

INDEX.

SUBJECT.	Page.		
	Part I.	Part II.	Part III.
Pearl River, Miss., examination of.....	111	879	
Pearl River, Miss., improvement of.....	107	878	
Pee Dee River, N. C., examination of.....	95	723	
Pee Dee River, S. C., examination and survey of.....	44	247	
Penobscot River, Me., improvement of.....	100	801	
Pensacola Harbor, Fla., improvement of.....	163	1609	
Pentwater Harbor, Mich., improvement of.....	162	1606	
Pere Marquette Harbor, Mich. (see Ludington).....	87	626	
Perquimans River, N. C., improvement of.....	179		
Petaluma Creek, Cal., examination and survey of.....	65	395	
Plattsburgh Harbor, N. Y., improvement of.....	76	497	
Pier and bulkhead lines of Baltimore Harbor, report on.....	50	271	
Plymouth Harbor, Mass., improvement of.....	77	505	
Pocomoke River, Md., improvement of.....	63	390	
Port Chester Harbor, N. Y., improvement of.....	171	1671, 1681	
Port Clinton Harbor, Ohio, improvement of.....	59	358	
Port Jefferson Harbor, L. I., N. Y., improvement of.....	46	255	
Portland Harbor, Me., improvement of.....	183	1802	
Port Orford, Oreg., examination of, for harbor of refuge.....	52	282	
Portsmouth Harbor, N. H., survey of.....	48	262	
Portsmouth Harbor, N. H., improvement of.....	100		
Port Royal River, S. C., examination and survey of.....	74	462	
Port-warden's line at Philadelphia.....	154	1519	
Port Washington Harbor, Wis., improvement of.....	54	306	
Providence River, R. I., improvement of.....	51	273	
Provincetown Harbor, Mass., improvement of.....	183	1877	
Public Buildings and Grounds, District of Columbia.....	176	1728	
Pultneyville Harbor, N. Y., improvement of.....			
Q.			
Quincy, Ills., examination of Mississippi River at.....	133	1130	
Quincy, Ills., improvement of Mississippi River at.....	130	1130	
Queenstown, Md., improvement of harbor at.....	75	487	
R.			
Racine Harbor, Wis., improvement of.....	155	1526	
Rahway River, N. J., improvement of.....	67		
Rahway River, N. J., examination of.....	75	483	
Rappahannock River, Va., improvement of.....	85	607	
Raritan River, N. J., improvement of.....	64	392	
Reconnaissances and explorations.....	188		
Red River, La.:			
examination for improvement of falls of.....	118		
improvement of upper.....	114	964	
examination of upper.....	118	986	
improvement of mouth of.....	113	959	
removing snags from.....	114	961	
Red River Raft, La., removal of.....	112	951	
Red River of the North, improvement of.....	135	1189	
Reedy Island, Delaware River, ice harbor at.....	73	444	
Reservoirs at sources of Mississippi River, survey for.....	136	1193	
Richmond's Island, Me., harbor of refuge at.....	46	257	
River and harbor improvements.....	42		
Roanoke River, N. C., improvement of.....	87	624	
Rock Island Bridge, sheer-booms at.....	132	1144	
Rock Island Rapids, Mississippi River, improvement of.....	131	1132	
Rogue River, Oreg., examination of.....	183	1823, 1856	
Rondout Harbor, N. Y., improvement of.....	60	374	
S.			
Sabine Pass, Tex., improvement of.....	108	902	
Sabine River, Tex., improvement of.....	108	904	

INDEX.

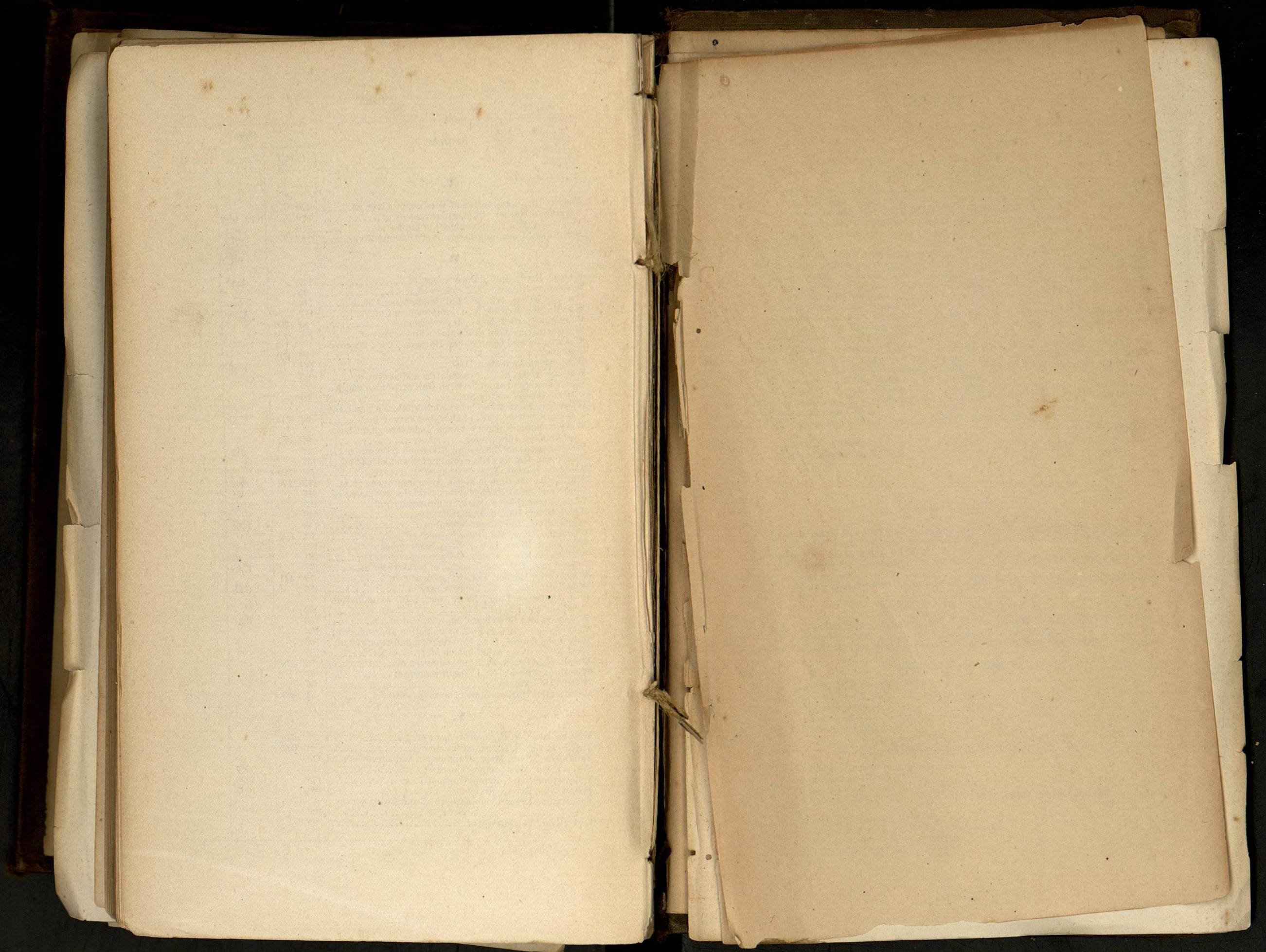
SUBJECT.	Page.		
	Part I.	Part II.	Part III.
Sabine River, Tex., examination and resurvey of.....	112		
Sacramento and Feather rivers, Cal., improvement of.....	178	1749	
Sacramento River, Cal., examination and survey of.....	179		
Saginaw River, Mich., improvement of.....	169	1659	
Saint Anthony, preservation of Falls of.....	134	1159	
Saint Augustine Creek, Ga., improvement of.....	97	763	
Saint Charles, Mo., examination of Missouri River at.....	127	1083	
Saint Clair Flats ship-canal, Mich.....	168	1651	
Saint Clair River at the mouth of Black River, Mich., improvement of.....	169	1656	
Saint Croix River, Me., improvement of.....	43	245	
Saint Croix River, Wis., improvement of.....	135	1179	
Saint John's River and Fernandina, Fla., deepening inside passage between.....	98	765	
Saint John's River, Fla., examination of upper.....	99	795	
Saint John's River, Fla., survey and improvement of bar at mouth of.....	98	766	
Saint Joseph, Mo., improvement of Missouri River at.....	123	1065	
Saint Joseph's Harbor, Mich., improvement of.....	166	1631	
Saint Joseph River, Mich., from mouth to Elkhart, Ind., examination and survey of.....	167		
Saint Louis Harbor, Mo., improvement of.....	118	1024	
Saint Mary's Falls Canal, Mich., construction of.....	167	1641	
Saint Mary's Falls Canal, approaches to, survey of.....	168		
Salem River, N. J., improvement of.....	68	412	
Salem River, N. J., survey and examination of.....	75	474	
Saline River, Ark., examination of.....	118	1003	
San Buenaventura Harbor, Cal., examination of.....	180	1770	
San Diego Harbor, Cal., improvement of.....	179	1763	
Sandusky City Harbor, Ohio, improvement of.....	171	1672, 1682	
San Joaquin River, Cal., improvement of.....	179	1764	
San Luis Obispo, Cal., examination of harbor at.....	180	1765	
Santa Barbara Harbor, Cal., examination of.....	180	1769	
Santee River, S. C., examination and survey of.....	95		
Saugatuck Harbor, Mich., improvement of.....	165	1625	
Savannah Harbor and River, Ga., improvement of.....	96	740	
Savannah River, Ga., survey of, above Augusta.....	99	747	
Saybrook Bar, mouth of Connecticut River, jetty at.....	56	317	
Schuylkill River, Pa., improvement of.....	69	416	
Scituate Harbor, Mass., survey of.....	52	284	
Scuppernon River, N. C., improvement of.....	92	698	
Sea-coast and lake-frontier defenses.....	4		
Sebewaing Harbor, Mich., resurvey of.....	170		
Secretary Creek, Md., examination and survey of.....	81		
Seekonk River, R. I., improvement of.....	54	305	
Sheboygan Harbor, Wis., improvement of.....	154	1518	
Sheepshead Bay, N. Y., examination of.....	66	400	
Sheer-booms at Rock Island Bridge, construction of.....	132	1144	
Shenandoah River, Va. and W. Va., examination and survey of.....	81		
Ship Canal between Delaware and Chesapeake Bays, survey for.....	81	587	
Ship Canal across Bergen Neck, N. J., examination and survey for.....	66		
Ship Canal from Saint Mary's River, Fla., to the Gulf of Mexico, survey for.....	99		
Shrewsbury River, N. J., improvement of.....	66	403	
Sioux City, Iowa, improvement of Missouri River at.....	124	1078	
Sipsey River, Ala., examination and survey of.....	106		
Slaughter Creek, Md., examination and survey of.....	81		
Snagboats on the Mississippi, Missouri, and Arkansas Rivers.....	120	1049	
Snake River, Wash., improvement of.....	181	1789, 1839	
Sodus Harbor, N. Y., Great, improvement of.....	176	1729	
Sodus Harbor, N. Y., Little, improvement of.....	176	1731	

INDEX.

SUBJECT.	Page.		
	Part I.	Part II.	Part III.
South Haven Harbor, Mich., improvement of	165	1627	
South River, N. J., examination and survey of	66		
Southport Harbor, Conn., improvement of	59	354	
Staten Island, N. Y., improvement of New Jersey Channel	64	392	
Staunton River, Va., improvement of	86	621	
Staunton River, Va., examination of	88	622	
Stonington Harbor, Conn., improvement of	56	326	
Sturgeon Bay Canal, Wis., harbor of refuge at	152		1488
Superior Bay and entrance, Wis., improvement of	150		1468
Superior Bay for harbor improvement, examination and survey of	136		
Survey of northern and northwestern lakes and of the Mississippi River	184		1891
Surveys and examinations for improvement of rivers and harbors, estimates for	184		
Surveys and explorations 40th parallel, completion of	186		
Surveys and explorations west of the 100th meridian	186		1977
Susquehanna River, Pa., examination and survey of	75		
Suwannee River, Fla., examination of	106	857	
Susquehanna River, near Havre de Grace, Md., improvement of	75	487	
Swanton Harbor, Vt., improvement of	65	396	
T.			
Tallahatchie River, Miss., examination of	118		985
Tallahatchie River, Miss., improvement of	116		971
Tampa Bay, Fla., examination of	106	870	
Tangipahoa River, examination of	111	946	
Tar River, N. C., improvement of	92	700	
Tar River, N. C., examination of	95	700	
Taunton River, Mass., improvement of	54	303	
Tchefuncta River, La., examination and survey of	112		
Tchula Lake, Miss., examination and survey of	118		1247
Teche Bayou, La., examination and survey of	112		
Tennessee River above Chattanooga, improvement of	137		1247
Tennessee River below Chattanooga, improvement of	137		1248
Tickfaw River, La., examination and survey of	112		
Thames River, Conn., improvement of	57	331	
Thunderbolt River, Ga., improvement of	97	763	
Toledo Harbor, Ohio, improvement of	170		1670, 1678
Tombigbee River, Ala., improvement of	104	830	
Tombigbee River, above Columbus, Miss., improvement of	105	833	
Tone's Bayou, La., closing of	112		951
Tone's Bayou, La., examination of	118		991
Torpedo defense	35		
Tread Haven Creek, Md., examination and survey of	81		
Trent River, N. C., improvement of	94	711	
Trent River, N. C., examination of	95	711	
Trinidad Harbor, Cal., examination and survey of	180		
Trinity River, Tex., examination and resurvey of	112		
Trinity River, Tex., improvement of	110	918	
Tuckahoe Creek, Md., examination and survey of	81		
Two Rivers Harbor, Wis., improvement of	153		1512
U.			
Umpqua River, Oreg., &c., examination and survey of	183		
Upper Columbia and Snake Rivers, Oreg., and Wash., improvement of	181		1789, 1839
Upper Mississippi River, improvement of	134		1165
Upper Willamette River, Oreg., improvement of	181		1788, 1831
Urbana Creek, Va., improvement of	85	616	

INDEX.

SUBJECT.	Page.		
	Part I.	Part II.	Part III.
V.			
Venice, Ill., examination of Mississippi River at	120		
Vermillion Harbor, Ohio, improvement of	172		1673, 1687
Vicksburg, Miss., improvement of harbor at	116		974
Vermillion, Dak., improvement of Missouri River at	125		1079
W.			
Wabash River, Ind., improvement of	147		1439
Waccamaw River, N. C., survey of	95		
Wachita River, Ark. and La., improvement of	114		965
Waddington Harbor, N. Y., improvement of	177		1738
Wareham Harbor, Mass., improvement of	53	300	
Warrior River, Ala., examination and survey of	106		
Washington and Georgetown Harbors, D. C., improvement of	82	591	
Washington Aqueduct, D. C.	184		1885
Wateree River, S. C., examination and survey of	95		
Water communication between Gulf of Mexico and Atlantic Ocean, survey for	99		
Water communication between Norfolk, Va., and the Atlantic Ocean south of Hatteras, survey for	94	714	
Water communication between Delaware and Chesapeake bays, surveys for	81	587	
Water-gauges on Mississippi River and tributaries	117		982
Waukegan Harbor, Ill., examination and survey of	157		
Westport Harbor, Mass., survey of	56	320	
White River at Buffalo Shoal, Ark., improvement of	115	126	969
White and Saint Francis rivers, Ark., improvement of	115		968
White River Harbor, Mich., improvement of	163		1613
White River, Ind., examination of	149		
White River, Ind., improvement of	148		1454
Wicomico River, Md., improvement of	77	502	
Willamette River, Lower, Oreg., improvement of	180		1787, 1825
Willamette River, Upper, Oreg., improvement of	181		1788, 1831
Wilmington, Cal., construction of breakwater at	178		1746
Wilmington Harbor, Del., improvement of	72	441	
Wilson Harbor, N. Y., improvement of	175		1725
Winnepesaukee Lake, N. H., outlet of, examination and survey of	52		
Wisconsin and Fox rivers, improvement of	156		1531
Withlacoochee River, Fla., examination and survey of	106		
Wolf Lake Outlet, Ind., examination and resurvey of	160		
Wolf River, Wis., examination of	156		
Woodbridge Creek, N. J., examination of	75	478	
Woodbridge Creek, N. J., improvement of	67		
Wood's Holl, survey of	56		
Wood's Holl Harbor, Mass., improvement of	53	297	
Y.			
Yadkin River, N. C., improvement of	87	626	
Yadkin River, N. C., examination of	88	627	
Yallahusha River, Miss., examination and survey of	118		
Yazoo River, Miss., improvement of	115		967
Yellowstone River, improvement of	128		1095
Yellowstone River, survey of	128		1097
Yellowstone River, examination and continuing survey of	128		
York River, Va., survey of	95		



judged by the two recent surveys for accurate comparison. At the same time what are now fast banks, as considered in survey, grown up to timber and in many cases cultivated, were bars at the time of the government land surveys, and the then shore-lines are now often exhibited as inland benches. These benches, when carefully run out and their relative age ascertained, seem to imply a river always very much as now.

The Garonne is the only example of the successful improvement of a sand bearing stream of radical type. It is of little value as a study in connection with general plans for the improvement of the Missouri, as here the force and volume of the current are so great, and its capabilities for erosion and deposition so enormous that the amount that can be accomplished in one year when the proper methods are understood, is beyond conception.

To improve the river for navigation its persistence in the present phenomena must be corrected in confining its course to one channel, often narrower and as much lengthened as is possible. In doing this bars must be built up, bluffs must be used as shore lines as far as practicable, and every concave shore line elsewhere must be revetted. When methods are developed it is believed that this may be done for \$5,000 to \$10,000 per mile and permanent 7 feet of low-water obtained.

Such a work would be at first but an experiment, as the effect of attempting to change a river of the Missouri class so radically cannot be foreseen and never will be unless the experiment of improving a reach is once tried.

As preliminary to improving any reach careful survey of all old shore lines and surface investigations by ample borings should be made, and no project can be intelligently offered until such data are available and thoroughly and maturely studied.

A physical study of the Platte would be suggestive.

In whatever of success the work may have attained, I desire to acknowledge the aid of my assistants, A. S. Potter, F. M. Harris, and J. W. Nier, the latter this season in charge at Kansas City.

I am, major, very respectfully, your obedient servant,

L. E. COOLEY.

Maj. CHAS. R. SUTER,
Corps of Engineers, U. S. A.

LIST OF ILLUSTRATIONS.

Map of Missouri River at Nebraska City and vicinity, extending from Jones' Point to Mosquito Junction, from surveys made in October and November, 1878, and partial surveys since. Scale, 2,000' = 1".

Three photographs illustrating method of building mats and launching same from mattress-boat Spider.

Three photographs illustrating method of building and launching mats with double boat Peanut.

Plate I.—Boats. Scale, 8' = 1".

Figs. 1, 2, and 3. Plan, elevation, and end view of mattress-boat Spider.
Figs. 4, 5, and 6. Plan, elevation, and section of brush-barge.
Figs. 7, 8, and 9. Plan, elevation, and section of mattress-boat Peanut.

Plate II.—Tools. Scale, $\frac{1}{2}$ ".

Figs. 1 and 2. Harpoon-shuttle.
Figs. 3 and 4. Brush-jack.
Fig. 5. Needle for same.
Fig. 6. Hook-needle.
Fig. 7. Curved needle.

Plate III.—Mattress fastenings. Scale, $\frac{1}{4}$ " = 1' or $\frac{1}{8}$ ".

Fig. 1 a and b. Fastenings made by jack.
Fig. 2 a and b. Shuttle-fastening.
Fig. 3 a and b and c. Hook-needle fastening.
Fig. 4 a and b. Mat without poles made with curve needle and curved needle fastening.
Fig. 5. Sewing to wire with shuttle.
Fig. 6. Lock-stitch with hook-needle and shuttle.
Fig. 7. Harness-stitch with two shuttles.
Fig. 8. Chain-stitch with short shuttle.