about 462 cubic yards were also used as filling. The total cost of the filling w $2,378.08.

The metal work for such portions of the lower lock and guard gates as are embedd in the wall had been ordered the year before. These were received and embedd in the masonry.

Snubbing hooks for maneuvering and making fast were manufactured and plac in that portion of the lock wall constructed.

The usual office records were kept to supply all desired details of costs and qua tities. The detailed drawings of the masonry are practically completed. The wor ing drawings for the stonecutters for the upper lock gate are all finished and tho for the upper guard gate very nearly so. The details of the gates and the sh drawings are well advanced.

The cost of the work for the year may be summarized as follows, proportionin engineering, superintendence, and incidentals to the various accounts according t their totals:

Concrete masonry	$106,012.(
Stone masonry	119,141.:
Excavating	10,087.(
Lock gates	5,499.:
Maneuvering machinery and appliances	1,721.:
Filling behind walls	2,378.(
Total for lock construction	244,840.:
Plant in excess of that dropped	1,968.(
Total cost for the year	242,871.(

Under the authority granted by the Secretary of War the State of Oregon, by i agents, entered upon the canal grounds during May, 1891, and commenced oper tions upon the construction of a portage railroad. The road was finished duri September, and the first boat reached the upper end of the road September 15 a the lower end September 20. The boats in connection with the road commenced ru ning regularly September 22 and continued until January 12, 1892, when they we laid up on account of the cold, stormy weather and the ice in the river between he and The Dalles. The boats began their regular trips again February 14 and co tinued until May 16, when the lower boat was taken off on account of high wat No transferring by the road has been done since. When the lower boat stopp running in May the river stood at 92 on the lower gauge, just 20 feet above assum low water. The boat was taken off more on account of the danger and difficulty making a landing than on account of the difficulty of reaching the landing pla Although the boat is of small power she had very little trouble in coming up throu the lower rapids, but as she approached the foot of the main rapids she was oblig to keep over near the Washington shore, and to make the landing had to cross t swift current diagonally to the landing place on the Oregon side. The landing all stages is necessarily on the upstream side of the portage incline and at the high stages a strong current sweeps over the lower end of this incline, putting a boat danger of being carried down onto the piles of the incline or being driven heavil against the wharf boat. When the canal is completed and the incline removed, it necessarily will be, this trouble will be avoided and boats can easily ascend t lower rapids and make the lower entrance of the canal until the river is conside ably above the stage at which the boat stopped this year.

ımmary of the weather and water-gauge records is transmitted herewith.
e following drawings relating to the work aro also transmitted:
ɜet 1, showing the work finished and that proposed.
ɛet 2, showing the dates and amounts of the work already done on the lock-
ıber walls and lower-entrance walls.

Very respectfully, your obedient servant,

HARRY TAYLOR,
First Lieutenant of Engineers.

j. THOS. H. HANDBURY,
Corps of Engineers, U. S. A.

U U 3.

ROVEMENT OF COLUMBIA AND LOWER WILLAMETTE RIVERS BELOW PORTLAND, OREGON.

ıe object of this improvement is now to make and maintain a navi-.e channel from the city of Portland, Oregon, to the sea, having a water depth of 25 feet. There is included in this reach 12 miles of Willamette River and 98 miles of the Columbia, measured along the ›-water channel. Before the commencement of the improvement in ›rdance with previous projects the low-water depth of channel at the ılest places was between 10 and 15 feet. At the end of the present · there is a low-water depth of 20 feet throughout the entire dis-·e, except at the points in Cathlamet Bay, where there is but 19 The average rise of the tide in this bay is 7 feet.

ıe original project under which this improvement has been carried with modifications and extensions was adopted in 1877. Some lging work had been done previous to that time. It contemplated a navigable low-water channel having a depth of 20 feet should naintained by means of permanent constructions to protect the ks, contract the rivers in wide places, direct the currents, and con-the amount of water that should pass through sloughs having a imental influence upon the main channel. While these construc-s were being put in place and until their influence was fully de-ped dredging was resorted to in several localities to give a tempo-· relief to commerce. Works of a permanent character have been ted in the Willamette River across the head of Swan Island Chute; ıe head of Willamette Slough, to control the amount of water pass-into that channel; also along the left bank of the river from that t to its mouth, to prevent erosion and excessive widening of the r; also across other sloughs and channels near the mouth of the lamette River, to control its waters and those of the Columbia in vicinity. Permanent structures were placed in the Columbia River St. Helens, Burke Slough, and Martin Slough, all of which have luced very beneficial effects upon the navigable channel in their nity. During the time that these were in contemplation or process onstruction dredging was resorted to to give temporary relief.

ıe amount expended by the United States in this improvement since adoption of the project of July 1, 1877, is $649,805.97. It appears previous to that date $221,780.46 had been expended in various ·ations looking to the improvement of the Willamette and Colum-rivers between Portland and the sea. The aggregate of the appro-tions and allotments, including proceeds from sales of property to r appropriations, up to June 30, 1892, is $889,745.71. In addition his amount the citizens of the city of Portland have in various ways expended a considerable sum, the exact amount of which can not ... assisting to keep open a deep channel to the sea ... available for this work at the end of the present ...

... fiscal year ending June 30, 1892.—The map o... between Cathlamet and Point Ellis, opposite ... was being made at the end of last fiscal year was ... a reach of 24 miles in extent and in the w... A survey of the river at Martin Island, cov... and including the shoal at that point, was mad... During last November a resurvey of the r... extent, at Walker Island was made. These were ... observation of the effects of the works o... constructed at these points. The map o... from the southern limit of Portland to the mouth o...

... last August in the Columbia washed awa... end of the dam at the head of Martin Sl... there was an opening eroded 14... feet deep. This slough and the one just al... were the original cause of the Martin Is... was closed during September and October ... manner: Two rows of piles were d... each row 6 feet from each other. The ... above low water and those of each row conn... and also by longitudinal planks spiked t... and 1 foot apart. Fascines were filled i... and weighted down with r... was placed in front of and below ... Brace piles were pl... The bank wher... for a short dist... The old portion o... material had settled ... average length ... and 8,000 feet of lu...

... by the addition o... The cost of this repair ...

... Swan Island i... of the Chief of E... One rec... was entered ... material in ... this chu... down the channel o... the current over ... The len... two rows of ... each row 6 feet apa... Fascines are plac... the line of the dam ... until they can be ... feet wide and became na... as it approached low water ... Brush with rock to hold it down formed the main part of the dam, the piles preventing any portion of it being washed away. It was the original design that all the piles should be sawed off at a uniform height of 4 feet above low water and connected together in each row by waling pieces bolted to them. As the piles were driven from the north end southward to about the middle of the dam a deposit of sand was made on the lower side, and this built up in some portions 4 and 5 feet above low water. In these portions the waling was either omitted on placed above the 4-foot level. To prevent this deposit from being scoured out at any time a mattress of fascines was put over it and covered with rock. On the south half of the dam where the original design could be carried out, where the waling pieces were bolted on, planks were spiked to the piles on the inside down to low water to prevent stone from rolling out. Fascines were placed between the rows on the top of those already in place and loaded down with rock.

Work was commenced under the contract October 29, and by its terms should have been finished within ninety days from its date. It was pushed as rapidly as practicable, but owing to the river remaining at an unusual height for this season of the year the work could not be finished at the specified time. An extension of time was asked and granted until April 30, 1892. By this time all the material required for the dam was in place according to specifications, excepting that 830 piles remained to be sawed off. The estimated cost of this, at 15 cents each, will be deducted from the retained percentage of the contractors before final settlement is made.

Since the dam was completed it has been submerged by backwater from the Columbia River. Its effect upon the bar at Swan Island would, under this condition, be nothing. The results will be developed after the next Willamette high water.

The following material was furnished in place under this contract:

42,679 linear feet piles, at 14½ cents	$6,188.45
3,016.11 cords of fascines, at $2.65	7,992.69
15,058.69 tons of rock, at 60 cents	9,035.20
69,301.4 feet, B. M., lumber, at $12	831.61
1,769 pounds spikes, at 3¼ cents	57.48
5,230 pounds wire, at 3½ cents	183.05
1,452 bolts, at 30 cents	435.60
Total	24,724.08
Less $124.50 for piles not sawed off	24,599.58

On the 15th of September the chain bucket dredge belonging to the city of Portland, known as the *City Dredge*, with its tender, the tug *Vaughn*, were placed at the Government service, and, after employing the necessary crew, set to work at the Swan Island Bar in the Willamette River. This shoal was at that time giving trouble to deep-sea vessels. The old cut had not been entirely cleared out to 20 feet depth during the preceding season. Dredging operations were continued at this point until the end of October, when the dredge and outfit were returned to the city authorities and by them turned over to the Port of Portland Commission for work elsewhere. The total amount of material removed from Swan Island Bar during the season was 21,860 cubic yards, at a cost of 12½ cents per cubic yard, including repairs and all other expenses.

A project for improving the Lower Willamette and Columbia rivers so as to secure a navigable channel having at low water a depth of 25 feet from Portland to the mouth of the Columbia, was called for by the river and harbor act approved September 19, 1890. The report upon

[illegible]

nished April 30. This is all the permanent work in the Willamette River, called for by the project. Since their completion the dikes have been covered by back water from the Columbia. Under these conditions these dikes will have little or no effect upon the channel. When the Columbia River recedes and they can direct the currents of the Willamette, favorable results may be expected.

In the Columbia River 11,750 feet of diking was built at Walker Island. This was completed May 28.

The 15,000 feet of diking at Snag Island in Cathlamet Bay, called for by the project, is now under contract by the Port of Portland, and in process of construction.

In addition to the above work the Port of Portland has removed with the city dredge 32,725 cubic yards of material from the bar between the foot of Swan Island and St. Johns, leaving at that place a channel 100 feet wide, 21 feet deep at low water; also 40,205 yards from Postoffice Bar, leaving a channel 150 feet wide, 21 feet deep; also 24,650 yards from the bar at Walker Island, leaving a channel 100 feet wide, 20 feet deep.

Of the work called for by the project, there are the additions to the present dike at St. Helens and the dike at Martin Island Bar that have not been commenced, although practically the whole of the dredging is yet to be provided for.

Estimates for the fiscal year ending June 30, 1894.—At the time of writing this report the effect of the work done under the project for obtaining a 25-foot channel from Portland to the sea by the Port of Portland can not be ascertained. The Columbia River is at its high summer stage and over the top of all the dikes, excepting those in process of erection in Cathlamet Bay. Whether this work will have to be strengthened or supplemented with other work in order to attain the object in view can not now be stated. The estimated cost of the work to be done under the project, that has not been entered upon by the Port of Portland, is $303,600. Should $150,000 of this amount be provided for expenditure during the fiscal year ending June 30, 1893, then it will be necessary to provide the remaining $153,600 for carrying on the work during the fiscal year ending June 30, 1894, which amount can be profitably expended during that year.

Money statement.

July 1, 1891, balance unexpended	$61,912.22
June 30, 1892, amount expended during fiscal year	43,752.94
July 1, 1892, balance unexpended	18,159.28
July 1, 1892, amount covered by uncompleted contracts	2,472.40
July 1, 1892, balance available	15,686.88
Amount appropriated by act approved July 13, 1892	150,000.00
Amount available for fiscal year ending June 30, 1893	165,686.88
Amount (estimated) required for completion of existing project	153,600.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	153,600.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

teamers plying on the Upper Willamette, Lower Willamette, Columbia, and Cowlitz rivers, Oregon and Washington.

ame of vessel.	Tons.	Draft.	Name of vessel.	Tons.	Draft.
		Ft. In.			Ft. In.
'o. 2	150.51	2	Manzanilla	129.87	3
	41.28	4	Maria	184.58	3
	85.26	1 8	Mascot	199.46	3
	213.52		Mayflower	23.00	
	189.68	2 3	Messeng	54.53	
	6.61		Michigan	597.19	13 6
t	20.35	10 9	Milwaukee	29.70	2
	76.16		Modoc	337.55	5
	234.24	2 6	Northwest	301.98	1 3
	40.90		No Wonder	235.30	3
	4.99		N. S. Bentley	401.42	1 6
	376.94	6	O. K.	47.76	4 6
	1.05		O. & C. R. R. Ferry	255.92	
lshaw	14.20		Orient	429.76	5
	10.64		Ocean Wave	507.34	
ch	17.07		Ocklahama	394.19	6
	106.45		Oregon	1,642.28	20
Kalama	2.33		Oswego	21.43	3 6
Frankfort	133.47		Queen	23.75	
a	1,746.14	20	Quinnat	4.20	
	43.55		R. P. Elmore	42.76	8
	19.06	5 6	Regulator	834.88	
:er	566.22		Ramona	114.14	
ity	296.38		R. R. Thompson	912.06	10 6
h	13.47		Rowena	4.50	
	60.36		Rush	12.38	
	25.03		R. Miler	41.39	
yer	24.44		R. C. Young	84.85	
	37.01	7 6	Sarah Dixon	278.84	
	82.38		Sakana	3.84	
	16.51		State of California	1,260.06	20
	420.54		Stark St. Ferry	174.75	2 10
Hayward	456.57		Stark St. Ferry No. 7	299.36	2
se	137.41		S. G. Reed	607.26	8
No. 2	72.92	12	Salem	240.08	1 8
ight	7.93		Salem No. 3	36.00	1 6
	276.41	5	Sea Foam	4.95	
	32.09	5	T. J. Potter	589.60	9
Chance	71.17		Tacoma	1,311.81	
eaver	276.15	2 4	Toiwa	6.27	
Canby	44.48	9	Telephone	413.24	4
r Newell	134.43	1 6	Three Sisters	327.33	1 1
Moon	56.15	1 6	Toledo	206.72	1 5
Queen	697.04	6	Tonquin	18.61	5 6
	129.58	2 9	Undine	280.48	3
	213.40	2	Victorian	809.17	
	62.03		W. H. Harrison	52.86	
	36.84		Wenona	34.67	
est	7.68	5	Western Queen	74.72	
ay	194.74	4	Willamette Chief	523.92	6
. Stephens	26.40	5 4	Willapa	249.52	
Kellog	272.12	2 2	Willowa	92.05	
as	9.66		Wm. M. Hoag	431.13	1 6
Vaugn	21.64	6	Wilmington	752.07	
	23.72	10	Young America	42.10	
	338.38	6			

U U 4.

)VEMENT OF WILLAMETTE RIVER ABOVE PORTLAND, OREGON.

project for this improvement was adopted in 1878. It consists gging operations, bar scraping, contraction of water over shoals, ock removal, with the object of giving easy navigation for lightboats from Portland to Eugene City, Oregon, a distance of 172

The mouth of the Yamhill River, 40 miles above Portland, was ead of an inconvenient low-water navigation in a draft of 2½ feet; foot could be carried above.

ring the low water of last season boats drawing 18 inches could ascend as far as Corvallis.

The total amount appropriated for this work to the end of the year since the present project was adopted is $124,000. At the commencement of the present fiscal year there was a balance on hand $6,464.42.

Work done during the season.—The work done during the season consisted of snagging operations, covering the river from Portland to gram Bend, 2 miles below Harrisburg, a distance of 150 miles, and concentrating the water over shoal places by closing chutes and building wing dams. This work was done by the crew of the United States snag boat *Corvallis*. The boat was outfitted early in July with usual snagging and bar-scraping appliances for shallow streams. In addition it was provided with a moveable set of gins and a hammer for pile-driving purposes. It left Portland on the 6th of July in charge of Capt. George Raabe, who for many years has been engaged in navigation upon this river and is thoroughly conversant with all its difficulties, and knew well where work with the limited funds available could be done to the best advantage.

The boat proceeded up the river as far as the stage of water would permit, removing only the most troublesome snags. Arriving at the upper end of the course near Harrisburg July 20, it then dropped back making a more thorough cleaning out of the snags. The remainder of the month and the first week in August were occupied with snagging work above Corvallis. A good channel was cleaned out in this reach which will extend the period of navigation here fully a month.

The remainder of the season, which closed September 20, was spent in operations below Corvallis. In the vicinity of Weston there were several places particularly troublesome at low-water stages; these were improved by building low dams made by driving short piles into the sand to a depth of 5 or 6 feet at intervals of from 6 to 10 feet and placing against these small logs and brush weighted down with gravel, rock, or whatever heavy material might be near at hand. At Chapman Bar a wing dam of this character was built 500 feet in length; also one at Brentano Slough 215 feet in length; also one at Candiani Bar 225 feet long. The result of these was to concentrate the water and give immediate relief in this part of the river.

During the season there were 577 snags removed.

The work done by Capt. Raabe seemed to give satisfaction to those engaged with him in the navigation of the river. It resulted in giving 2½ feet at low water as high up as Salem, and extending the period of navigation above that point fully a month. This work, however, is temporary, and in the nature of things much of it may have to be done over again.

The whole of the funds available for work under this appropriation was not expended at this time, when it might have been to good advantage to the upper portion of the river. A small proportion was held in reserve to relieve any urgent necessity that might arise upon the river below Oregon City.

Estimate for the fiscal year ending June 30, 1894.—If these wing dams and dams at the heads of chutes which are put in to serve the purpose of temporary emergencies during low water could be made stronger and more permanent so as to resist the high-water flow, more satisfactory progress could be made in the improvement of this river. In order to provide for the immediate and urgent needs of navigation during low water, the small amounts usually appropriated must be spent in the manner described in temporary work at many places. An appropriation of $60,000 in one sum would permit this to be made permanent, and after that yearly appropriations of from $10,000 to $12, would keep the river in reasonably good boating condition during the low-water season.

The amount of commerce on the river and the economical prosecution of the work to be done seem to justify an appropriation of at least $60,000 for the fiscal year ending June 30, 1894.

APPROPRIATIONS.

Act of—		Act of—	
March 3, 1871	$16,000	March 3, 1881	$15,000
March 3, 1873	3,000	August 2, 1882	5,000
June 23, 1874	7,500	July 5, 1884	10,000
March 3, 1875	25,000	August 5, 1886	10,000
August 14, 1876	20,000	August 11, 1888	29,000
August 18, 1878	20,000	September 19, 1890	11,000
March 3, 1879	12,000		
June 14, 1880	12,000	Total	195,500

Money statement.

July 1, 1891, balance unexpended	$6,464.42
June 30, 1892, amount expended during fiscal year	3,350.49
July 1, 1892, balance unexpended	3,113.93
Amount appropriated by act approved July 13, 1892	*30,000.00
Amount available for fiscal year ending June 30, 1893	33,113.93
Amount that can be profitably expended in fiscal year ending June 30, 1894	60,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

This river is in the collection district of Willamette and Oregon. The ports of entry are Portland and Astoria, Oregon. The nearest light-house and works of defense are at the mouth of the Columbia River.

Statement of Upper Willamette River traffic for year ending June 30, 1892.

The following figures are furnished by the transportation companies doing business on the river.

	Tons.
Passengers (111,566)	8,367
Grain	14,894
Lumber	818
Live stock	314
Coal	251
Wool	368
General merchandise	45,860
Total	70,872

U U 5.

IMPROVEMENT OF COWLITZ RIVER, WASHINGTON.

The project for the improvement of this river, which was adopted in 1882, contemplates the removal of sand bars, rocks, snags, overhanging trees, and other obstructions in the channel from its mouth to a point about 50 miles above. Work has been done to Toledo, 30 miles above the mouth. The ruling depth at low water prior to this was 14 inches. It is now 30 inches when the low water can be kept concentrated on one or two troublesome bars. The original estimate was $5,000 for the first year and an annual expenditure thereafter of $2,000 per year. The total amount that has been appropriated for this work is $19,000.

*Of which $3,000 is to be used in improving Yamhill River.

... this river September 23, and ... Her operations extended to ... removed from the chan... Turtle River Bar. I... downstream an... at that place ... gravel, with logs an... was done by the cre... of a rise in th... that time.

... the river again Jun... of wing dams ... the purpose of increasin... the year. June 3... the balance of th...

... effective, and ... above Olequ... Northern Pacific Railwa...

... with the pr...

... 219

U U 6.

IMPROVEMENT OF YOUNGS AND KLASKUINE RIVERS, OREGON.

The project for this improvement contemplates the removal of snags, sunken logs, and overhanging trees from Youngs River as far up as the lower end of the cut-off, a distance of 7 miles; and also from the channel of the Klaskuine as far up as Kamms Wharf, a distance of 2 miles. The latter river empties into the former 6 miles above Youngs Bay.

The estimated cost of this improvement was $1,600. The total amount appropriated for the work $1,600. The total amount expended $1,206.79, which has resulted in a channel of 7 feet depth at high tide to the limits named. The balance now available, $393.21, will be sufficient to complete the project. No further appropriation is asked.

Money statement.

July 1, 1891, balance unexpended	$393.21
July 1, 1892, balance unexpended	393.21

U U 7.

GAUGING WATERS OF COLUMBIA RIVER, OREGON AND WASHINGTON.

The object of these gaugings is to ascertain and keep a record of the fluctuations of the Columbia River with the view to gathering information that may be useful in works of improvement on the river, and also by gauges established at various points to indicate to pilots, captains, and others interested in navigation the stage of water on crossings and places of difficult navigation.

A self-registering tide gauge has been in operation at Astoria, Oregon, and one at Cathlamet, Wash., during the entire year.

Daily sheets from the Astoria gauge were exhibited on a bulletin board in that city. These show the stage of water and condition as to roughness on the bar at the mouth of the river and are of great service to commerce.

It is estimated that $1,500 can be profitably expended in this work during the fiscal year ending June 30, 1894.

APPROPRIATIONS.

August 2, 1882	$500
July 5, 1884	1,000
August 5, 1886	1,000
August 11, 1888	2,500

Money statement.

July 1, 1891, balance unexpended	$962.32
July 30, 1892, amount expended during fiscal year	516.00
July 1, 1892, balance unexpended	446.32
Amount that can be profitably expended in fiscal year ending June 30, 1894	1,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

U U 8.

[illegible] No. 28, Fifty-second Congress, first session.

[illegible] OF WILLAMETTE RIVER, OREGON, FOR [illegible] NAVIGATION AT CLACKAMAS RAPIDS AND ROSS [illegible] CITY OF CORVALLIS.

UNITED STATES ENGINEER OFFICE,
Portland, Oregon, November 19, 1890.

GENERAL: To comply with your letter of September 20, 1890, direct-[illegible] to make preliminary examinations and reports upon certain [illegible] and bays, provided for in the river and harbor act approved September 19, 1890, with a view to ascertaining whether or not they are worthy of improvement by the General Government, I have the honor to report as follows upon—

Willamette River [illegible] improvement of navigation at Clackamas Rapids and Ross Island and near city of Corvallis.

The falls of the Willamette are located on that river about 12 miles above the city of Portland, Oregon. Around this immense water power there is gradually being built up large manufacturing establishments and commercial interests. There are also large interests invested along the river between the two places, notably the iron manufacturing establishment at Oswego. There is communication by water between Portland and Oregon City at Willamette Falls. At low water boats drawing more than 3 feet can not ascend to Oregon City, and those drawing more than 6 can not ascend to Oswego. In this portion of the river the two formidable obstructions to greater draft boats are the bars at Ross Island and Clackamas Rapids. The Ross Island bar is near the upper or southern limit of the city of Portland. It is caused by a widening of the river bed in this locality, which disperses the waters, diminishes the flood velocities, and causes a deposition of the heavy material carried along. It will be practicable to improve this bar within reasonable limits of expense to such an extent that vessels drawing 10 feet or more can pass over it at low water. This would be of great assistance to the large interests that are being developed along this reach of the river.

The river and harbor act approved September 19, 1890, appropriates [illegible] for improving Willamette River above Portland, "of which sum [illegible], or so much thereof as may be necessary, may be used, [illegible] of the Secretary of War, for improvement of the river [illegible] Rapids and Ross Island." In my project for the ex-[illegible] thus appropriated, which was submitted under [illegible], 1890, and has been returned to me approved, [illegible] survey of the Willamette River in the vicinity [illegible] of this survey has been done, and as [illegible]

additional surveys and investigations will be necessary at this
n order that plans and estimate of cost of the improvement
ry may be made. For this purpose I recommend that an allot-
$400 be made from the funds available for examinations and
. The present commerce of the river is about 50,000 tons. As
is invested at the falls and at other localities along the river
this commerce will of course increase, and this increase will be
or less, according as the river is in a more or less navigable
m.

ity of Corvallis is located on the concave bank of a sharp bend
Villamette River. For some years past the river has been erod-
banks in the bend next above this and has been threatening a
which if permitted to take place would leave Corvallis some 2 or
from the river. A portion of this eroded bend has been pro-
y the General Government at a cost of $12,500. During the
ter of the Willamette of last February the Corvallis Board of
ras greatly alarmed lest this cut-off would then take place, as
volume of water was escaping through the fields and across the
land opposite the city. Some efforts were then made to obtain
sional action in the matter, but nothing could be done. The
nt so far as it extended protected the bank, but erosion con-
above it. It is necessary in the interests of the commerce of the
ette River that this locality receive further special attention at
ds of the Government. Before deciding what is best to be done
l survey covering about 5 miles of the river should be made to
n what is the extent of the change that has taken place here
recent years and what are the real probabilities of a cut-off.
ata necessary to the formation of plans and estimates for the
quired should be collected. For this work there should be
$1,000.

Willamette River at Clackamas Rapids and Ross Island and
e city of Corvallis I believe, for reasons stated herein, to be
of improvement by the General Government, and so report,
ving made personal examination at these localities.

Very respectfully, your obedient servant,

THOS. H. HANDBURY,
Major, Corps of Engineers.

Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

ugh Col. G. H. Mendell, Corps of Engineers, Division Engineer,
Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
San Francisco, Cal., November 21, 1890.

ctfully forwarded.

Villamette River at the three points named—Clackamas Rapids,
land, and Corvallis—is considered to be worthy of improvement.

G. H. MENDELL,
Colonel, Corps of Engineers,
Division Engineer.

[illegible] IMPROVEMENT OF WILLAMETTE RIVER AT ROSS ISLA[illegible] OREGON.

UNITED STATES ENGINEER OFFICE,
Portland, Oregon, September 30, 18[illegible]

[illegible] with your instructions based upon the [illegible] river and harbor act approved September 19, 1[illegible] [illegible] following project for the improvemen[illegible] [illegible] River at Ross Island. This island is located near [illegible] Portland, where the river suddenly wi[illegible] [illegible] and then becomes contracted again to 1[illegible] [illegible] 2 miles. There are here two isla[illegible] [illegible] three channel ways, each about 800 [illegible] there is a low flat gravel bar. At [illegible] stages all the water discharged by the river passes dow[illegible] [illegible] At stages above this the other two carry off [illegible] water, and at extreme high stages the island[illegible] [illegible] As a result of these topographical conditions the dep[illegible] [illegible] navigation is not as great in this portion of the [illegible] and immediately above where 18 feet a[illegible] [illegible] as the ruling navigable depth. In the [illegible] where all the water is to be found during the low stages, [illegible] limits the draft of vessels to 7 feet.

In this locality the high water of February, 1890, which is p[illegible] [illegible] record, reached a height of 30 feet [illegible] The volume of discharge at low-water s[illegible] [illegible] cubic feet per second. The extreme rise an[illegible] [illegible] feet.

[illegible] the river bed in this locality is sa[illegible] [illegible] great resistance [illegible] [illegible] material.

[illegible] this locality a consi[illegible] [illegible] map coveri[illegible] [illegible] surveys made in the [illegible] navigation [illegible] surveys wa[illegible] [illegible] the Chief of Engineers [illegible] 1888, the changes that hav[illegible] [illegible] sand and gravel have filled in ma[illegible] [illegible] channel ways, and the [illegible] water. As a consequence of th[illegible] [illegible] the west channel, which is n[illegible] [illegible] Although the material here [illegible] considerable erosion ha[illegible] [illegible] expect eventually to [illegible] this shoal. The ruling depth [illegible]

[illegible] vessels that now have occasion to go above th[illegible] [illegible] The Willamette River at this point is [illegible] occasioned by backwater from the ris[illegible] [illegible] extend from the latter part of May to the [illegible] The extreme of this rise has reached 28 feet. Th[illegible] [illegible] rainfall on the watershed of the Willamette, an[illegible]

[illegible] House Ex. Doc. No. 28, Fifty-second Congress, firs[illegible] ly about the end of December. The extreme of this flood n this locality 30 feet. Before the river can reach its ex- ge again, except in case of a sudden freeze up about its head ibject to backwater from the rise in the Columbia. There t four months in the year when vessels of the draft men- t go above this shoal.

l having a depth of 14 feet at extreme low water can be ', this would doubtless meet all the necessities of the pres- '. The project that I recommend for this is to close the ist channel ways or chutes to a height of 4 feet above low row all the water that now passes down these to that height t channel; and to assist the erosion that must follow this o the extent that will be necessary to form a cut 100 feet eet deep. The material of which this shoal is composed compact gravel, the erosion will be slow and the dredging difficult than in the ordinary sand bars. The additional ter that it is proposed to throw down this channel will ntain the depth to which we may dredge and cause it mprove. These two chutes convey, practically, no water stage in the river. At a 4-foot stage they convey fully he total discharge, and at higher stages a larger propor- ean velocity through the west channel with these chutes nearly double what it now is at this stage. The dam closing these chutes will be about 3,000 feet long and as shown upon the tracings herewith. The detailed draw- id the channel that it is proposed to dredge are also shown ie sheet. It is estimated that the dredging to be done to obtain 14 feet at low water will be approximately 26,000

ile above the head of Ross Island and in front of the ood there is a sand bar over which at low water a ruling t is found. The material of this is sand, and can be more than that which forms the obstruction below. A cut ds in length will be necessary here. To obtain a channel and 14 feet deep it will be necessary to remove 12,000 cubic . It is evident that the river bed at this point is too wide natural flow of the water to maintain a channel as deep 'redging will give relief, but to maintain this depth per- oss the bar it may be necessary to build a contracting dike ; in length from one or the other shore in this locality.

ng estimate of the cost of the work here proposed is sub-

eet, at $10	$30,000
,000 cubic yards, at 50 cents	13,000
200 cubic yards, at 25 cents	3,000
t, at $12	4,800
	50,800
	5,100
	55,900

improvements completed vessels of the class considered e Willamette River to Jennings Bar, which is 10¾ miles on Street bridge, Portland. The foot of Clackamas Rap-

. . . miles below the fall . . .

. . . interests that will be be . . . miles above P . . . of the output of the . . . amounts to 75,0 . . . to permit deep-sea vessel . . . improved a large pro . . . products of this com . . . and from the works. . . . process of lightering mu . . . to the extent tha . . . there is every reason to believe . . . advantage and developmen country.

The quarries . . . at present obtained for the the mouth of the Columbia River are located near Oswego. . . . pected that during the present year between 150,000 and 200 will be used. This is transported in barges drawing 9 feet w loaded. Any improvement of the low-water depths over the will be of great benefit to this work. The commerce that benefited by this improvement would seem to warrant that it

Very repectfully, your obedient servant,

THOS. H. HANDBURY,
Major, Corps of En

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. G. H. Mendell, Corps of Engineers, Division Pacific Division.)

[First indorsement.]

U. S. ENGINEER OF
San Francisco, Cal., Octob

Respectfully forwarded to the Chief of Engineers, U. S. . . .

G. H. MEND
Colonel, Corps of Engineers, Division

SURVEY OF . . . RIVER AT CLACKAMAS RAPIDS.

UNITED STATES ENGINEER OFF

ie in the discharge section and the meeting of the current from ackamas. This, of course, causes a deposition of the material carried along by both streams. The Willamette at its lower has not sufficient volume or velocity to carry this material farther The result is a submerged gravel dam over which boats navi- the river must climb in their passage up the river. The pres- f this dam has increased the low-water slope of the river from es per mile, the average from Portland to the foot of the rapids, et and 5 inches per mile, over a distance of about 9,000 feet. The e low-water slope from Portland to Oregon City is 7½ inches per The Clackamas River, coming in nearly at right angles to the nette, has a slope of 12½ feet per mile. We have no data concern- 3 volume of its discharge. At low water it is insignificant, but the rainy season its volume is considerable, bringing down large ties of heavy gravel, as the results show. The low-water dis- of the Willamette is about 15,000 cubic feet per second.

ie fall of the year 1851 an attempt was made to improve naviga- this rapid by building a dam from the left bank at the head of id out into the stream so as to force the Willamette water over right bank where the Clackamas enters, with the design to estab- e channel down that side. This resulted in an entire failure, and ter navigation terminated at this point until a part of the dam moved. The dam was made of brush and gravel, and paid for unds raised by subscription among the citizens of Oregon City. was already too much dam in the Willamette caused by the débris t down by the Clackamas. From time to time portions of this n, which is now entirely submerged at low water, have been re- . The opening through it is now about 200 feet in width with a of 3½ feet at low water. Boats of ordinary power ascend this t all stages of the river. At the extreme low stage considerable is experienced and sometimes the process of lining has to be d to.

onsequence of this débris brought in by the Clackamas a pool is in the Willamette River which extends almost a mile up to the the Willamette Falls. These falls are surmounted by a series locks, having a lift of 10 feet each. These locks and the water of the falls are owned and operated by a corporation existing the laws of the State of Oregon. The lower miter sill of these s located with reference to the low water in the pool so as to give h of 3 feet over it at that stage. Were the whole of this gravel noved, or even so much of it as would accommodate the low-water rge of the river on the same slope that it has from Portland to t of the rapids, there would result a lowering of the level of this low-water stages which might interfere with the passage of boats e lower lock. This, however, will not be necessary in order to im- the navigation for all present wants of commerce.

present low-water channel of the Willamette River through the st part of this bar has an average width of about 300 feet with a f about 1 on 1,000. Its mean depth is 8 feet, excepting in the sec- st at the summit of the rapid where the old dam is located. The here is 500 feet. This channel seems to be all that the low-water the Willamette can maintain against the encroachments of the ater débris from the Clackamas.

problem of improvement resolves itself into two distinct parts, provide a good low-water channel for the Willamette without af- the depth of water on the miter sill of the lower lock at Oregon

The removal of the old dam at the head of the rapids can be effected by charges of dynamite; at the same time the gravel in which it is embedded is loosened and washed away. The cost of this work it is difficult to accurately estimate. It may be approximately given at $3,000. The total estimate of the cost of the improvement in accordance with the project is as follows:

Removal of the old dam	$3,000
Construction of 6,800 feet dike, at $10	68,000
	71,000
Contingencies	7,000
Total	78,000

The traffic to be benefited by this improvement as shown by the information furnished for the year ending June 30, 1891, by the transportation companies doing business on this portion of the Willamette River, was 116,600 tons.

Very respectfully, your obedient servant,

THOS. H. HANDBURY,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. G. H. Mendell, Corps of Engineers, Division Engineer, Pacific Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
San Francisco, Cal., November 2, 1891.

Respectfully forwarded.

The object of the construction is to store in the Willamette River bed gravel brought down by the Clackamas, which is a large stream in freshet, with a steep slope. After a period longer or shorter, perhaps a few years, storage room will be exhausted. A preferable plan, if practicable, is to store the gravel before it reaches the Willamette. It does not appear that an examination showing whether or not this system is practicable has been made. It ought to be made before the project is carried out. An examination may require modification of the project. Subject to this consideration the project is recommended.

G. H. MENDELL,
Colonel, Corps of Engineers,
Division Engineer.

SURVEY OF WILLAMETTE RIVER NEAR CORVALLIS, OREGON.

UNITED STATES ENGINEER OFFICE,
Portland, Oregon, October 30, 1891.

GENERAL: The river and harbor act approved September 19, 1890, provides that an examination and survey be made with the view to improving the navigation of the Willamette River, near the city of Corvallis, Oregon, and also that an estimate of the cost of the necessary improvement be submitted. This duty having been assigned to me by your letter of October 21, 1890, I now have the honor to submit the following report* thereon:

* Map accompanying this report not printed.

[illegible] The effective [illegible]

[illegible] were cleared [illegible] and beneficial with [illegible] the water during the periods of [illegible] of the soil. At the [illegible] was [illegible] between [illegible] of the land during [illegible] This in general is [illegible] considerable resistance [illegible] sand more [illegible] the sand is cleared [illegible] the high water currents have [illegible] The damage is greater [illegible] more settled and more [illegible] The sand [illegible] with well [illegible] that may [illegible] without a [illegible] induces the farmer to [illegible] more than [illegible] $ In the upper [illegible] of this [illegible] making the curve longer. [illegible] obtained from the survey [illegible] appears that the apex of the [illegible] of the average rate of [illegible] feet per [illegible] acres. The [illegible]

[illegible]

with the view to catching drift and checking the velocity of the water when it reached the overflow stage, the idea of this being to assimilate the conditions existing before the trees and underbrush were cut away. The effect of the high water of February, 1890, upon this, and the resulting scouring action of the water in its immediate vicinity, were not such as to warrant the further construction of works of this character. Above the upper end of the revetted portion of the bank there is a hard gravel beach for a distance of about 1,400 feet. This extends back from low water from 50 to 100 feet; then comes the bluff bank from 8 to 10 feet high, eroded more or less at high water. In this locality is the head of a low place in the land through which the water flows at ordinary high stages. Above this for a considerable distance the same gravel bed seems to underlie the bluff bank and protect it from erosion except at the higher stages of water. The profile along this low swale shows that the water commences running through it at the 10-foot stage. At that stage the water is 2½ feet above the top of the bank across the lower end of the slough and is backed up to within about 1,700 feet of the point of overflow at the upper end. The fall is then 10 feet. At the low-water stage the surface of the water in the river is on a level with a point 3,500 feet below the head of the swale. This seems to be filled about the head with coarse heavy material brought in during high water. The evidence that this is enlarging or growing deeper is not conclusive.

The total amount expended by the United States in protecting this bend was $12,496.

From a study of the results of this survey and a personal visit to the ground during high water and again at low water, I can not conclude that there is any danger that the channel of the river at low water will pass over this neck within any reasonable time in the future, or that the city of Corvallis will be deprived of its advantage of water transportation. At high stages of the river the water will continue to pass over these bottom lands as it has done in the past, and no amount of money within reason will prevent it.

The present condition of the river in this vicinity as regards navigation may be classed as very good when compared with many other localities along its course where no improvement is contemplated.

In the first bend above Corvallis we find the lower end of a chute that leads across a narrow neck to the river above. The length of this is 3,000 feet. At a 5-foot stage the water commences to run through this chute. The difference of level in the river at this stage between the head and foot of the chute is 8 feet. It is at present very much obstructed with fallen trees and driftwood. If this were cleared out and the trees and underbrush along its banks cut down for some distance back, it would gradually enlarge and serve as an escape during ordinary high stages for a large portion of the water that now passes down around the bend and over the bottom land in front of Corvallis. This fall of 8 feet in a distance of 3,000 feet will give a very swift current through the chute when it is cleared of the obstructions that now encumber it. The sand and gravel at its head may be expected to be washed away and in time the low-water flow of the river may take this course. This will produce a radical change in the regimen of the river in this vicinity and give great relief to the bend below. Navigation during the low-water stages will probably not be so convenient when this takes place as at present, but in time as the head of the slope is washed down it will be less steep and the velocity of the water diminished.

To the extent of clearing out this chute as indicated abov mend that work be done in this locality, and estimate the co improvement at $5,000.

Very respectfully, your obedient servant,

THOS. H. HANDBU
Major, Corps of En

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. G. H. Mendell, Corps of Engineers, Division E Pacific Division.)

[First indorsement.]

U. S. ENGINEER OFFIC
San Francisco, Cal., November 17

Respectfully forwarded.

If clearance of the chute A B shall result in a cut-off, through its length of 5,000 feet will be 8 feet, being at the rate per mile, whereas the average fall per mile is about $2\frac{1}{4}$ feet. W then, expect development of increased length by erosion of banks great disturbance of the channel. Indeed, if the new river sh lower its slope by development of length it would become unna at the cut-off.

It is not clear that the advantages to be secured can compen the disturbance to result, if the cut-off is to be a result.

It is stated by Major Handbury, in a letter of date subsequent of report, that indications point to a shifting of the low-water from the middle to the east branch. If this shall occur or if it certain that clearance of the chute will not make a cut-off, th tions herein named will disappear.

Subject to these qualifications the project is recommended.

G. H. MENDELL
Colonel, Corps of Engineers
Division Engine

U U 9.

PRELIMINARY EXAMINATION AND SURVEY OF THE LOWER W METTE AND COLUMBIA RIVERS, OREGON, WITH A VIEW OF SEC 25 FEET AT LOW WATER FROM PORTLAND TO THE MOUTH O COLUMBIA.

[Printed in House Ex. Doc. No. 18, Fifty-second Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., October 16, 1

SIR: I have the honor to submit herewith the accompanying of report dated September 8, 1891, by Maj. Thomas H. Hand Corps of Engineers, giving results of a survey of the Lower Willa and Columbia rivers, Oregon, with a view of securing 25 feet at low water from Portland to the mouth of the Columbia, made to comply with provisions of the river and harbor act approved September 19, 1890. A copy of his report of October 6, 1890, of the preliminary examination of the locality is also herewith.

Inviting attention to the accompanying reports of October 14, by the Board of Engineers, and of October 5, by the division engineer, Col. G. H. Mendell, Corps of Engineers, on Major Handbury's report, I have to recommend that the project of Major Handbury, as amended by the Board of Engineers, be submitted to Congress as the project for the improvement of the navigation of the Willamette and Columbia rivers between Portland and the Pacific Ocean, required by the act of September 19, 1890.

The project provides for a channel 25 feet deep. The estimated cost is $772,464.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

PRELIMINARY EXAMINATION OF THE LOWER WILLAMETTE AND COLUMBIA RIVERS, OREGON, WITH A VIEW OF SECURING 25 FEET AT LOW WATER FROM PORTLAND TO THE MOUTH OF THE COLUMBIA.

UNITED STATES ENGINEER OFFICE,
Portland, Oregon, October 6, 1890.

GENERAL: To comply with your letter of September 20, 1890, directing me to make preliminary examinations and reports upon certain rivers and bays with a view to their improvement, provided for in the river and harbor act approved September 19, 1890, I have the honor to report as follows upon—

The Lower Willamette and Columbia rivers, Oregon, with a view to securing 25 feet at low water from Portland to the mouth of the Columbia.

I am familiar with the portion of these rivers mentioned in this item and can safely say that in my opinion they are worthy of being improved as proposed by the General Government. Portland is the principal city of the northwest and is located on the Willamette River, 12 miles from its entrance to the Columbia and 110 miles from the Pacific Ocean. It is at the head of deep-sea navigation on these rivers and has a large and extensive foreign and domestic commerce. A project for the improvement of this reach of these rivers so as to give an available low-water channel of 20 feet has been in process of execution for some years and it is now about completed. Prior to the commencement of this improvement the ruling depth was 12 feet and at that time the depth of water on the bar at the mouth of the Columbia River was from 18 to 20 feet at low water. By reason of the improvement recently effected on the bar, this depth is now 25 feet, with a fair prospect that it will be 30 feet when the works of improvement are finished. The necessities of the commerce and trade of Portland are such that the deepest-draft vessels passing the bar at the mouth of the Columbia River should be permitted to pass to and from that port without lighterage. A low-water depth of 25 feet throughout this reach of 110 miles is a matter of very easy engineering attainment, and I think c obtained at very reasonable expense.

A study of the problem has already been entered upon under instructions of January 11, 1890. For the purpose of continuin surveys and investigations now in progress, I request that I be al from the appropriation made by this act for such purpose, the s $1,500.

Very respectfully, your obedient servant,

THOS. H. HANDBURY,
Major, Corps of Engin

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. G. H. Mendell, Corps of Engineers, Division Engi Pacific Division.)

[Second indorsement.]

U. S. ENGINEER OFFICE,
San Francisco, Cal., February 10, 18

Respectfully returned to the Chief of Engineers.

The Lower Willamette and Columbia rivers are worthy of impr ment.

G. H. MENDELL,
Colonel, Corps of Engineers, Division Engin

SURVEY OF THE LOWER WILLAMETTE AND COLUMBIA RIVERS, O GON, WITH A VIEW OF SECURING 25 FEET AT LOW WATER F PORTLAND TO THE MOUTH OF THE COLUMBIA.

UNITED STATES ENGINEER OFFICE,
Portland, Oregon, September 8, 18

GENERAL: The river and harbor act approved September 19, 1 directs that a project shall be submitted, with an estimate of the co carrying the same into effect, for obtaining a navigable channel in Lower Willamette and Columbia rivers from the city of Portlan the sea, having a depth of 25 feet at low water. Having completed duty which was assigned to me by your letter of September 20, 18 now have the honor to submit the following report.

The navigable water included in this project extends from the railway bridge in the city of Portland to the crest of the bar at mouth of the Columbia River, a distance of 114 miles, measured a the line of the present ship channel. Of this distance 12 miles ar the Willamette River, the remaining in the Columbia.

There is in this reach an aggregate of 10 miles, over which it wil necessary to deepen the channel more or less before a depth of 25 at low water will exist. Four miles of this are in the Willam River and six in the Columbia. The principal localities in which improvement in the present channel depths seem now to be neces are in the vicinity of the head of Swan Island; between the lower of Swan Island and St. Johns and Post-Office Bar in the Willam River, and at St. Helens, Martin Island, Walker Island, Cathlamet I and near Upper Astoria in the Columbia River.

Since a comprehensive study of the subject of this improven could be entered upon, it was necessary to make a resurvey of cer portions of each of these rivers. Our latest complete survey of

Columbia River, between Cathlamet and Tongue Point, dated back to 1867-'68. In this reach the river is excessively wide, its channels variable, and shoals are numerous. This has been resurveyed, and great changes from the conditions shown by the old charts have been developed. For use in this work and also the establishment of harbor lines for the city of Portland, a carefully prepared map of the Willamette River, from its junction with the Columbia to the south boundary of the city of Portland, has also been made. Maps of the other localities where works of improvement contemplated by this project are necessary, have recently been made in connection with the work in progress under the present project to obtain a channel 20 feet in depth at low water. These, with the other information on the files of this office, give the data necessary for our present purposes.

An examination of these maps reveals the cause of the shoal water in these several localities and at once suggests the general principle on which the plan of improvement should be based. In the Willamette River below Portland, wherever the width at low water is greater than 1,400 feet, the available channel is less than 25 feet in depth; and in the Columbia River as far down as the head of Cathlamet Bay, wherever this width is greater than 4,000 feet, the channel depth is less than 25 feet. Throughout Cathlamet Bay and from its head to the ocean, where an excessive width pertains with numerous sand bars, the ebb and flood of the tide play an important part in determining the location and depths of the channels. To examine the localities minutely where improvements are contemplated, we will commence at the Swan Island obstruction and take them in their order going down. At the railroad bridge, 1⅜ miles above the head of Swan Island, the low-water surface of the river is contracted to a width of 600 feet. At this point the water is so encumbered with wharves and other obstructions that there is practically no increase of width as the river rises. The average low-water depth here is 65½ feet, with a maximum of 80 feet. Below this point the river gradually widens and the depth becomes less. At the distance of 1 mile the width of 1,400 feet is reached, with an average depth of 19 feet and a maximum of 34 feet. One-fourth of a mile farther down the maximum depth of 25 feet is reached, and the low-water width of 1,600 feet, and here is where the first trouble begins. At the head of Swan Island the low-water shores are 3,800 feet apart. The water passes the island in two channels. The south channel is wide and shoal, having scarcely 2 feet at low water. The north, which is the main ship channel, is narrow, but has ample depth after the head of the island is passed. Early surveys show that the south channel had from 5 to 7 feet of water in it. This has gradually shoaled up to its present depths. Its low-water cross section is now 2,600 square feet. It is now practically a high-water chute. The cross section of the north channel at the same stage is 11,140 square feet, or four times as large as the south channel. At a 6-foot stage these sections are about equal, each being 16,000 feet.

The plan adopted in 1877 for the improvement of this part of the river so as to obtain a channel having 20 feet depth provided for closing this south channel or chute to a height of 2 feet above low water, thus forcing all the water flowing in the river to that height down the north channel. The conditions with regard to the amount of money available and the pressing necessities for work at other points have at no time since then until now been such that the funds could be spared for closing this chute. In the meantime a channel having 18 and 19 feet depth has been repeatedly dredged through the bar at the head of

per cent more water down the north channe
due to this, with the additional contraction c
from extending wharves out to the new har
in time open a channel of 25 feet depth. T
being difficult to move, it may take some yea
by the unaided erosive powers of the water.
in order to hasten the results after the dam l
channel through this bar to a depth of 22
pected, it will continually improve until at
tained. The material to be removed in order
150 feet wide will amount to 125,000 cubic ya
channel the removal of 236,000 cubic yards
channel having a depth of 22 feet at low wat
to the width at which its natural forces in
seem to be necessary to incur the increased
feet. There is an extreme rise of tide here
water stages of the Willamette, which can
the event of the arrival of vessels drawing m

Leaving this locality the next point at wh
width of river, and with it a less depth than
of Swan Island and St. John. The width
is now 2,400 feet. The velocity acquired
ing through the north channel is sufficien
25 feet for a distance of 2,700 feet below th
this time its force has become exhausted b
the excessive width. The tendency now i
lower end of the chute behind Swan Islan
when the upper end is closed to the heigh
built from the right bank commencing about
end of the island inclining downstream and
feet, thence downstream 3,500 feet, keeping
we keep the water concentrated sufficientl
depth until it reaches the same depth belo
[illegible] to be 4 feet above low water. The am

distance between the 25-foot depths above and below this bar is 11,000 feet.

To effect the desired improvement here I have to recommend that a dike be built perpendicularly from the right bank of the river 1,000 feet long, near the point where the 25-foot depth ceases on the upper side of the bar; a second one 3,000 feet below, 600 feet long, on the same side of the river a little below the head of Willamette Slough; a third one 1,200 feet below, still on the right bank, 400 feet long and inclining downstream, and that a training dike 4,500 feet long be built from the outer end of this downstream practically parallel to the present revetment of the concave bank in this locality and 1,300 feet therefrom. The locations of these are shown upon the tracing herewith. If, after construction, it be found that the distance between the first and second dikes is too great to effect the desired concentration throughout the space, a short intermediate dike can be supplemented. The expense of these will be much less than a long training dike built in 18 feet of water. Being on the convex side of the bend, much more satisfactory results may be expected from them than if otherwise located; these dikes, like the ones previously mentioned, to have a height of 4 feet above low water and to be similarly constructed.

In establishing the degree of contraction necessary to insure the 25-foot depth, I have assumed theoretically that the form of the river bed in cross section to be a segment of a circle having a versed sine equal to the depth required for the channel. Taking the area of the cross-section of the river as I find it I determine the length of the chord for this versed sine when the area of the segment is equal to that of the cross-section. For a 25-foot depth at low water I find that the sections in this locality average about 1,200 feet in width, and for a 29-foot depth at a 4-foot stage the average width is about 1,400 feet. These widths correspond very closely with what would be suggested by an examination of the map where a 25-foot channel is found under normal conditions.

The length of diking required at this bar is 6,600 feet. The amount of material to be excavated in order to obtain a low-water channel 150 feet wide and 22 feet deep is 200,000 cubic yards, and to obtain a 25-foot channel this amount is 375,000 yards.

The foregoing provides for the improvement of the Willamette River to its junction with the Columbia. Proceeding down the Columbia River the first locality that will require especial attention is the bar at St. Helens. Under the present project for obtaining a 20-foot channel a permeable jetty 5,500 feet long has been constructed at this point, having for its object the gradual building up of a sand bar behind it which will concentrate the water in the desired direction and increase its depth in the channel. This is slowly accomplishing its object, but before it can effectually open and maintain a channel having 25 feet depth some additional work will be necessary, looking to shutting off a large portion of the water that now escapes through the dike. This may be accomplished by sinking brush mattresses along the dike and holding these in place with stone. This new work should be brought up to the level of low water. Its cost is estimated at $5 per linear foot, and there is probably 5,000 feet that would require this addition. The amount of material necessary to be excavated here to obtain a 22-foot channel is 12,000 cubic yards; and to obtain the 25-foot channel, 46,000 yards.

Three miles below St. Helens Bar we reach Martin Island Bar. Here the river has a width of 6,000 feet. A portion of the water, estimated to be about one-tenth, was formerly discharged through Burke and

These have ... crossing ... dams which ... water over the ... feet. To prod... to diminish this ... done by constr... Shoal this to ... above low water. ... yards of mate... the removal of 150,0...

...s of improvement ... Walker Island. Here the ... three channels through ... depth of water. From M... Washington shore, to the east ... the Oregon shore to the west ... head of the island and passes ... has a ruling depth of ... of the discharge of ... The average rise of tide here ... has some weight in determ... The earlier charts of this ... this middle channel was ... in the two other channels ... water passing down either ... sort of constraint to preve... intermediate shoal space ... be improved. The ch... by the pilots ... and the sandy shores ... in dark or foggy we... the Oregon side ...

... 25-foot channel is maintained ... landing, 1,600 feet below the ... opposite side of this channel ... at low water. The water that ... at this point must be what ... begins to feel the influence of ... Middle Channel. By restraining this ... and contracting it within the ... so that the 25-foot channel can ... be done by constructing a ... shore and 1,600 feet from it, exte... the crossing of the Middle Channel ... channel is again found ... thence to the head of Walker Isla... ... After this dike ... will take place ... ...wards. The ... ...ted in its passage ... to improve ... height of 6 feet ... The amount of ...

in order to secure a channel having 22 feet depth is 80,000 cubic yards; and to secure 25 feet, 170,000 yards.

Below Walker Island a 25-foot channel may be found until the head of Cathlamet Bay at Jim Crow Point is reached. At this point, which is 29 miles from the crest of the bar, the river commences to widen rapidly, spreading out over numerous shoals separated by channels of varying depths. The width between the mouth of John Day River on the Oregon side and the mouth of Gray River on the Washington side where the widest part is found is 9 miles. Just below this, between Tongue Point and Portuguese Point, it contracts to 4 miles. The main volume of water at Jim Crow Point is divided into two parts, one going down the Washington shore and maintaining the present ship channel along that side for 5 miles farther down, where it crosses over to Tongue Point; the other on being deflected from Jim Crow Point continues in a southwesterly direction, maintaining a 25-foot channel until Snag Island is reached. Here its force is wasted by its being spread out over the adjacent shoals and through smaller channels. Formerly there were two well-defined channels here, one to the north, the other to the south of Snag Island, these joining again below the island. The north channel is now entirely closed, but an opening to the northward is still maintained farther down, through which a large volume of water escapes. At this point the South Channel is shoal. There is a space here of about 3,000 yards length with an average depth of 14 feet, leaving 11 feet to be dredged for a 25-foot channel and 8 feet for the 22-foot channel. After passing this, 25 feet can be carried to a point about 1 mile north of Tongue Point. There is a distance of about 1,000 yards here where dredging may be necessary to give the depth required. At Tongue Point there is a channel leading directly west, having for a short distance at a point near Fort Stevens a least depth of 18 feet, and another passing close around the point and along the shore in front of Astoria. This channel carries greater depths than 25 feet throughout, excepting for a short space just above Upper Astoria. Here the ruling depth is 20 feet.

Following the present ship channel from Jim Crow Point down it inclines south to round the shoal water in the vicinity of Pillar Rock, thence back to the Washington shore, which it follows to the crossing, thence over to Tongue Point. The ruling depth here is practically 20 feet at mean low tide. The average rise of tide is 7 feet.

This channel has the great disadvantage of making a crossing in a wide place in the river bed where the sands are continually working down and changing its direction and capacity. Works erected with the view to holding it in any one position would at times have to contend against the natural inclinations of the river, and would therefore be expensive and uncertain in their results. It would be practicable to force this water to continue down the north shore, and improve the depth of water on that side, should the necessities of commerce warrant the expense. At present the problem is to obtain the depth of 25 feet to the sea by the most practical and economical route, and with the least disturbance of the present existing conditions. Taking the channels in this locality in their different positions as we now find them, and considering the present tendencies of their several courses, together with other facts and interests bearing upon the problem, it would seem best to restore and maintain the one passing to the south of Snag Island. If the water that is diverted by Jim Crow Point into the head of this channel can be continued down and kept from spilling out as it were over the adjacent shoals, and these shoals [illegible] 400,000 cubic yards [illegible]

[illegible] the [illegible] of [illegible],000 [illegible]

[illegible] the [illegible]

[illegible] of [illegible]

[illegible] The [illegible]

[illegible] that before the permanent [illegible]

[illegible] feet of water here. [illegible]

[illegible] 000 cubic yards [illegible]

[illegible] 000 [illegible]

[illegible] before the channel [illegible]

[illegible] 000 cubic yards [illegible]

[illegible]

[illegible]

o that of extreme tide and covered with grass. When this is done the water will be deep and confined to well-defined channels.

We have every reason to believe that at none of the localities where improvement is required will there be anything more formidable to remove from the desired channel than sand, with perhaps an occasional snag or stump buried in it. The undertaking is not formidable in its character nor are there any difficult abstract engineering problems to be solved. It is merely a question of time and money. If the funds necessary for the execution of the project can be supplied as they can be profitably expended the first results will soon be obtained. We are not wanting in examples from experience, which show clearly that if the funds are not so provided the cost will be greatly increased and the time of procuring the desired results will be greatly prolonged. In the meantime the advantages and profits of the improvement are being lost.

On the tracings which are forwarded herewith I have indicated the positions that seem to me to be the most proper in each case considered for the permanent works to occupy. I also transmit a sheet showing the characteristic cross sections of these works as I would recommend that they be built. These works are all of the same general construction differing only in strength and amount of material used per foot depending upon the forces to be resisted at the location where they are placed. They may be briefly described. Drive two parallel rows of piles to a depth of 12 feet into the bottom of the river. The tops of these to be 4 feet above low water, except at Walker Island where they are to be 6 feet. The rows to be from 4 to 6 feet apart, piles in each row 6 feet apart and each pile opposite an interval in the other row. Piles in each row to be fastened together at top with a waling piece bolted to each one, and also by boards at intervals of 8 inches spiked or fastened to them horizontally on inside, extending from top down to 2 feet below low water. Place one layer of 9-inch fascines 15 feet long between the rows of piles, hold down with rock. Place layers of fascines alternately perpendicular and parallel to rows of piles, to any desired thickness depending upon location; sink these with rock and pile rock on top to height necessary on each side; then fill in between rows of piles to top with fascines and weight down with rock. Hold the two rows of piles together by occasional pieces reaching across the interval and spiked to the waling pieces. In some localities a back brace to resist a tendency to overturn may be necessary. By assembling the material in this manner we can in all cases build a structure proportional in strength to the resistance to be overcome, and with the minimum amount of material. The piles serve as a nucleus around which to build and hold the brush and rock in place. Scouring is provided for and repairs are easily made, and additional strength when necessary is easily given.

The cost of these dikes will vary from \$5 to \$23 per linear foot, depending upon location. A careful estimate has been made for those required in the Willamette and Columbia rivers, separately, based upon the present ruling prices for labor and material and our experience in constructing similar works in this locality.

From the approximate estimate that I have made, it appears that about 400,000 cubic yards of sand will have to be dredged from the channel in the Willamette River and 600,000 from that in the Columbia to secure a 22-foot channel, making 1,000,000 cubic yards in all. The distance that any part of this is to be moved need not in any location exceed 2,000 feet.

To insure early and successful results and economy in carrying out the project herein proposed, it is advisable that the amount estimated for its completion be made available before it is commenced, and the erection of the permanent structures should in all cases precede the dredging. Should funds be provided in this manner, there is no doubt but a healthy competition could be engendered for doing the dredging and for delivering the material for the permanent structures in place.

My estimate for the cost of this work is as follows, and contemplates contracting works which will ultimately produce by the natural process of erosion a channel 25 feet in depth at low water; but to hasten this result and, by taking advantage of the tides, secure the benefits of this depth, I estimate for dredging to a depth of 22 feet at low water where this may be found to be necessary.

WILLAMETTE RIVER.

It is contemplated that the expense of closing the chute on the south side of Swan Island will be paid from the funds now available for work under the present project for improvement, and that this work will be done this fall and winter.

Dredging Swan Island Bar:	
125,000 cubic yards, at 15 cents	$18,750.00
Between foot of Swan Island and St. John:	
Diking 4,000 feet, at $10	40,000.00
Dredging 65,000 cubic yards, at 15 cents	9,750.00
Post-Office Bar:	
Diking 6,600 feet, at $8.70	57,420.00
Dredging 200,000 cubic yards, at 15 cents	30,000.00
Total	155,920.00

COLUMBIA RIVER.

St. Helen Bar:	
Additional work necessary to present dike, 5,000 feet at $5	25,000.00
Dredging 12,000 cubic yards, at 15 cents	1,800.00
Martin Island Bar:	
Dike, 2,000 feet, at $9	18,000.00
Dredging 40,000 cubic yards, at 15 cents	6,000.00
Walker Island:	
Diking 13,800 feet, at $10	138,000.00
Dredging 80,000 cubic yards, at 15 cents	12,000.00
Snag Island:	
Diking 15,000 feet, at $11	165,000.00
Dredging 400,000 cubic yards, at 15 cents	60,000.00
Dredging at crossing 1 mile above Tongue Point, 60,000 cubic yards, at 15 cents	9,000.00
Dredging in front of Upper Astoria, 20,000 cubic yards, at 15 cents	3,000.00
Total	437,800.00
Total for both rivers	593,720.00
Add 20 per cent for contingencies	118,744.00
Cost of one dredging machine	60,000.00
Total	772,464.00

The demand for an increased depth of water from Portland to the sea has kept pace with the growth of that city and the development of the country tributary to it. Previous to 1866 the ruling depth at low water was from 9 to 12 feet. Vessels loaded deeper than this in order to reach Portland must take every advantage of high tide and high stages of water in the river. The usual mode of procedure was to bring the vessels either to St. Helen or the mouth of the Willamette River, and lighter as much of its cargo as would enable it to get over the shoal water above. The efforts at improvement were directed to ting a channel to the sea 15 feet depth at low water. This being ained it was followed by a demand for 18 feet and then for 20 feet. ring these times the ruling depths over the bar at the mouth of the lumbia River were from 19 to 22 feet at low water. Vessels draw- more than 22 feet were rarely chartered for this port. In conse- ence of the jetty now in process of construction and nearing comple- n at the mouth of the Columbia River we have now an actual depth 27 feet over the bar at low water with every reason to believe that re will be 30 feet before the end of the year. There is no apparent son why the very deepest-draft vessels may not now be chartered cargo at the city of Portland. If the channel in the Columbia and illamette rivers at the points mentioned in this report be not im- oved to the depth corresponding to the draft of the vessels which ll not exceed 25 feet except in cases so rare that they need not be ovided for, then the vessel must be lightered at Astoria in propor- n as her draft exceeds the depth of the channel. Deep-sea vessels ll always attempt to load as far inland as circumstances of profit will rmit. Lightering at best is an expensive operation, and in these ys of close competition it is desirable in all cases to keep it at a nimum. The demurrage consequent upon this is always a large item expense. The total lighterage to and from Portland during the year ding June 30, 1891, was 24,300 tons. This is growing less each year navigation improves. The rate now paid for lighterage is 50 cents r ton. The average draft of the foreign vessels passing out over the r during the year was 21 feet.

Portland, situated at the head of deep-water navigation, over 100 les inland, possessing great wealth and assured prosperity, is natu- ly desirous that all products and commodities coming to her port or ported from it shall have every advantage of cheap transportation. e value of the exports from the Columbia River during the year end- June 30, 1891, was $6,089,585; the imports, $1,325,400. The gross nage passed in and out over the bar at the mouth of the river, as ported by the collectors of customs at Portland and Astoria, was 23,818 tons. In addition to this deep-sea tonnage there is a local nage amounting to 1,154,294 tons, making a showing of over 3,000,000 s for the Willamette and Columbia rivers between Portland and sea. The total custom-house receipts for last year were $649,531.83. The jobbing trade of the city of Portland for 1890 is estimated to be 31,550,000, against $115,000,000 for 1889; an increase of $16,550,000.

More detailed statistical data bearing upon this improvement will be nd in my annual reports on the improvement of the mouth of the lumbia River and the improvement of the lower Willamette and lumbia rivers, submitted to the Chief of Engineers for the year end- June 30, 1891.

Accompanying this report there are transmitted the following trac- gs.* Columbia River from Cathlamet to Tongue Point; Columbia ver in vicinity of Walker Island; Columbia River in vicinity of Martin and; Willamette River from Portland to its junction with the Colum- , two sheets; one sheet showing characteristic sections of proposed kes.

Very respectfully, your obedient servant,

THOS. H. HANDBURY,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. G. H. Mendell, Corps of Engineers, Division Engi- er, Pacific Division.)

ot reprinted; printed in House Ex. Doc. No. 38, Fifty-second Congress, first session

LETTER OF COLONEL G. H. MENDELL, CORPS OF ENGINEERS, DI[illegible]
ENGINEER, PACIFIC DIVISION.

UNITED STATES ENGINEER OFFICE,
San Francisco, Cal., October 5, [illegible]

[illegible] remarks apply to the report and pro[illegible] [illegible] low-water channel from [illegible] forwarded.

[illegible] THE WILLAMETTE RIVER.

[illegible] the Willamette River is recommended, with t[illegible] [illegible] proposed for Post-Office Bar ought [illegible] parallel instead of perpe[illegible] [illegible] Experience has fully demonstrated that the ge[illegible]

[illegible] RIVER.

[illegible] dike at St. Helens be filled [illegible] feet of water at and beyo[illegible]

[illegible] ISLAND BAR.

[illegible] there is less than [illegible] feet of water is a[illegible] [illegible] inadequate. It i[illegible] [illegible] the Deer Island S[illegible] [illegible] St. Helens is [illegible]

[illegible]

[illegible] BAY.

[illegible]

ponent in this part of the river exceeds the fresh-water drainage. A wide and deep channel in Cathlamet Bay, able to pass the flood without needless retardation, would give a greater rise of tide at all points above, and work improvement in all channels below, including the bar at the entrance. But any channel to be permanent through a wide expanse of sands needs to be maintained by constructions which shall insure a common path for its proportion of the flood and ebb. There have been several channels through this bay, each used for a time, then obstructed beyond the point of convenient navigation, and abandoned for another. There has always been a minimum depth of about 14 to 16 feet somewhere in Cathlamet Bay, which has limited and delayed navigation, no matter where the channel has been. The channel now used is on the north shore, crossing the river to Tongue Point. This has been in use for a number of years. For a long time the channel was in the middle of the bay, varying its position from time to time. The processes by which one channel deteriorates and another is bettered have not been clearly established. It is by no means certain that the sand which obstructs the channel is brought from above, down stream. Nor is it established that the sand is brought from below by the flood tide, although there is good reason to suppose that this is at least partially true. Whatever its direction the movement is in the deepest water. The fact that a portion of a tidal channel lies across the axis of an estuary is, in my judgment, neither a good nor a bad symptom. In selecting a channel for improvement, it is thought that the volume of tidal water as exhibited by the width and depth is a controlling consideration. Another consideration is convenience of navigation. The channel on the north shore is on the whole easier to navigate in dark or thick weather.

Selection of the channel to be improved ought to be made at the time when the works are about to be constructed. In regard to the features of the proposed improvement it may be said that the dredged channel ought, for convenience of navigation, to be straight, and wider than 150 feet. Its curved trace seems to have been adopted to take advantage of a better depth for a short distance. This is not recommended as being really economical.

There seems to be no necessity in these tidal waters to carry construction to a greater height than 2 or 3 feet above low tide.

Subject to these considerations the project, so far as it relates to Cathlamet Bay, is recommended.

LOWER BAY.

Vessels have always passed to and from the ocean below Tongue Point by way of the southern channel which lies in front of Astoria. This channel appears to have deteriorated. It is obstructed in front of Astoria by the Gilman Reef, and by the wreck of the *Sylvia de Grasse* and the rock upon which she struck. These features, together with cross channels leading from the Astoria Channel to the Middle Channel, seem sufficient to account for the dwindling that is apparent from comparisons of channel sections at Smiths Point and others above as far as Tongue Point. Preservation of the capacity of this channel in its former integrity is regarded as an important feature of this system of river improvement. The dredging proposed just north of as well as below Tongue Point are palliatives which may temporarily arrest decay, but it is thought to be insufficient for permanent improvement.

Martins Island, Walker Island, or below, can not
project for the Willamette. Judicious improveme
the influence of the tide at Portland, and thus ir
the Willamette to some extent; but there is nothin
which requires a modification of the works project
River.

It is to be observed that while the project is nc
low stage of river, the estimates are, so far as th
based on a depth of 22 feet, in a narrow channel.
and indeed it is to be expected, that a narrowed se
by natural action, yet it may also be said that
wherever there are other sections situated so as t
ment by deposits of scoured material, to make th
dredging.

The constructions proposed consist of walls of
tion is temporary in character, as the parts alte
will have a life of a few years. A better but mor
would be to make the work all in stone and brush

Inasmuch as these improvements are on the line
ing commerce, it is worth consideration whether
be made permanent once for all.

The estimates, both of values and quantities,
Handbury are accepted without revision.

Very respectfully, your obedient servant.

G.

Colonel, Corps of Engineers,

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

REPORT OF THE BOARD OF ENGI

this is a convex bank, the Board is of opinion that spurs are preferable to parallel works.

In reference to the points of difference at Martins Island Bar the Board is of opinion that the single spur dike proposed is not sufficient. It should be placed about 1,000 feet below the location shown on the tracing, and a longitudinal dike should be constructed from its outer end downstream to give a proper direction to the currents, the length to depend upon the effects while the works are under construction.

At Walkers Island Bar the Board concurs with the division engineer in his proposed modification of the project.

At Cathlamet Bay the Board concurs with the following recommendations by the division engineer:

Selection of the channel to be improved ought to be made at the time when the works are about to be constructed. In regard to the features of the proposed improvement it may be said that the dredged channel ought, for convenience of navigation, to be straight and wider than 150 feet. Its curved trace seems to have been adopted to take advantage of a better depth for a short distance. This is not recommended as being really economical.

There seems to be no necessity in these tidal waters to carry construction to a greater height than 2 or 3 feet above low tide.

Subject to these considerations the project, so far as it relates to Cathlamet Bay, is recommended.

As to making the dikes permanent the Board is of opinion that if sufficient funds are supplied this is, in the end, the most economical.

Respectfully submitted.

HENRY L. ABBOT,
Colonel of Engineers, Brt. Brig. Gen., U. S. A.,
President of the Board.
C. B. COMSTOCK,
Colonel of Engineers, Brt. Brig. Gen., U. S. A.
D. C. HOUSTON,
Colonel of Engineers.
G. L. GILLESPIE,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

U U 10.

[Printed in House Ex. Doc. No. 36, Fifty-second Congress, first session.]

PRELIMINARY EXAMINATION OF COLUMBIA RIVER, FROM THE MOUTH OF WILLAMETTE RIVER TO THE UPPER LIMITS OF THE CITY OF VANCOUVER, WASHINGTON, WITH A VIEW OF ESTABLISHING A SHIP CHANNEL.

UNITED STATES ENGINEER OFFICE,
Portland, Oregon, October 11, 1890.

GENERAL: To comply with your letter of September 20, 1890, directing me to make preliminary examinations and reports upon certain rivers and bays, provided for in the river and harbor act approved September 19, 1890, with the view to their improvement, I have the honor to report as follows, upon:

Columbia River, from the mouth of the Willamette River to the upper limits of the city of Vancouver, with a view to establishing a ship channel.

I am i iar with this reach of the Columbia River, having frequent had my ntion called to the obstructions therein for the removal which a stimate is desired. A call for this estimate was made by resolution of the Senate during its last session, but no funds be available from which the expenses of a survey could be paid, the formation desired could not at that time be supplied.

The difficulty to navigation at this point lies in a sand bar locat between Vancouver and the mouth of the Willamette River, abou miles below. There is but 9 feet on this bar at low water. Were removed vessels drawing 20 feet or more could easily ascend ab Vancouver. The commerce of this city is growing rapidly, and it is improbable that within a short time it may assume considerable p portions. In fact, with the removal of this bar I see no reason w deep-sea going vessels may not habitually load and unload at the do of this city. I regard this portion of the Columbia River as be worthy of improvement al Government, and therefore r ommend that I be auth e the necessary surveys and e mate of costs of the impr oper to be made.

To make this survey plans and estimate of cost, I e mate that the sum of $1 equired.

Very respectfully, nt servant,

THOS. H. HANDBURY,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. C
Chief of Enginee

(Through Col. G. H. Me s of Engineers, Division Enginee Pacific Division.)

[First indorsement.]

PORTLAND, OREGON, *October 13, 1890.*

Respectfully forwarded, recommended.

G. H. MENDELL,
Colonel, Corps of Engineers,
Division Engineer, Pacific Division.

SURVEY OF COLUMBIA RIVER, FROM THE MOUTH OF WILLAMET RIVER TO THE UPPER LIMITS OF THE CITY OF VANCOUVER, WAS INGTON, WITH A VIEW OF ESTABLISHING A SHIP CHANNEL.

UNITED STATES ENGINEER OFFICE,
Portland, Oregon, October 29, 1891

GENERAL: The river and harbor act approved September 19, 18 provides that an examination and survey be made with an estimat the cost of improvement of the—

Columbia River, from the mouth of the Willamette River to the upper limi the city of Vancouver, with a view to establishing a ship channel.

This duty having been assigned to me by your letter of Octobe 1890, and being now completed, I have the honor to submit the fol ing report:

The city of Vancouver, Wash., is located upon the right bank of Columbia River, 103 miles above its mouth, and 5 miles above the m of the Willamette River. There is now practically a 20-foot cha roughout this distance until a point $2\frac{1}{2}$ miles above the mouth of the illamette is reached, where the water suddenly shoals to 9 feet. Passg this shoal, which is about 3,600 feet wide at its narrowest part, a annel of 20 feet depth or more is again found and can be carried above e limits of Vancouver. This shoal is evidently caused by the withrawal from this portion of the river of the large proportion of its water hich passes behind Hayden Island. The upper end of this island is pposite Vancouver. It has a length of $4\frac{1}{4}$ miles and a width of 2,500 et at its widest part, with an average width of about 1,800 feet. Its p is about 18 feet above low water, and is covered during the high ages. The bottom lands in this vicinity on the Oregon side, and also n the Washington side below Vancouver, are also covered during these ages.

The low-water discharge of the Columbia River at this point is aproximately 77,000 cubic feet per second. Of this amount 28,000 cubic et pass behind Hayden Island, and 49,000 down the main channel. hese amounts are the results of rough observations, and may be hanged by more carefully collected data. They are sufficiently near orrect, however, for the purpose of this report. The extreme high ater of 1876 reached a level of 30 feet above the low-water datum. Ve have no data regarding the quantity discharged at that stage. The rea of a low-water section across the head of the slough behind Hayden Island is 25,000 square feet, and that of a section of the main river t its widest place between Vancouver and the mouth of the Willamtte is 38,460 square feet. Immediately above the head of the slough he river has a low-water width of 3,400 feet, with a channel 1,000 feet ide and a depth varying from 20 to 30 feet. Where the slough again oins the main river at the foot of Hayden Island we find the same idth between banks with two channels, one 800 feet wide with depths ver 63 feet, the other 1,000 feet wide, with depths from 20 to 23 feet. he widest distance between banks on the north side of the island here the difficulties to navigation are experienced is 3,200 feet. In his locality there is a sand bar extending out from the right bank and ccupying the middle of the river down as far as the foot of Hayden sland. Portions of this are bare at low water, and on other portions he depths vary from zero to 9 and 10 feet. This is evidently caused y the diminution in velocity and volume of water, due to that which asses behind the island during the low and medium stages of the iver. The sections above the head of the chute and below the foot f the island show that if the low-water discharge of the chute, which s 36 per cent of the total discharge of the river, can be restored to the main channel, there must necessarily be an improvement in the navigable capacity of this channel. Should the slough be closed to a level with the top of the island, the main channel would eventually be scoured out to a section something like what is found below the foot of the island. There is no necessity for this, however, as the channel lepth here is excessive.

As a means of obtaining the necessary depth of water over this obstruction for deep-sea going vessels I recommend that the chute behind Hayden Island be closed by a dam having a height of 4 feet above low rater; this dam to be built of piles, brush, and rock; to have a width f 6 feet at the top and a base from 25 to 30 feet in width in the deepest rater.

The length of the dam will be 3,000 feet. The banks at the two ends hould be protected for a distance of 250 feet against erosion at high

hing the place now is the bar just below the town, which it is pro-
‹l by this project to remove.

Very respectfully, your obedient servant,

THOS. H. HANDBURY,
Major, Corps of Engineers.

rig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

'hrough Col. G. H. Mendell, Corps of Engineers, Division Engineer, ific Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
San Francisco, Cal., November 2, 1891.

espectfully forwarded, recommended.

G. H. MENDELL,
Colonel, Corps of Engineers,
Division Engineer.

U U II.

ABLISHMENT OF HARBOR LINES IN WILLAMETTE RIVER AT PORTLAND, OREGON.

THE CHAMBER OF COMMERCE OF PORTLAND, OREGON,
Portland, Oregon, December 13, 1890.

EAR SIR: I have the honor to inclose herewith memorial of this nber, calling your attention to the necessity of establishing harbor s on both sides of the Willamette River in front of our city. Copies his same have been sent to our Senators and Representatives and pray your earnest attention to the subject.

Very respectfully, etc.,

D. D. OLIPHANT,
Secretary.

he Hon. SECRETARY OF WAR.

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
December 20, 1892.

'espectfully returned to the Secretary of War.

he chamber of commerce of the city of Portland, Oregon, requests Secretary of War to establish harbor lines for the harbor of Port-l, on both sides of the Willamette River, in front of the cities of 'tland, East Portland, and Albina, and as far down the river as St. ns, under the provisions of section 12 of the river and harbor act roved September 19, 1890.

t is recommended that a Board of Engineers be appointed to consider l report upon the subject of harbor lines at Portland within the lim-above designated, the Board to consist of Col. G. H. Mendell, Maj. omas H. Handbury, and Capt. Thomas W. Symons, the expenses r just below the town, which it is pro-

bedient servant,

THOS. H. HANDBURY,
Major, Corps of Engineers.

Y,
U. S. A.

, Corps of Engineers, Division Engineer,

st indorsement.]

U. S. ENGINEER OFFICE,
San Francisco, Cal., November 2, 1891.

ommended.

G. H. MENDELL,
Colonel, Corps of Engineers,
Division Engineer.

U U II.

OR LINES IN WILLAMETTE RIVER AT PORTLAND, OREGON.

COMMERCE OF PORTLAND, OREGON,
Portland, Oregon, December 13, 1890.

honor to inclose herewith memorial of this ention to the necessity of establishing harbor Willamette River in front of our city. Copies sent to our Senators and Representatives and tention to the subject.

, etc.,

D. D. OLIPHANT,
Secretary.

RY OF WAR.

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
December 20, 1892.

rned to the Secretary of War.

commerce of the city of Portland, Oregon, requests Var to establish harbor lines for the harbor of Portes of the Willamette River, in front of the cities of ortland, and Albina, and as far down the river as St. provisions of section 12 of the river and harbor act mber 19, 1890.

nded that a Board of Engineers be appointed to consider rbor lines at Portland within the limo consist of Col. G. H. Mendell, Maj. t. Thomas W. Symons, the expenses of the Board to be paid from appropriation for "improving lower Will amette and Columbia rivers in front and below Portland, Oregon."

With the approval of the Secretary the order convening the Board will be issued from this office.

THOS. LINCOLN CASEY.
Brig. Gen., Chief of Engineers.

[Third indorsement.]

WAR DEPARTMENT,
December 23, 1890.

Approved as recommended by the Chief of Engineers.

By order of the Assistant Secretary of War:

JOHN TWEEDALE,
Chief Clerk.

MEMORIAL OF PORTLAND, OREGON, CHAMBER OF COMMERCE.

PORTLAND, OREGON, *December 8, 1890.*

The chamber of commerce of the city of Portland desires to invite the attention of the Secretary of War to the fact that it is essential to the preservation of the harbor of Portland that harbor lines be established on both sides of the Willamette River in front of the cities of Portland, East Portland, and Albina, and as far down the river as St. Johns.

It is apparent to the chamber of commerce, and it is hoped that it will also be to the Secretary of War, that the different municipalities bordering on the river should be guided in the establishment of wharves, and that all encroachments upon the river should be restrained by some definite plan fixed by authority above them all; also that a plan for the improvement of the river and the fixation of the channel on the northeasterly side of Swan Island should be definitely determined in the general interest of the harbor and of commerce.

The chamber of commerce of Portland therefore prays that the Secretary of War will, in conformity with the authority granted to him by section 12 of the river and harbor act of September 19, 1890, cause to be fixed the harbor lines of the harbor of Portland within the limits above designated.

The Hon. SECRETARY OF WAR.

REPORT OF BOARD OF ENGINEERS.

PORTLAND, OREGON, *May 23, 1892.*

GENERAL: The Board of Engineer Officers convened by virtue of Special Orders No. 88, dated Headquarters, Corps of Engineers, U. S. Army, Washington, D. C., December 24, 1890, for the purpose of establishing harbor lines for the city of Portland, Oregon, has the honor to submit the following report:

The city of Portland is located upon the Willamette River, about miles above its junction with the Columbia and 110 miles inland fr the Pacific Ocean. It is the head of navigation for deep seagoing v sels. The city as at present constituted includes both sides of t Willamette River for a distance of about $4\frac{3}{4}$ miles. In its southern p tion the city limits extend from the west bank only to the middle of t channel for a distance of about $1\frac{1}{2}$ miles north of its southern limit, a in the northern portion these limits extend from the east bank only the middle of the channel for a distance of about $4\frac{1}{4}$ miles south of northern limit. By this arrangement there is a part of the right ba of the river in the southern portion of the city and a part of the l ank in its northern portion that are not at present within its limits. he total length of the river between the extreme northern and southern oundary lines is 10½ miles.

Near the southern boundary the river bed between the main banks is ccupied by two islands, Ross Island and East Island, which divide its aters at the higher stages into three channel ways. These islands re overflowed at a stage about 17 feet above low water. At the low age practically the whole of the water passes down the most westerly nannel. A project is now before Congress awaiting appropriation, hich proposes to close the middle and east channel way to all water up a height of 4 feet, by a dam to extend from the right bank across to e head of Ross Island. This work is projected with the view to improving navigation at this point to a depth of 14 feet.

Near the northern portion of the reach the river bed is divided by wan Island into two channel ways; the westerly one being a high-ater chute now closed by a dam across its upper end to all water elow a 4-foot stage. The easterly channel way is the one used by deep-ea vessels, and in fact all craft coming to Portland from below. Swan sland is overflowed at a stage about 12 feet above low water. At all ther points within the reach under consideration the river flows in a ingle channel way unobstructed save by the wharves and bridges that ave been erected at various points for the accommodation of its comnerce and the convenience of traffic across it. The normal width of he river at a bank full stage is about 1,600 feet. At its narrowest point n its original condition the width was 800 feet. By the construction of bridges and wharves natural widths have been very much encroached upon. At its narrowest point, which is the location of the steel railroad bridge, the river is now but 600 feet wide.

It has been a fortunate circumstance for the adjacent property in times of flood that the bottom of the river is susceptible to erosion. What has been lost in available discharge area by wharf encroachments and bridge piers has in general been compensated for by a deepening of the river. In the heart of the city where the greatest encroachments have taken place depths are now found as great as 95 feet. The low-water discharge of the river is approximately 15,000 cubic feet per second. It has been estimated from rough discharge observations taken two days after the highest water reached in February, 1890, which is the highest of which there is any authentic record, that at the extreme of this flood the discharge was approximately 400,000 cubic feet per second. This flood in the Willamette reached at Portland a height of 28.4 feet above low water. The area of cross section at the steel railroad bridge, which is the narrowest point of the river within the limits of Portland, is at low water 37,825 square feet and at extreme high water 55,000 square feet. The original area of cross section at this point was at low water 29,000 square feet and at extreme high water 50,000 square feet. By contracting the width of the river from 800 feet o 600 and putting in the bridge piers scouring has been induced to uch an extent that the high-water cross section has actually been increased 5,000 square feet, and the average low-water depth increased 7½ feet.

A map of the Willamette River between the extreme north and south mits of the city of Portland, showing the bridges, streets, wharves, nd other features along the banks, has been prepared for the Board. tracing from this map, with the harbor lines recommended for approval marked in red, is herewith transmitted.* The necessary data

*Omitted.

nfluential citizens owning property bordering upon the river and interested in the commerce of the city.

The argument of Mr. George on this occasion was to the effect that, inasmuch as public convenience seemed to demand that free bridges be constructed across the Willamette River in the city of Portland for the purpose of easy communication from one portion of the city to the other, and that these bridges to a certain extent would obstruct free navigation on the river, and their piers and abutments would necessarily occupy a considerable percentage of the cross section available for the flow of the water at these narrow places, which circumstances might tend to increase the overflow on the adjacent property during freshets, the harbor lines should be placed well back upon the adjacent wharves, and it should be required that these, being private interests, should be eventually removed, in order that the evil effects anticipated from the obstruction which the proposed bridge piers will offer to the flow of the water may be made as small as possible. This idea is embodied in a series of resolutions passed by the committee of which he is chairman, and presented to the Board. A copy of these resolutions accompany this report.

At this meeting Mr. R. Koehler, manager Southern Pacific Company, in Oregon, called attention to the fact that the proposed lines as they are located between the steel bridge and East Ankeny street in East Portland would subject his company to serious loss of property and materially interfere with the shipping business transacted at its wharf just above the east end of the steel bridge. Mr. Koehler's views are set forth in a written communication to the Board, copy of which accompanies this report.

Communications were received by the Board from Mr. J. E. Haseltine, owner of the property situated between East Pine and East Oak streets, on the east side of the river, which is crossed by the proposed harbor line; and also from Mr. C. A. Dolph, a part owner and representing the owners of the property directly opposite on the west side, which is crossed by the proposed line. Copies of these communications are herewith inclosed. It is claimed in both these cases that the existing structures do not extend beyond the harbor lines authorized by the city ordinances; that they have been in existence for some years, and were erected at considerable expense to their owners for the accommodation of general shipping business; that to require these to be removed back to the harbor lines proposed by the Board, in order to accommodate shipping at their docks, would necessitate the use of powder to blast away the bottom and bank of the river, which is a hard, compact conglomerate that is not eroded, except with the greatest difficulty, by the action of the water, and that to do this blasting would endanger the stability of the remaining parts of the structure. It is also claimed in all these cases that the projecting portions of the wharves form but a small percentage of what would otherwise be the available area for the flow of the water.

These three cases occur, unfortunately, in the narrowest portions of the river and in the heart of the business portion of the city, where every foot that can be gained which will facilitate the flow of the flood waters is of the utmost importance. In this locality there is already the steel railroad bridge, the piers of which occupy 6½ per cent of the high-water cross section of the river, and plans are now before the Secretary of War for another to cross at Burnside street, about 2,200 feet above this. The piers of this bridge will occupy 9 per cent of the high-water cross section at its locality. Twenty-one hundred feet farther up is the Morrison Street Bridge, and 1,400 feet above this is the Madis Street Bridge. In order to a clearer understanding of the situation this locality the Board has prepared a map on a larger scale, showi these objectionable structures and their relations to harbor lines esta lished by city ordinances and the lines proposed by the Board. this are plotted sections of the river at the points where these whar are located. A tracing from this is herewith inclosed.

In the case of the Southern Pacific Wharf it is observed that if outer line be produced it will intersect the bridge at a point 80 f outside of the eastern abutment. As the north end of this wharf within 35 feet of the bridge the result is to practically diminish the wid of the waterway at this point 12 per cent and the area of cross s tion of the river at high water 6 per cent. The wharf line proposed the Board intersects the axis of the bridge at a point 40 feet inside t outer line of the wharf and 25 feet inside the established city harb line.

The bank at this point is a hard, compact gravel, very difficult to move except by blasting, which breaks it up into its small compone parts, that are easily washed away. The water being extremely de immediately in front, it is not probable that dredging to any conside able extent will be necessary in order to get rid of the blasted materi

At the point on the center line, of East Pine street where the propos harbor line crosses Mr. Haseltine's wharf the shortest distance betwe the dock lines established by the city on the two sides of the river 680 feet. The city dock line, with which the outer edge of this wha coincides, is 60 feet in advance of the proposed harbor lines at the ce ter of East Pine street. By this arrangement the northwest corner this wharf is set back and its abnormal projection into the river rem died. About 9 per cent is gained in the width of the river and abo 3 per cent in the high-water area of cross section.

On the west side of the river and almost immediately opposite t wharf just considered is the third, which projects abnormally into t stream. At this point the river is 740 feet wide between establish dock lines. Originally a dock line was established by the city of Po land between Washington and Pine streets, practically upon the li proposed by the Board; subsequently this was moved out to its prese position, with which the projecting wharf coincides. At the center Pine street this extends beyond the proposed line 40 feet. By setti this line back nearly 5½ per cent is gained in the width of the riv and 2 per cent in the area of high-water cross section.

Respectfully submitted.

THOS. H. HANDBURY,
Major, Corps of Engineers
THOMAS W. SYMONS,
Captain, Corps of Engineers

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
July 16, 189

Respectfully submitted to the Secretary of War.

It having been made manifest to the Secretary of War that the tablishment of harbor lines is essential to the preservation and pro tion of the harbor at Portland, Oregon, a Board of Engineers was constituted by Special Orders No. 88, Headquarters, Corps of Engineers, December 24, 1890, to consider and report upon this subject; and the within report by the majority of the Board recommends for approval of the Secretary of War the harbor lines described in the inclosed paper and delineated upon the accompanying chart.

It is recommended that the lines selected be approved, and that the Secretary place his approval both upon this report and the tracing submitted.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

WAR DEPARTMENT,
August 9, 1892.

Approved.

L. A. GRANT,
Acting Secretary of War.

DESCRIPTION OF PIER HEAD LINES ALONG THE WILLAMETTE RIVER BETWEEN THE NORTH AND SOUTH BOUNDARY LINES OF THE CITY OF PORTLAND, OREGON, RECOMMENDED FOR ADOPTION AND APPROVAL OF THE SECRETARY OF WAR BY THE BOARD OF ENGINEER OFFICERS CONVENED BY VIRTUE OF SPECIAL ORDERS NO. 88, DATED HEADQUARTERS CORPS OF ENGINEERS, U. S. ARMY, WASHINGTON, D. C., DECEMBER 24, 1890.

The location of the lines, with distances and bearings mentioned in this description, are shown in red ink upon a map on file in the United States Engineer office in Portland, Oregon. A tracing from this was forwarded to the Chief of Engineers, U. S. Army, with report dated May 23, 1892.

Left bank, going north.—Commencing at a point in the center line of Madison street which shall be 300 feet from the intersection of said center line with the center line of Front street, measured in an easterly direction; thence to a point on the center line of Morrison street which shall be 200 feet from the intersection of said center line with the center line of Front street, measured in an easterly direction; thence to a point on the center line of Washington street which shall be 222 feet from the intersection of said center line with the center line of Front street, measured in an easterly direction; thence to a point on the center line of Stark street which shall be 250 feet from the intersection of said center line with the center line of Front street, measured in an easterly direction; thence to a point on the center line of Pine street which shall be 285 feet from the intersection of said center line with the center line of Front street, measured in an easterly direction; thence to a point on the center line of Ash street which shall be 282 feet from the intersection of said center line with the center line of Front street, measured in an easterly direction; thence to a point on the center line of Ankney (A) street which shall be 245 feet from the intersection of said center line with the center line of Front street measured in an easterly direction; thence to a point which shall be 130 feet north of the center line of Davis (D) street and 212 feet east of the center line of Front street; thence to a point on the center line of Flanders (F) street which shall be 395 feet from the intersection of said center line with the center line of First street, measured in an easterly direction; thence to a point which shall be 110 feet north of the center line of Glisan (G) street and 265 feet east of the center line of First street; thence to a point on the center line of the present steel railway bridge, which shall be 169 feet from the center of the pivot pier, measured in a westerly direction; thence to a point which shall be 380 feet northeasterly from the west side of North Front street, measured on a line which shall be drawn perpendicular to said west side at its intersection with the center line of Johnson (J) street; thence to a point which shall be 340 feet easterly from the westside of North Front street, measured on a line which shall be drawn perpendicular to said west side at its point of intersection with the east side of North Seventh street; thence to a point which shall be 500 feet northeasterly from the west side of North Front street, measured on a line which shall be drawn perpendicular to said west side at its point of intersection with the east side of North Seventeenth street; thence to a point, on the prolongation northward of the center line of Blackstone street, which shall be 1,750 feet from the intersection of said center line tion westward of the center line of Russell street which shall be also on the ıgation southward of outer face of the docks of the North Pacific Terminal any and 700 feet, more or less, from the intersections of said center line of Rusreet with the center line of Loring street; thence along the outer face of said Pacific Terminal Company Docks, direction N. 39° 45′ W., distance 3,120 feet, oint; thence in a direction N. 31° 30′ W., distance 2,630 feet, to a point; thence irection N. 26° W., distance 2,000 feet, to a point; thence N. 44° W., distance feet, to a point; thence in a direction N. 53° W., distance 5,280 feet, to a point; e in a direction N. 88° 30′ W., distance 400 feet. to a point; thence in a direc. 69° W., distance 800 feet, to a point; thence in a direction S. 84° 30′ W., dis500 feet, to a point; thence in a direction N. 66° W., distance 1,100 feet, to a ; thence in a direction N. 51° 30′ W., distance 5,000 feet, to a point; thence to a on the prolongation southwesterly of the south side of Oneonta (Main) street, town of St. John, which shall be 320 feet from the intersection of said south rith the east side of Front street; thence to a point on the prolongation southrly of the center line of Burlington (Washington) street which shall be 240 rom the intersection of said center line with the east side of Front street; thence oint on the prolongation westward of the north side of Baltimore (Fanny) which shall be 430 feet from the intersection of the said north side with the ide of Front street.

n Island.—Commencing at the point of intersection of the line of the Governdam at the head of Swan Island Chute with a line drawn parallel to Sherlock ıe and 1,560 feet therefrom; thence, in a direction N. 58° 45′ W., distance 5,960 o a point; thence in a direction N. 44° 30′ W., distance 4,650 feet, to a point; e in a direction due north, distance 360 feet, to a point; thence in a direction S. ., distance 1,750 feet, to a point; thence in a direction N. 80° E., distance 1,500 o a point; thence in a direction S. 61° E., distance 500 feet, to a point; thence in ction S. 53° E., distance 4,000 feet, to a point; thence in a direction S. 30° E., ıce 4,036 feet, to a point; thence in a direction S. 60° W., distance 456 feet, to oint of beginning.

APPENDIX V V.

SUPERVISION OF THE HARBOR OF NEW YORK.

REPORT OF CAPTAIN FREDERICK RODGERS, U. S. NAVY, SUPERVISOR OF THE HARBOR OF NEW YORK, FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

OFFICE OF THE SUPERVISOR
OF THE HARBOR OF NEW YORK,
New York, September 10, 1892.

GENERAL: In accordance with instructions dated August 26, 1892, I have the honor to submit the following annual report:

As this report only covers the period included in the past fiscal year, and as I did not assume charge of this office until July 7, I can only submit a report of the operations of the office as shown by the records thereof.

I have to state that, upon assuming charge of the office, I found three of the four vessels employed under its jurisdiction were not in efficient condition for service, and the fourth one, the tug *Nimrod*, the only really efficient vessel of the lot for general patrol work, had been so continually employed and under steam that she badly needed a general overhauling, in order to preserve her for future service.

I am informed that lack of necessary funds for the purposes prevented the necessary repairs upon these vessels.

I concluded that it was most desirable and a measure of economy to put all these vessels in as efficient condition as practicable for work during the present year, and, with the authority of the office of the Chief of Engineers, the two launches, *Active* and *Alert*, have been thoroughly overhauled and are now in excellent order. The *Argus* is now under repairs and it is proposed to give the *Nimrod* a general overhauling when the services of the former vessel become available.

In reference to the repairs to the *Argus* on this and the last occasion, it was a question whether she was worth the expenditure. It is possible that one more year's service may be got out of her, but I doubt whether it would be expedient to spend any more money on her. However, unless repaired and put in a reasonably serviceable condition, but vessel would be available for patrol work in the lower bay.

I find from the records, that the *Argus* originally cost $21,950 cluding $700 for plans, and her equipment $1,227.75, making a t cost of $23,177.75. She appears to have been commissioned on Nov ber 9, 1889, and since that date the sum of $7,186.12 appears to h been spent in repairs.

I am satisfied from the experience I have had so far, that the rec mendation of the supervisor in his report of July 9, 1891, is founded, viz.:

> I have to renew my suggestion in the preceding report, that two more tug furnished, one of which will be required to replace the *Argus* before many mo and the other as an auxiliary to relieve broken-down patrolers and perform e service, which is frequently necessary. It is a well-known fact that no steam lines can be handled properly without an extra boat, and the same obtains for service of this office.

There should be, for an efficient performance of the duties requi in patrolling the harbor and adjacent waters, at least three light-dr but seaworthy, propellers of about 100 feet in length, with fair sp and proper accommodations for the crew to live on board. In a tion to the *Nimrod*, two more vessels of about the same size wo therefore be required. These vessels would cost $45,000 each, $12,000 annually for crew and maintenance, including repairs. appropriation for this purpose, in addition to the usual one of $33,(is recommended.

The work of the office, and that of those under its jurisdiction, pears to have been efficiently performed.

There has been moved and deposited into and at legally designa places outside the harbor and behind bulkheads in the neighborh of New York, during the fiscal year ending June 30, 1892, the amo of 10,072,311 cubic yards of material, mud, city refuse, garbage, ce dirt, ashes, acids, lime, and other matter as per the following recap lation:

Place of deposit.	Kind of material.	Amo
		Cubic
Mud buoy	Mud, etc	5,17
Refuse Buoy	City refuse, garbage, etc	1,52
Scotland Light-ship	Mud, etc	45
Long Island Sound	do	79
North River	Dirt, ashes, etc., behind bulkheads and on shore for filling.	40
East River	do	20
Harlem River	do	40
Hudson River	do	13
Raritan River	do	11
New York Bay	do	9
Staten Island Sound	do	27
Newark Bay	do	23
Swinburne Island	do	
Pelham Bay	do	
Jamaica Bay	do	
Shoal Harbor, New Jersey	do	
Shrewsbury River	do	
Passaic River	do	17
Barren Island	Acids, dead animals, etc., on shore in store	5
Total		10,07

Permits issued ....

From the foregoing detailed statement it will be seen that 7,954 cubic yards of city refuse, mud, etc., was deposited in the ocean r the mouth of the harbor, and that 2,061,470 cubic yards of cellar (

shes, and other inoffensive material was utilized for filling in behind ulkheads, reclaiming land, etc., for which special permits were issued.

The following is a statement to July 1, 1892, of the appropriations nade for "prevention of obstructive and injurious deposits within the arbor and adjacent waters of New York City":

ppropriation, 1888-'89, act of June 29, 1888		$30,000.00
xpended to July 1, 1890		29,957.09
Balance July 1, 1890		42.91
ppropriation, 1889-'90, act of March 2, 1889		31,070.00
xpended to July 1, 1890		22,315.22
Balance July 1, 1890		11,754.78
utstanding liabilities, contracts, orders, etc		8,584.04
Balance after deducting liabilities		3,170.74
ppropriation, 1889-'90, act of March 2, 1889, for the purchase or construction of a vessel		60,000.00
xpended to July 1, 1890		36,520.00
Balance July 1, 1890		23,480.00
ppropriation, 1890-'91, act of August 30, 1890:		
For pay of crew and maintenance of steamer *Argus*	$8,000.00	
Expended to July 1, 1891	6,379.08	
		1,620.92
For pay of crew and maintenance of new vessel to be purchased or constructed	10,000.00	
Expended to July 1, 1891	9,621.61	
		378.39
For pay of inspectors and deputy inspector, office force, and expenses of office	15,000.00	
Expended to July 1, 1891	11,785.40	
		3,214.60
		5,213.91
utstanding liabilities		165.00
Balance July 1, 1891		5,048.91
ppropriation, 1891-'92, act of March 3, 1891:		
For pay of inspectors and deputy inspectors, office force, and expenses of office	$15,000.00	
Expended to July 1, 1892	10,609.52	
		$4,390.48
Outstanding liabilities		2,456.05
Balance July 1, 1892		1,934.43
For pay of crew and maintenance of steamer *Argus*	$8,000.00	
Expended to July 1, 1892	7,093.75	
		906.25
Outstanding liabilities		883.22
Balance July 1, 1892		23.03
For pay of crew and maintenance of steamer *Nimrod*	$10,000.00	
Expended to July 1, 1892	8,646.34	
		1,353.66
Outstanding liabilities		1,312.59
Balance		41.07
otal balance appropriation 1891-'92		2,051.01

The following is a list of the employés o
date of their appointment, rating, pay, a

Name.	Rating.	P
John G. Morison	Chief clerk and inspector	1,
A. C. Murphy	Stenographer	
Aaron Elliott	Messenger	
E. C. Hager	Master and deputy inspector	1,
James Quirk	do	1,
E. McGovern	Pilot and deputy inspector	
F. I. Stillwell	do	
G. R. Barker	do	
William Halliday	do	
Fred. A. Tappan	do	
John B. Folan	Fireman	
George Murphy	do	
J. T. Tait	do	
John Saunders	do	
Charles Halliday	Engineer	1,
R. Hammond	Fireman	
R. Humber	Second deckhand	
James Bailey	Cook	
Bernard Kelly	Fireman	
W. A. Bloomer	Chief engineer	1,
Charles Kelly	Fireman's helper	
F. J. Wren	Carpenter	
George Wyman	Cook	

I strongly recommend that two additi
force of this office, as suggested in a prec
The following is an estimate of appropr
the fiscal year ending June 30, 1894, by th
New York:

Detailed objects of expenditure, and explanation
Prevention of obstructive and injurious deposits within th adjacent waters of New York City:
For pay of inspectors, deputy inspectors, office force, a of office
For pay of crew and maintenance of steamer *Nimrod*
For pay of crew and maintenance of steamer *Argus*
For purchase or construction of two steam tugs
For pay of crew and maintenance of two steam tugs to b or constructed
Total

Very respectfully, your obedient se
I
Capta

Brig. Gen. Thomas L. Casey,
Chief of Engineers, U. S. A.

CORRESPONDENCE RELATING TO DUMPI
HOOK.

Office of the Supe
Har
Ne

General: I respectfully call to your a
of many of the inward bound freight stea
discharge their ballast outside the bar.
I have lately received a communication
in this subject, and they have requested

roaches to the harbor within which the discharge of all ballast shall 'egarded as illegal.

am of opinion that the continual deposit of large quantities of this erial near the entrance of the harbor will, in course of time, be a rce of danger and inconvenience to navigation. In a case recently orted to me by the pilot commissioners, the British steamer *Hurth* discharged her ballast outside the bar; and the pilot states that master informed him that he was ordered by his owners to do so side the jurisdiction of the United States authorities before entering . Four hundred tons of stone were thrown overboard from this mer about 3½ miles from the bar. I think there can be no doubt the dumping of such large quantities of stone, or any other heavy erial generally used for ballast in 7 or 8 fathoms of water should be nibited.

he British steamer *Elmville* is also reported by one of the inspec- of this office as having discharged her ballast about 5 miles to the hward of Sandy Hook light-ship. From the best information at disposal, I believe that this practice is almost universal, and that ome instances it is probable that vessels are discharged much nin the 3-mile limit.

fter consultation with Lieut. Col. Gillespie, United States Engineer ps, the officer in charge of the improvement of the harbor, I am of opinion that no deposits of ballast should be permitted within 15 s of the Sandy Hook light-ship, or in less than 16 fathoms of water, I request that this limit may be approved as defining the adjacent ers of the harbor.

Very respectfully, your obedient servant,

H. B. ROBESON,
Captain, U. S. Navy, Supervisor.

rig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
December 24, 1891.

espectfully submitted to the Acting Secretary of War with recom- ndation for approval.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

WAR DEPARTMENT,
JUDGE-ADVOCATE-GENERAL'S OFFICE,
Washington, D. C. December 29, 1891.

espectfully returned to the Secretary of War.

ection 6 of the river and harbor act of September 19, 1890 (26 Stat.,), provides—

iat it shall not be lawful to cast, throw, empty, or unlade, or cause, suffer, or ure to be cast, thrown, emptied, or unladen, either from or out of any ship, ves- lighter, barge, boat, or other craft, or from the shore, pier, wharf, furnace, manu- turing establishments, or mills of any kind whatever, any ballast, stone, slate, el, earth, rubbish, wreck, filth, slabs, edgings, sawdust, slag, cinders, ashes, se, or other waste of any kind, into any port, road, roadstead, harbor, haven, gable river, or navigable waters of the Unted States, which shall tend to impede bstruct navigation, or to deposit or place, or cause, suffer, or procure to be depos- or placed, any ballast, stone, slate, gravel, earth, rubbish, wreck, filth, slabs, ngs, sawdust, or other waste in any place or situation on the bank of any navi-

LETTER OF THE ATTORNEY-GENERAL.

DEPARTMENT OF JUSTICE,
Washington, D. C., January 6, 1892.

SIR: I have by reference the letter of December 23, written by H. B. Robeson, supervisor of the harbor of New York, to Gen. Casey, Chief of Engineers, with the indorsements, touching the matter of the deposit of ballast outside of New York Harbor, and at a distance of more than 3 miles from the shore, at low-water mark.

You ask my opinion as to whether or not the supervisor of the harbor, or the War Department, can interfere to prevent these deposits.

In answer, I have to say: I know of no statute authorizing such interference, nor of any power to so interfere in the absence of statute. The indorsement of Col. Lieber, Acting Judge-Advocate-General, seems to cover the subject-matter.

Very respectfully,

W. H. H. MILLER,
Attorney-General.

The SECRETARY OF WAR.

PROPOSED DRAFT OF AN ACT TO PREVENT THE DUMPING OF BALLAST OR OTHER BULKY MATERIAL IN THE APPROACHES TO NEW YORK HARBOR AND BAY OFF SANDY HOOK.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That any vessel or vessels from which may be dumped or discharged ballast or other bulky material in the approaches to New York Harbor and Bay within fifteen miles of the Sandy Hook light-ship, or in less than sixteen fathoms of water, shall not be allowed by the collectors of customs to receive passengers or cargo, or clear from New York or any port adjacent to New York Harbor and Bay, for the period of six months from the time of the commission of such dumping or discharging of ballast or other bulky material.

SEC. 2. That it shall be the duty of the supervisor of the harbor of New York, appointed and acting under the provisions of an act entitled "An act to prevent obstructive and injurious deposits within the harbor and adjacent waters of New York City, by dumping or otherwise, and to punish and prevent such offenses," approved June twenty-ninth, eighteen hundred and eighty-eight, to detect by proper measures any vessel or vessels which may dump or discharge ballast or other bulky material within the limits specified in the foregoing section of this act, and upon being satisfied of the commission of such act or acts to report the same to the collectors of customs at ports adjacent to New York Harbor and Bay for action by them in pursuance of the provisions in the said foregoing section; and the provisions of the said act approved June twenty-ninth, eighteen hundred and eighty-eight, and the jurisdiction of the said supervisor of the harbor of New York, are hereby extended, so far as they are applicable and consistent with the provisions of this act, to embrace the waters included within the limits specified in section one of this act.

SEC. 3. That the collectors of customs at any or all the ports adjacent to New York Harbor and Bay, upon receipt of information from the said supervisor of the harbor of New York that any vessel or vessels have dumped or discharged ballast or other bulky material within the limits specified in section one of this act, are hereby authorized and directed not to allow said vessel or vessels to receive passengers or cargo or clear from the respective ports within six months from the time of commission of such dumping or discharging of ballast or other bulky material, as provided in section one of this act.

INDEX.

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INDEX.

INDEX.