LAND'S END

A HISTORY OF THE NEW ORLEANS DISTRICT, U. S. ARMY CORPS OF ENGINEERS, AND ITS LIFELONG BATTLE WITH THE LOWER MISSISSIPPI AND OTHER RIVERS WENDING THEIR WAY TO THE SEA

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
1979		**00-00-1979 to 00-00-1979**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Land's End: A History of the New Orleans District, U. S. Army Corps of Engineers, and Its Lifelong Battle with the Lower Mississippi and Other Rivers Wending Their Way to the Sea	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **U.S. Army Corps of Engineers,New Orleans District,7400 Leake Avenue,New Orleans,LA,70118**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**139**	

DEDICATED

To the Men and Women of the New Orleans District

LAND'S END

A History of the New Orleans District, U. S. Army Corps of Engineers,
and Its Lifelong Battle with the Lower Mississippi and
Other Rivers Wending Their Way to the Sea

by

Albert E. Cowdrey

1977

IN COMMAND, NEW ORLEANS DISTRICT

DISTRICT ENGINEERS, NEW ORLEANS

RESIDENT MILITARY ENGINEERS, NEW ORLEANS[1]
Under Superintending Engineer for Gulf of Mexico Frontier

Captain	James Gadsden[2]	1818[3]	
Captain	W H Chase[2]		1828[4]
2nd Lt	A H Bowman	Feb 1833	Jun 1833[5]
Captain	J G Barnard	Mar 1840	Dec 1847[6]
1st Lt	P G T Beauregard	May 1841	Nov 1846
1st Lt	Henry L Smith	Nov 1846	Jun 1848
Captain	J G Barnard	Jun 1848	Nov 1852
1st Lt (Bvt Maj)	P G T Beauregard	Jun 1848	Apr 1857

Under Board of Engineers for the Gulf Coast

Captain (Bvt Maj)	P G T Beauregard	Apr 1857	Jan 1861
Bvt 2nd Lt	W H McFarland	Jan 1861[7]	

CHIEF ENGINEER, DEPARTMENT OF THE GULF
Under Commanding General, Department of the Gulf (USA)

1st Lt	Godfrey Weitzel	Mar 1862	Dec 1862
1st Lt	D C Houston	Dec 1862	Jul 1864
Captain	Peter C Hains	Jul 1864	Jun 1865
Captain	Miles D McAlester	Jun 1865[9]	

NEW ORLEANS ENGINEER OFFICE
Under the Board of Engineers, New York

Major	Miles D McAlester		Nov 1868
Major	F E Prime	Nov 1868	Apr 1869
1st Lt	D W Payne	Apr 1869	Jun 1869
Captain	Charles W Howell	Jun 1869	1881
Major	Amos Stickney	Dec 1881	Jul 1884
Captain	Thomas Turtle	Jul 1884	Feb 1885
Major	D W Heuer	Feb 1885	Oct 1887

Under Southwest Division (HQ New York)

Captain	W L Fisk	Nov 1887	Jan 1891
Major	James B Quinn	Feb 1891	Nov 1899
Major	M B Adams	Dec 1899	Jun 1901
1st Lt	E M Adams (Temp)	Jun 1901	Jul 1901

Under Gulf Division, New Orleans
After 24 July 1901

Lieut	E M Adams (Temp)	Jul 1901	Oct 1901
Lt Col	Henry M Adams	Oct 1901	Aug 1904
Lt Col	Clinton B Sears	Aug 1904	Jul 1906
Colonel	E H Ruffner	Jul 1906	Jul 1907
Major	James F McIndoe (Temp)	Jul 1907	Sep 1907
Colonel	E H Ruffner	Sep 1907	Aug 1908
Lt Col	Lansing H Beach	Aug 1908	Jun 1911
Major	Harry Burgess (Temp)	Jun 1911	Sep 1911
Lt Col	Lansing H Beach	Oct 1911	Aug 1912
Major	E H Schulz	Aug 1912	

NEW ORLEANS ENGINEER DISTRICT
Under Gulf Division, New Orleans, La

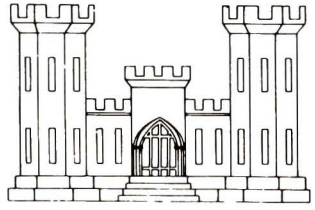
Major	E H Schulz		Oct 1916
Major	Julian L Schley	Oct 1916	May 1917
Colonel	J C Sanford	Jun 1917	Nov 1917
Mister	T E L Lipsey	Nov 1917	Mar 1919
Major	E J Dent	Apr 1919	Sep 1919
Colonel	Herbert Deakyne	Sep 1919	Feb 1920
Major	E J Dent	Mar 1920	Dec 1923
Colonel	C McD Townsend	Dec 1923	Jun 1926
Major	Malcolm Elliot	Jun 1926	Oct 1927
Captain	Lewis A Pick	Oct 1927	Jul 1928
Major	R F Fowler	Jul 1928	

FIRST NEW ORLEANS DISTRICT
Under Gulf Division, New Orleans, La

Major	R F Fowler		Jun 1932
Lt Col	Max C Tyler	Jun 1932	Nov 1932
Major	Henry Hutchins, Jr	Dec 1932	Jul 1936
Lt Col	Robert W Crawford	Jul 1936	Mar 1938
Lt Col	L W Miller	Mar 1938	Aug 1939
Captain	Robert G Lovett	Aug 1939	Nov 1940

NEW ORLEANS DISTRICT
Under Lower Mississippi Valley Division,
Vicksburg, Miss

Lt Col	Clark Kittrell	Nov 1940	Jan 1942
Colonel	Dewitt C Jones	Jan 1942	Apr 1943
Colonel	George H Hudson	Apr 1943	Jul 1945
Colonel	Fisher S Blinn	Jul 1945	Feb 1946
Colonel	Leonard B Gallagher	Mar 1946	Mar 1947
Colonel	John R Hardin	Mar 1947	Jul 1949
Colonel	Charles G Holle	Jul 1949	Apr 1953
Colonel	Charles T Tench	Apr 1953	Jun 1955
Colonel	William H Lewis	Jul 1955	Aug 1958
Colonel	George C Cookson	Aug 1958	Aug 1961
Colonel	Edward B Jennings	Aug 1961	Jul 1964
Colonel	Thomas J Bowen	Aug 1964	Jul 1968
Colonel	Herbert R Haar, Jr	Aug 1968	Jul 1971
Colonel	Richard L Hunt	Jul 1971	Jul 1974
Brig Gen	E R Heiberg III	Jul 1974	Aug 1975
Colonel	Early J Rush III	Aug 1975	



FOURTH MRC DISTRICT
Under the Mississippi River Commission,
New York and St Louis

Captain	A M Miller	1882	
Colonel	Amos Stickney	Aug 1882	Feb 1886
Major	Charles W Raymond	Feb 1886	Dec 1886
Captain	Dan C Kingman	Dec 1886	Oct 1890
Captain	John Millis	Oct 1890	Oct 1894
Major	James B Quinn	Nov 1894	Nov 1894
Captain	George McC Derby	Nov 1094	Jun 1898
Major	J H Willard	Jun 1898	Nov 1898
Captain	Henry Jervey	Dec 1898	Mar 1899
Major	George McC Derby	Mar 1899	Sep 1902
Captain	Charles S Bromwell	Oct 1902	May 1904
Lt Col	Henry M Adams	May 1904	Jul 1904
Major	James F McIndoe	Jul 1904	Sep 1907
1st Lt	Wilbur Willing	1908	
Major	Harry Burgess	Aug 1908	Jul 1910
Captain	Robert R Ralston	Jul 1910	Dec 1910
Major	Harry Burgess	Dec 1910	Dec 1911
Major	Clarence O Sherrill	Dec 1911	Aug 1914
Major	W G Caples	Sep 1914	Nov 1916
Major	Richard C Moore	Dec 1916	Apr 1917
Captain	Beverly C Dunn	May 1917	
Lt Col	George M Derby	May 1917	Aug 1919
Colonel	H S Hetrick	Aug 1919	Jan 1920
Major	E J Dent	Jan 1920	Feb 1920
Colonel	J Franklin Bell	Feb 1920	Sep 1920
Major	R T Colner	Sep 1920	May 1924
Major	H S Bennion	May 1924	Aug 1926
Major	W H Holcombe	Aug 1926	

NEW ORLEANS RIVER DISTRICT
Under Lower Mississippi Valley Division,
Vicksburg, Miss

Major	W H. Holcombe	Sep 1928

SECOND NEW ORLEANS DISTRICT
Under Lower Mississippi Valley Division,
Vicksburg, Miss

Major	W H. Holcombe		Apr 1931
Lt Col.	J N Hodges	Apr 1931	Aug 1935
Lt Col	J H. Carruth	Aug 1935	May 1936
Lt Col	William F. Thompkins	May 1936	Jul 1940
Lt Col	Clark Kittrell	Jul 1940	Nov 1940

[1] Not an official title [2] Superintending Engineer [3] *Monthly Returns* missing, 1819-1832 [4] Moved to Pensacola, 1828 [5] *Returns* show no officers permanently at New Orleans, 1834-1840

[6] Duties at N O divided between Beauregard and Barnard [7] Ordered to duty in Mexico [8] Forts seized by troops of State of La , 12 Jan 1861 [9] Title changed Jul 1865 to "Chief Engr. Dept of La."

TULSA DISTRICT
SOUTHWESTERN DIVISION

FORT WORTH DISTRICT
SOUTHWESTERN DIVISION

VICKSBURG DISTRICT

NEW ORLEANS DISTRICT

MOBILE DISTRICT
SOUTH ATLANTIC DIVISION

ARKANSAS

LOUISIANA

TEXAS

MISS

ALA

INSET A

INSET B

INSET C

PROJECT LEGEND

LAKES (RES.) PRIVATE & OTHER AGENCIES — Completed or Under Construction

NATURAL LAKES

L M V D PROJECTS

Completed	Under Construction	Authorized by Congress	
			LAKES (RES.)
			WATERWAYS, CHANNELS OR CANALS — Less than 9' / 9' To 25' / 25' & Over
			CHANNEL & DRAINAGE IMPROVEMENTS
			LOCK
			LOCK & DAM
			WEIR
			DRAINAGE OR CONTROL STRUCTURE (D S)
			FLOODGATE (F G)
			PUMPING STATION (P S)
			LEVEE OR FLOODWALL (NEW OR ENLGT.)
			LOCAL OR HURRICANE PROT. LEVEE

GENERAL LEGEND

- DIVISION AND DISTRICT HEADQUARTERS
- DISTRICT HEADQUARTERS
- DIVISION BOUNDARY
- DISTRICT BOUNDARY
- COUNTY OR PARISH SEAT
- STATE CAPITAL
- HEAD OF NAVIGATION
- DRAINAGE BASINS

LOWER MISSISSIPPI VALLEY DIVISION
NEW ORLEANS DISTRICT
PLAN OF DEVELOPMENT FOR CIVIL WORKS

SCALE IN MILES
10 0 10 20 30 40

CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LOUISIANA

NOVEMBER 1976

FOREWORD

In 1975 members of the Corps of Engineers celebrated their organization's 200th anniversary—a remarkable record of service to the American people. Conscious of our long history, we have undertaken to secure from competent scholars accurate and readable studies of our past.

On arrival in New Orleans, I found that a history of the New Orleans District had been prepared by one of my predecessors. However, since the other publication, much water had flowed down many rivers, hurricanes had spread death and destruction over wide areas, and other major and minor disasters had occurred requiring new solutions. The Congress and the White House had also passed laws and regulations which required new thinking and new methods in promulgating new life and property saving projects. These were all taken into consideration by Dr. Cowdrey as we updated the history. He has not only brought the history up to date but he has also strengthened and upgraded the whole narrative.

The result is more than a simple district history. Here we gain appreciation of how the people of our region made their land habitable by learning to control their waterways for navigation and flood control—and then set out to solve the problems of pollution which had been caused in part by their own success. The role of the Corps in both development and protection has been a great one. For 174 years the men and women of our organization have worked for and with the Louisiana environment. Their accomplishments have woven an outstanding story that has become a study piece for students from over the world. Above all, this book is the story of the New Orleans District and its people, past and present.

EARLY J. RUSH III
Colonel, CE
District Engineer

ACKNOWLEDGEMENTS

While the author alone is responsible for the interpretations advanced in this work, and for any errors which may occur, he acknowledges fully that whatever is useful in it belongs in large measure to the many people, in and out of the Corps, who assisted him.

Preparation of the original history was made possible by assistance from Robert W. Blakeley, Chief of the Office of Administrative Services, OCE; of Dr. Jesse A. Remington, Lenore Fine, and other members of the Corps' Historical Division; of Professor Charles Roland of the University of Kentucky; and of staff members of the National Archives, the Library of Congress, and the Howard-Tilton Memorial Library. The present retitled and enlarged volume adds new material which the author garnered during his own work as a member of the Historical Division, as well as new research specifically directed at events in the New Orleans District. Materials supplied by Fred M. Chatry, Chief, Engineering Division, New Orleans District, were particularly useful.

The author's gratitude goes to old friends, and a new commander, in the District itself: to Bruce Sossaman, Public Affairs Officer; to Daniel Alloy, Chief, Office of Administrative Services (now retired); to Michele Rome, who typed the manuscript; and to members of the District, past and present, who gave him his first instruction in the ways of the Corps and who granted the interviews cited in these pages. Colonel Early J. Rush III, has presided over the project. Warren B. Dodd, Executive Assistant to the District Engineer, has done more than any other individual to make the history possible. For the many others who assisted, but whose names cannot even be listed here, the dedication of this volume will have to serve as the author's acknowledgement of their skill and efforts, freely given.

ALBERT E. COWDREY
Baltimore, 1977

CONTENTS

INTRODUCTION

In the time scale of geology, the Mississippi River is something new under the sun. In Cretaceous times, the Mississippi Embayment was an arm of the sea, and the drainage of the Middle West, halted by a range of low hills in what would become Missouri, ran north toward the St. Lawrence. Then the glaciers of the last Ice Age advanced. At the edge of the glaciers, about the line of the present Missouri and Ohio Rivers, streams ponded, merged, and sought a new outlet to the south. The falling sea level caused by the formation of the ice sheet had meantime emptied the Embayment, and across this land, which had lately been seabottom, a new river began to incise its course. This was the lower Mississippi; the time was only about 1 million years ago.[1]

During the Ice Ages the level of the sea rose and fell as the glaciers periodically melted and formed anew, and these changes were written into the valley of the Mississippi. When the sea retreated, the river cut deep braided channels into the marine deposits; returning after ages of high water, it buried its former channels under fresh alluvium. In time, despite the melting of the glaciers and the consequent rising of the sea, the Embayment filled with alluvium, and the Mississippi took its present form, a stream meandering in broad loops across the surface of a great wedge of clay and sand.[2] The present layer of earth was laid down in the last 30,000 years, and the present delta of the river—not only the outlet through Plaquemines but the five former outlets whose traces remain upon the surface sediments—took form during the past 10,000 years.[3] What men called the Father of Waters was a geologic child.

The forces that shaped the land never ceased to work. The sediment that filled the Embayment warped and depressed the faulted bedrock. The greatest earthquake ever recorded on the North American continent was caused in 1811 by a settling of the Mississippi Structural Trough near New Madrid, Missouri. The last attempt of the Mississippi to form a new outlet was frustrated by the works of man in the mid-20th century. The land the Mississippi built continued to change, as Lafcadio Hearn wrote of its islands a century ago, "more slowly, yet not less fantastically, than the clouds of heaven."[4]

The Alluvial Valley or flood plain of the Mississippi emerged as a region of rich bottom lands averaging 50 miles in width that ran south some 600 miles from Cape Girardeau, in the Commerce Hills of Missouri. Here, long before the coming of European man, the river established its own unique "regimen." In times of low water, it ran in a channel bounded by natural levees raised above the level of the plain. These levees took form because the heaviest burden of silt precipitated near the edges of the river during overflows. During great floods, on the other hand, much of the flood plain became the channel of the Mississippi—28,000 square miles of swamp and forest that played an essential part in the river's functioning.[5]

The swamps were natural reservoirs that prolonged but mitigated floods by retaining vast quantities of water during rises and releasing it again as the river fell. Near the Gulf, natural outlets—Bayou Plaquemine, Bayou Manchac, Bayou Lafourche, the Atchafalaya River—helped to carry off the water. Flooding was a natural, almost yearly phenomenon, not a devastating occurrence at intervals of decades. Utilizing its flood plain, the river expanded or contracted according to need. It constantly changed its channel, yet retained an approximately stable length. Always eroding the concave banks of its many turns, the Mississippi gradually shaped them whenever the land would allow, into immense nooses. Then, in times of flood, it cut off one or more noose, shortening its length by as much as 15 miles. But within the new, direct channel its velocity increased, undermining some weak bank below the cutoff. The increased erosion below soon compensated for the length that had been lost upstream. The bends of the Mississippi migrated southward over the course of ages, yet the river became what engineers called a "poised stream"—one with all its major forces in balance.

When men set about building a civilization in the flood plain, they had to interfere with this natural balance. Unless they were willing to give up cities, towns, large-scale agriculture, and industry, and live at a subsistence level, the river had to be restrained. To raise its natural levees was the simplest and cheapest course, and the first Europeans had hardly settled in the Valley before they adopted it. Yet, the levee system cut across the regimen of the river at almost every significant point. Land-building ceased with the seasonal overflows. The river in flood was denied use of the Alluvial Valley and confined to its low-water channel, plus whatever additional cross section the levees themselves could provide it. The swamp reservoirs were cut off. For various reasons the distributaries were tampered with.

Inevitably, the waters rose as they were constricted. Pressures against the levees increased. Floods ceased to be yearly phenomena at the cost of becoming infrequent catastrophes. During great floods the whole immense mass of water, moving at great velocity, debouched upon the Delta. Here the changes taking place on the whole river registered their combined effect.

The deltaic plain was the part of the Valley in which major tributaries ceased to enter the river and distributaries begin to leave it.[6] Above the deltaic plain the points of land where the Mississippi met with other streams pointed south; within it they pointed north. By this reckoning the Delta began at Old River, above Baton Rouge, where the Red River entered and the first and greatest distributary, the Atchafalaya, left the Mississippi.

The Delta was a curious landscape. Most of the world was sky. Almost absolutely flat, the land broke up near the sea like a puzzle into the streams and hummocks of the salt marsh. Vulnerable to rising water brought by the river and to the wind and falling water of tropical storms, society required artifice to survive in a region where nature might reasonably have asked a few more eons to finish a work of creation that was incomplete.

Since 1803, the U. S. Army Corps of Engineers has played a constantly increasing role in adapting the Delta to the requirements of man. The Engineers have been charged with opening the streams to commerce, protecting farmlands and cities from flood, and cleaning up the ruin after storms. They have had to deal with the great river in all its moods—and, as Mark Twain said, " one might as well bully the comets in their courses... as try to bully the Mississippi into right and reasonable conduct."[7] Since the Louisiana Purchase, their achievements and failings have written much of the Delta's history.

In 1970, some 3.5 million people inhabited the New Orleans District. The population was growing; industry and cities were spreading. But beneath the visible society was a physical substructure little noticed by visitor or resident—the delicate artifice of flood and storm control which made human settlement possible at all.[8]

CHAPTER ONE

THE AGE OF LOCALISM

The French were the first Europeans to struggle with the problems of the Mississippi. Columbus may have seen the mouths of the river during the course of his mysterious fourth voyage—the River of Palms shown on the "Admiral's Map" in the Spanish archives has been called the first portrayal of the Passes of the Mississippi.[1] DeSoto did see the river, and after his death his followers became the first Europeans to witness a Mississippi flood, a great one that lasted 80 days and drowned the land to the branches of the tallest trees.[2] But the exploration of the Spanish left no mark outside their chronicles.

Instead, it was the French, late in the 17th century, who explored, built forts, made treaties with the Indians, and scattered the banks of the river with names that have clung to it ever since. When, in 1717, Jean Baptiste LeMoyne, Sieur de Bienville decided to move the capital of his colony from "the sterile lands of *Biloxi*, *Mobile*, and *St. Louis Bays*, to the rich country bordering the Mississippi,"[3] he began the changing of the Delta's landforms. For the site he chose, though higher than the surrounding swamp, was subject to overflow and had to be protected if it was to be inhabited at all.[4] Sieur Blond de la Tour, one of Bienville's engineers, examined the site and found "only... some unimportant houses, scattered here and there, made by voyageurs who had come down from Illinois." The region seemed so unpromising that he protested against establishing the capitol there; overruled by Bienville, he had a "pretty long and wide" strip cleared along the river and set to work:

> ...with the help of some piqueurs, he traced on the ground the streets and quarters which were to form the new town, and notified all who wished building sites to present their petitions to the council.... It was ordained that those who obtained these plots should be found to enclose them with palisades, and to leave all around a strip at least three feet wide, at the foot of which a ditch was to be dug, to serve as a drain for the river water in time of inundation. The Sieur de la Tour deemed these canals, communicating from square to square, not only absolutely necessary, but to preserve the city from inundation, raised in front... a dike or levee of earth, at the foot of which he dug a similar drain.[5]

By 1727 New Orleans had a levee over a mile long, a yard high, and 18 feet wide at the top.[6]

As the levees grew, the French, in 1724, introduced the practice of holding riparian landholders responsible for maintaining them. The reason, of course, was that the people settled first on the high lands of the natural levees. Not only were these lands safer from floods, they were exceptionally fertile, for the river deposited large-particled loam upon the banks and carried the finely-divided and much less workable clays into the backlands. Also,

Laying out New Orleans.

mists flowed into the lowlands and crops saturated with heavy dews could be killed by a brief dip of the temperature below the freezing point. But as the backlands were settled, riparian dwellers increasingly resented the servitude written into their deeds. The levees protected all, but all did not do their share in the cost of maintenance. The flood of 1735, marked not only by its high stages but by its six-month duration, destroyed most of the levees in the young colony. The landowners were evidently remiss in replacing them, for an ordinance of 1743 threatened them with forfeiture of their property unless the levees were completed by the first of the following year. The practice of entrusting vital and very expensive public works to a few individuals meant that low, weak levees built to no standard and maintained with ignorance and ill grace became the rule.

The Louisiana Purchase brought an influx of new settlers, but no change in basic levee law. American Army Enginers had other duties. Major Decius Wadsworth of the Corps was sent to the new territory at the time of its transfer to the United States,[7] but his duties were military—to survey the defense of a remote and vunerable acquisition.[8] Civil duties would not begin until the War of 1812 had come and gone.[9]

Despite the exploits of Perry on the Lakes and of Jackson at New Orleans, the war by and large was a humiliating affair. Every failing of American society and every weakness of American arms was mercilessly revealed.

American soldiers often fought badly. The huge country was still mostly wilderness, and moving troops to any spot threatened by an enemy was a slow and costly business. Jackson's presence at New Orleans was as much a matter of luck as of management. And danger did not come only from outside. Sectional loyalties were strong, and a party of New Englanders threatened to secede from the Union when the war ruined their trade. The peace was hardly signed when America began to make preparations for an "inevitable third war" against England. The lessons of 1812-1815 were studied by national leaders with added urgency because they were convinced that a new war would be fought, and that it would be essentially a replay of the one just past. From this belief grew a new program for America, masterminded by such leaders as Henry Clay and John C. Calhoun. To protect the country against the British fleet, the seacoast must be ringed with defenses. To bind its people together a national system of communications must be built. A new kind of government would be needed to carry out this program. Vast works which promised little immediate profit would have to be financed by the Federal Government or the states. Since the United States was an undeveloped country, where skill went at an even higher premium than capital, the Army Engineers began to take on a variety of unaccustomed duties.

Founded in 1775, the Engineers had an erratic history before the 19th century. On the day before Bunker Hill the Continental Congress had provided for one chief engineer and two assistants to be assigned to the army. Late in 1776, Washington had been authorized to raise a Corps of Engineers to serve for 6 months.[10] The Corps was formally organized in 1779, but disbanded after the conclusion of peace in 1783. A Corps of Artillerists and Engineers was created in 1794 when war threatened again, but the modern Corps of Engineers did not take form until 16 March 1802. At that time, Congress authorized the President to establish a corps of 16 officers and 4 cadets, to "be stationed at West Point, in the State of New York, and... constitute a Military Academy; and at all times to do duty in such places and on such service as the President of the United States shall direct."[11] At its beginning, then, the Corps included West Point, and the Military Academy formed the only school of engineers in the United States until the establishment of Rensselaer Polytechnic in 1824.[12]

Soon civil duties beckoned. At the time of West Point's founding, President Thomas Jefferson had looked forward to a civil role for its graduates, and the needs of an undeveloped nation soon made his hopes a reality. As a French visitor to the United States noted in the 1830's, "the greatest difficulty which the Americans encountered in the execution of their public works, was not to procure the necessary capital, but to find men capable of directing operations." The "officers of the engineer corps and of the topographical engineers," he pointed out, "were those who filled the need."[13]

Both civil and military roles took form in Louisiana. In any program of national defense, the state, site of a British invasion, would be one of the points to be protected. On 21 March 1815—less than 3 months after the Treaty of Ghent was signed—Brigadier General Joseph G. Swift, the Chief Engineer, wrote acting Secretary of War Alexander J. Dallas that he had made arrangements for sending

> ... Officers of Engineers to the various Important Ports and harbors between Maine and New Orleans, for the purpose of Inspection, and Reporting fully upon, the present state of Fortifications—and to select, if requisite, judicious Sites for New Works to protect the principal positions on the Sea Board and the avenues to them. —I have commenced upon the above plan by sending an Officer of Engineers to South Carolina

> and Georgia, and I have Officers ready to proceed to Mobile and New Orleans—I shall retain this office in N. Y. 'til I receive your orders upon this subject—[14]

Lieutenant Hyppolyte Dumas was dispatched to Mobile and New Orleans, and the next year, Lieutenant James Gadsden followed. Repairs were started on local forts. Gadsden was promoted to captain, and by November 1818 had received the title "Superintending Engineer for the Gulf of Mexico Frontier." By this time Spain had ceded Florida to the United States, and Gadsden reported to Major General Andrew Jackson, Commander of the Department of the South, on the conditions of the Florida fortifications, especially of Barrancas in Pensacola Harbor.[15] Thus, Engineer work in Louisiana began to shape up. Their first responsibility was to fortify the nation's soft underbelly; the Gulf region was to be treated as a unit, and placed under a superintending engineer. This pattern would remain unchanged until the 1850's.

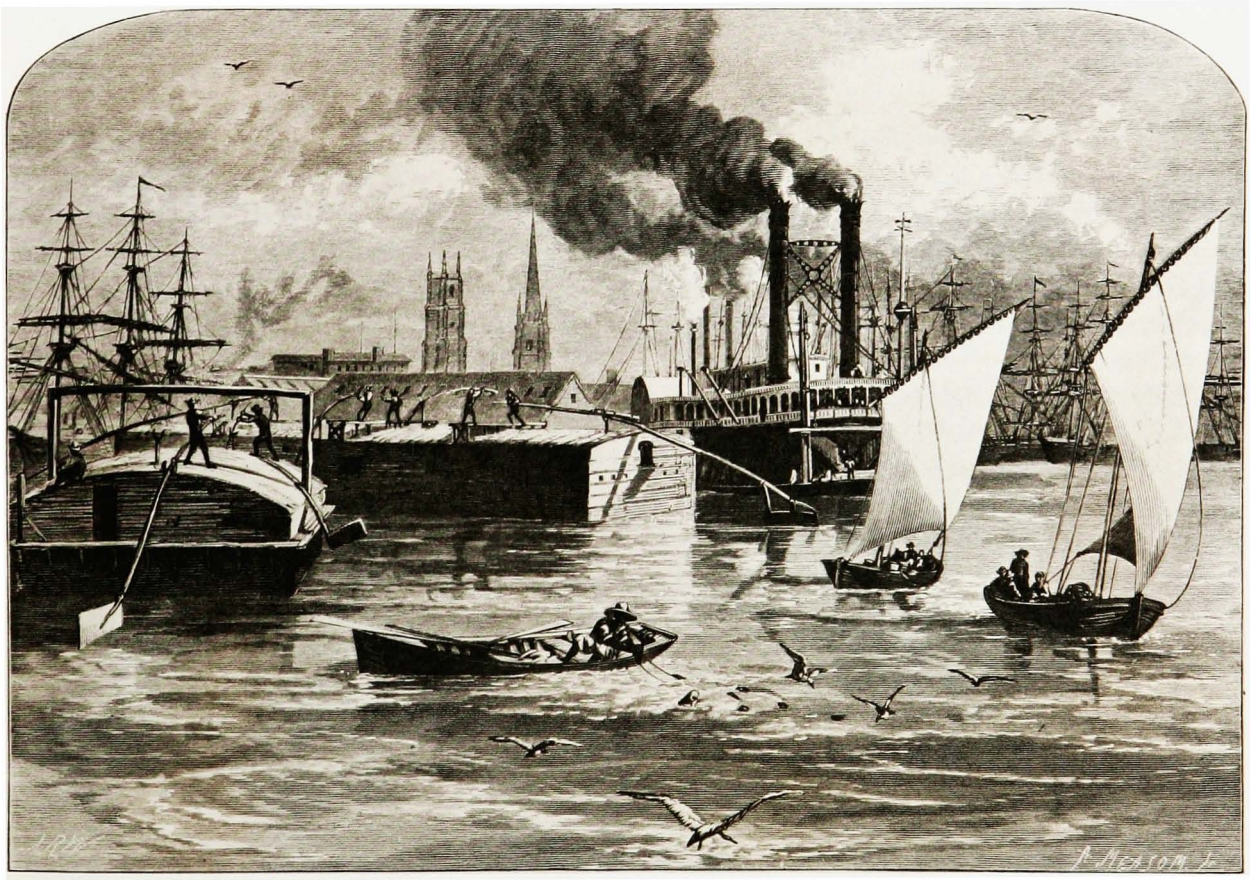
Linked to the new military activity was a plan for unifying the nation by constructing a network of national roads and canals. Originally sketched by Treasury Secretary Albert Gallatin in Jefferson's time, the internal improvement program received a new impetus from the experiences of war. Aided by favorable laws and court decisions, growth of the program during the 1820's decisively enlarged the mission of the Corps of Engineers.

In 1816, on the authorization of Congress, President Madison employed Simon Bernard, one of Napoleon's engineers, and assigned him to the Corps of Engineers with the rank of brigadier general. A Board of Engineers for Fortifications was then created, with Bernard a member. Despite considerable jealousy from his American colleagues, Bernard played a decisive part in the development of the Corps during the succeeding decade.[16] Bernard and his fellow members of the Board embarked on an exhausting program of travels about the country, beginning at New Orleans in February 1817.[17] Here Captain William T. Poussin, one of a staff of topographical engineers recently employed by the government, joined him the following month.[18] Together with Lieutenant Colonel Joseph G. Totten, another member of the Board, these officers played an important role in shaping the new national policy. Bernard, Gadsden, and a third officer formed a Board of Commissioners on the Gulf of Mexico Frontier and recommended the sites to be fortified. Gadsden was appointed to superintend the work, which the Chief of Engineers enumerated as "the Works at Mobile Point, at the Rigolets, at Chef Menteur, at Plaquemine(s) and at Grand Terre." He was promised "such assistants as the strength of the Corps will permit," and the Chief of Engineers undertook to advertise for proposals to furnish "Brick & Stone & Workmen at Mobile, Lake Pontchartrain, River Mississippi & Lake Barataria."[19] A contract for the fortification work was signed with a civilian, Nathaniel Cox, who was to serve as "Agent (of) Fortifications" at New Orleans. Provision was made to spend about $43,000 per month for "nearly three years," according to the optimistic first estimate of the Chief of Engineers.[20] Between 1819 and 1830 the future Forts Jackson, Macomb, Pike, and Livingston—and the smaller Battery Bienvenue and Tower Dupres on Lake Borgne—began to rise. In 1841 work started on Fort St. Philip as well. Most formidable of the forts was Jackson, a structure combining great strength with enormous firepower. Gaining fame in the Civil War, the fort would defend the river until 1898.[21]

Meantime, Congress at the urging of representatives from the developing west, began to make provision for exploring and mapping the Mississippi and Ohio, and clearing obstructions from their channels.

Traffic on both rivers was swelling as their borderlands were settled. The farmers of the Ohio country still shipped their produce to New Orleans by raft and keelboat, but in 1811 the steamboat began its career upon the western waters. In 1819 Congress authorized the Engineer Department to survey the tributaries of the Mississippi,[22] and in 1820, it voted $5,000 for a survey of the Mississippi and Ohio, "for the purpose of facilitating and ascertaining the most practicable mode of improving the navigation of those rivers."[23] During the last three months of 1821 Captain Hugh Young, Captain Poussin, and Lieutenant Stephen Tuttle carried out the survey under the direction of the Board of Engineers, mapping the river with considerable thoroughness from St. Louis to New Orleans. The Board's report of 1822, based upon the work of these officers, helped to influence Congress to undertake clearance of the river. The main danger to navigation was "snags," dead trees toppled into the river by caving banks. Some of these, called "planters," became fixed in the bed of the stream; others, called "sawyers," were more loosely anchored, and oscillated with the current just below the surface of the water. Snagging was an obvious first step to make the river a useful commercial and military highway. Though superficial by later standards, much of the language of the report passed into that of a House committee which recommended government action.[24]

Armed with the report, Westerners and Southerners argued that the navigation of the great river was as much a national concern,



The Mississippi at New Orleans.

and as deserving of the taxpayer's dollar, as ocean commerce. However, many lawmakers doubted that the Federal Government had constitutional authority to improve rivers. In the spring of 1824, Chief Justice John Marshall decided in the case of *Gibbons* v. *Ogden* that Congress held power over commerce on all navigable waterways—a legal breakthrough that made the federal civil works program possible. Congress acted, and on 24 March 1824 President James Monroe signed the first law committing the Federal Government to improve the Mississippi River.[25] Seventy-five thousand dollars was appropriated to enable the government to build and operate snag boats to clear the Mississippi from the mouth of the Missouri to New Orleans, and the Ohio from Pittsburgh to its junction with the Mississippi. This work would continue with some interruptions until 1854.

Congress next turned to surveys. An act of 30 April 1824 authorized the President to employ Army Engineers to draw up surveys, plans and estimates "for the routes of such roads and canals as he may deem of national importance, in a commercial or military point of view, or necessary for the transportation of the public mail...."[26] The language of the act clearly reflected the government's new, close ties with private capital. Members of the Engineers, especially the Topographical Engineers, now were loaned to private companies whose activities were supposed to be of national interest.[27] In this capacity the Topographical Engineers surveyed, among other works, the Chesapeake and Ohio Canal and "the railroad from Baltimore to the waters of the Ohio." In addition, work progressed under Engineer guidance on the Cumberland National Road, surveys for the improvement of the Tennessee River at Muscle Shoals, and for a proposed canal across Florida. A national road from Washington to New Orleans, also projected, bogged down in political squabbles among the proponents of four competing routes.[28] Considering that at this time the Corps consisted of 22 officers and 10 full-time Topographical Engineers, the ubiquity of its members and the importance of their activities were astounding.[29]

Yet the program of internal improvement was politically premature. After 1828 Andrew Jackson emerged as the popular spokesman of all the interests which did not share in the benefits of the American System. He broke up the alliance between government and business, crushed the Bank of the United States, and condemned Federal partnership with private capitalists. He proposed to turn the job of improvement over to the States, and vetoed a test bill giving Federal aid to the Maysville Road Company in Kentucky. Since the Maysville Road would have run past the plantation of his archenemy Henry Clay, there was some question of personal spite about the veto.[30] Later, however, Jackson developed a set of standards for future projects which went beyond the politics of personal revenge. He ruled that internal improvement projects were to receive the aid of the United States only if they related to the seacoast, to navigable waterways, or to the transshipment of foreign commerce in some clear and direct way. Then, to drive home his point, he vetoed a Rivers and Harbors Act, and threatened to do the same with others in the future.[31]

It will surprise no one familiar with the ways of politics to learn that Jackson's administration backed many activities of precisely the sort which the President condemned. Indeed, by contrast with his successors in the White House, Jackson was rather favorable to internal improvements.[32] Yet, his administration did mark a turning point, after which such projects increasingly fell victim to constitutional scruples, state jealousy, and sectional conflicts. A law of 1838 forbade Topographical Engineers to work for private companies.[33] Survey work for railroads had ended and was not resumed until the

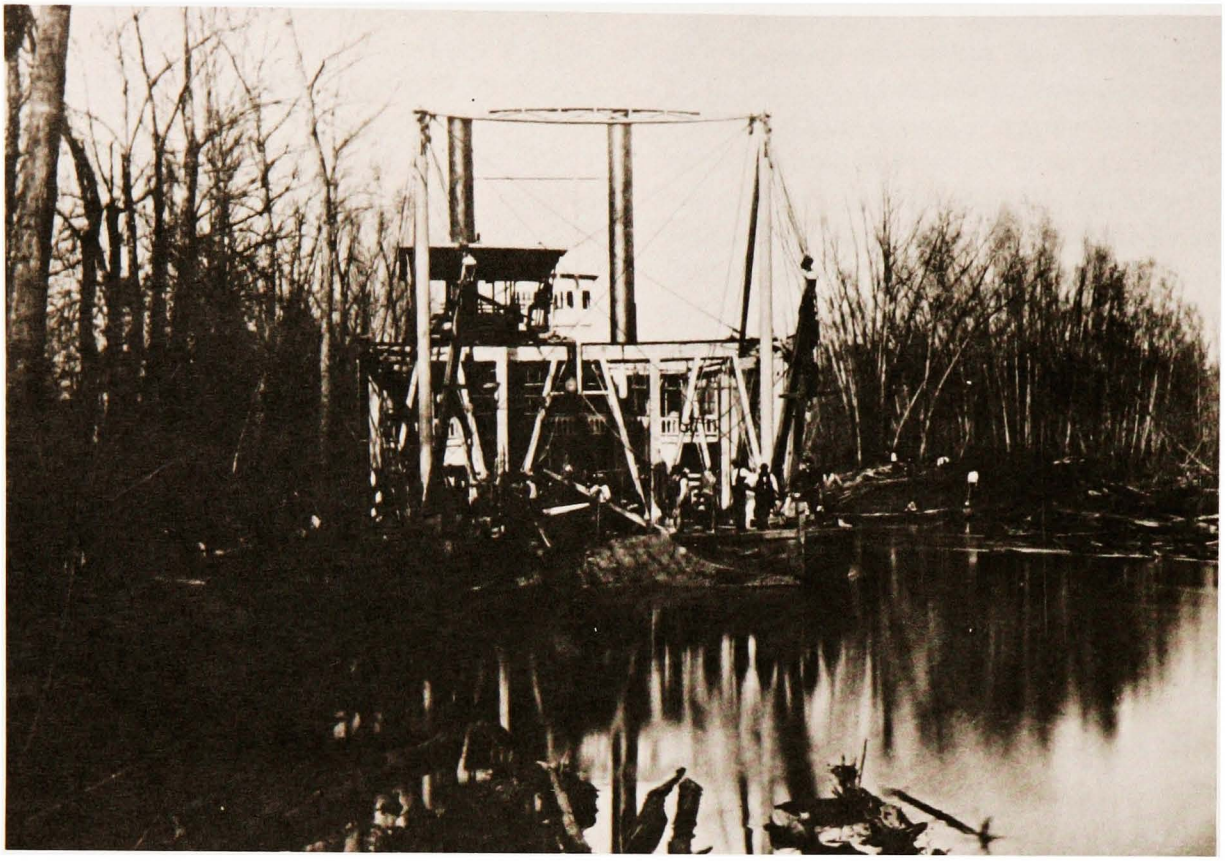
1850's. Other forms of improvement suffered more than the railroads, whose profits attracted private capital and local aid. Failure of Congress to make appropriations several times interrupted the work of the snag boats, and in 1855 the government sold the boats and abandoned the Mississippi to nature. The civil-works program was in decline. Great continuing works were undertaken by fits and starts, appropriations for the year ahead could never be counted upon, and promising works begun in one season were abandoned in the next. Fundamentally, the United States was a country of strong local loyalties, whose people believed in keeping the national government weak and its budgets small. Not until the emergence of the Republican Party would a power come on the national scene capable of gathering and applying the political force necessary to a continuing program of Federal action, and then only after the Civil War had permanently altered the nation's priorities and its ideas of the nature and powers of the national government.

Engineer operations in the Gulf region during these years included snagging carried out under the Chief of Engineers upon the Mississippi River; that of resident military Engineers at New Orleans on the fortifications of the city; and civil works occasionally assigned to these same men. In addition, the Topographical Engineers—after 1831 organized as a separate bureau of the War Department—carried out important survey work, culminating in the great Delta Survey of 1850-1861, one of the decisive events in the history of the Alluvial Valley.

These Federal efforts were supplemented by a determined effort on the part of the riparian states to reorganize the work of levee building on a sounder and more imaginative basis. After the great floods of 1849-1850 Congress also made an interesting though unsuccessful attempt to help the states to help themselves, as a substitute for direct Federal action. Finally, the period before the Civil War was marked by the appearance of river conventions, drawing support from a variety of interests along the river and from politicians as diverse as John C. Calhoun and Abraham Lincoln. The sum of all these efforts, Federal and state, was to demonstrate the ineffectiveness of uncoordinated local action, to give both the states and the Engineers some preliminary experience in organizing to meet the problem of the river, and to give those entrusted with the Delta surveys—the civil engineer Charles Ellet and the Topographical Engineers Captain Andrew A. Humphreys and Lieutenant Henry L. Abbot—the chance to draw up comprehensive plans for Federal action in the Valley.

On the Mississippi River, the snag boats were for years directed by their inventor, Henry M. Shreve. Famous as a steamboat builder and operator, Shreve was appointed as civilian superintendent of improvements on the Mississippi and Ohio and held the post from 1826 to 1841. He designed and built the first snag boats, and under general supervision of the Engineers worked indefatigably to clear the banks and channel. A man of immense energy, unencumbered by "book learning" and ready to dare anything, Shreve was a good representative of his age. His work extended to the Red River, which he found blocked by a gigantic raft. At the urging of Chief Engineer Colonel Charles Gratiot, he attacked the raft, snagging and blasting the dead trees and blocking up bayous by which the river had found ways around the obstacle. Restoring a moderate current to the main channel, he broke through into the upper river.[34] In 1835 he founded Shreve's Landing in what was still the territory of the Caddo Indians. The town was incorporated in 1839 and in 1871 would be chartered as the city of Shreveport.

Other efforts by the redoubtable "captain" were not so lucky. He tried several experiments with cutoffs, including one across



Scenes of the Great Red River Raft—1873.

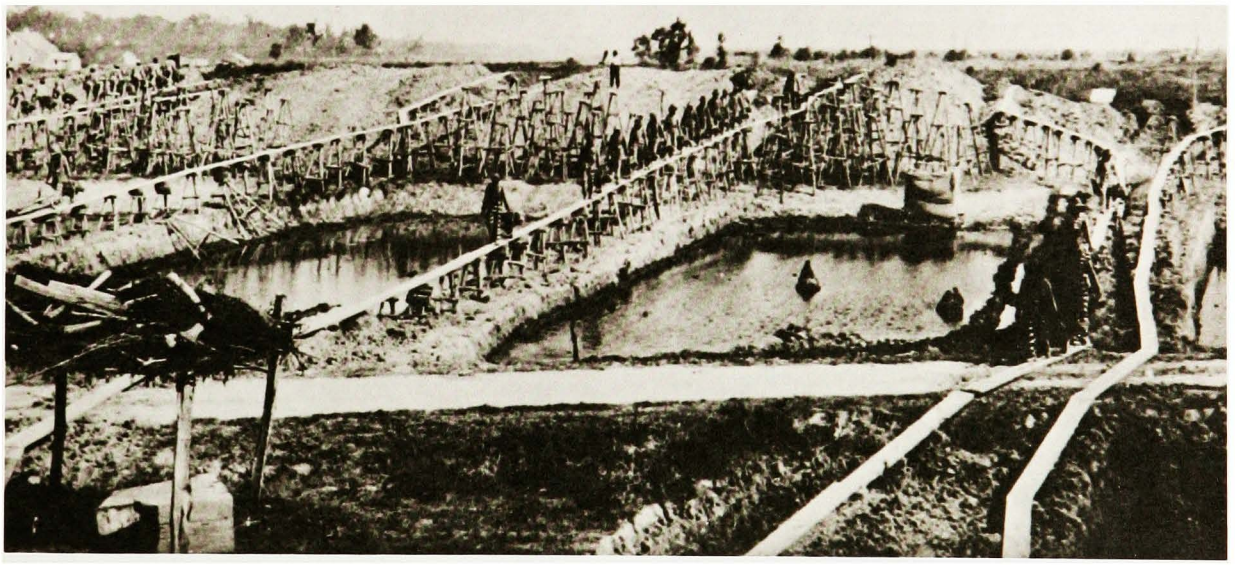
Turnbull's Bend where the Red River entered the Mississippi and the Atchafalaya left it. His purpose was to shorten the river and to permit steamboats to avoid shoals which had formed below the Red, but his work created a puzzle of five distinct channels—the Mississippi, the Red, the Atchafalaya, and the Upper and Lower Old Rivers (as the branches that had formed Turnbull's Bend came to be called), which plagued the Engineers until the middle of the twentieth century.[35] Moreover, "Shreve's Cut-Off," as contemporaries called it, along with Raccourci Cutoff which the State of Louisiana ordered to be made against the advice of its own state engineer, became the subject of studies by Ellet, Humphreys and Abbot, and many others. These studies made a general prohibition against cutoffs a part of accepted engineering lore. Not until the 20th century would the Engineers prove the controlled cutoff to be feasible.[36] A dominating figure in the history of the Valley, Shreve's influence was not always for the good. His bold, experimental approach led him into far-reaching errors as well as brilliant inventions and achievements.

Experiment, successful and unsuccessful, also characterized the efforts of the states to work out successful flood control policies. Action was essential; in Louisiana alone, nearly 5 million acres remained subject to periodic flooding. Until midcentury, the old reliance upon riparian landholders to build and maintain the levees continued without significant change. However, this policy became increasingly unrealistic as settlement

went apace behind the natural levees. Riparian owners demanded, and eventually compelled, their states to tax all residents in proportion to the benefits received. In Mississippi, taxation of the backlands began in 1846, though responsibility for actual levee construction remained a servitude of the riparian holders. By 1856 a complex system had emerged in Louisiana based in part upon the new and useful concept of the levee district. A levee district might be a parish or several parishes combined; it was run by a board of commissioners who possessed power to tax all residents of alluvial land, to let contracts, order new levees constructed, and repair old ones. Power to issue bonds was granted later in the century. The commissioners also were empowered to call out forced drafts of slaves to combat crevasses. "The (levee) Commissioners," wrote the Louisiana civil engineer Caleb G. Forshey, "employed engineers, enacted rules for levee dimensions, and raised this work of protection to the dignity of a profession."[37]

In 1849 and 1850 extremely severe flooding occurred, inundating a large part of New Orleans as well as the Delta farmlands. Congress, anxious to help insofar as states-rights dogma would allow, enacted the Swamp Lands Act, which granted the riparian states about 27.8 million acres of flooded lands lying within their borders. The states were to levee and drain these lands, and to pay for the work by selling the reclaimed land, which would presumably rise in value as the work progressed. The attempt to solve the flood problem by creating a sort of perpetual-motion machine, with revenue producing improvement and improvement producing revenue, ran as well as most such machines. The cost of reclamation was underrated, the work itself—notably in Louisiana—grossly mismanaged, and by the mid-1850's the scheme had evidently failed.[38]

Yet groundwork for national action was laid as a result of these same floods. In 1850 Congress appropriated $50,000 for a topographical and hydrographical survey of



Levee Building—old style. Convict and free labor work side by side at the Morganza Crevasse, 1890.

the river.[39] The decision to try to learn something about the Mississippi before attempting to control it was as wise as it was unusual. The Bureau of Topographical Engineers was assigned the work, and Captain Andrew A. Humphreys and Lieutenant Colonel Stephen H. Long undertook the survey, which was to last, with long interruptions, for 11 years.[40] At the same time, Charles Ellet, a civil engineer, began a second survey under the direction of the Secretary of War. The result was not only a fresh and comprehensive look at the river, but a vigorous clash of ideas whose outcome helped to shape Federal policy for generations to come.

Ellet's study of the river was relatively brief, and his report, *The Mississippi and Ohio Rivers* was published in 1851.[41] Roughly handled by Humphreys and Abbot, Ellet's work also received discriminating praise from later Engineers.[42] Its greatest weakness lay in a lack of extensive and precise measurement of the river's actual form and behavior. Ellet wrote:

> It is not the intention here, however, to enter into a minute discussion of the uninteresting and almost useless details of the recent floods in the lower Mississippi. The great object before us—to contrive measures for the protection of the Delta from overflow—is not to be attained by a microscopic examination of such local phenomena.[43]

Humphreys was to rest his conclusions upon precisely such a "microscopic examination." In consequence, even when he drew wrong conclusions, he was believed; even when Ellet drew right ones, his work remained suspect to the river's engineers. Ellet's work also betrayed its author's hobbies and private enthusiasms, too often with an insufficiency of proof that made the book an easy target for critics. *The Mississippi and Ohio Rivers* was eloquent on the possibilities of using reservoirs both to impound floodwaters and to release them at low-water stages for the improvement of navigation. Ellet ignored—as his critics were quick to point out—the unsuitability of the flat Alluvial Valley for dams, the role of rainfall within the Valley itself in causing floods, and the critical questions of precise location, feasibility, and cost in tributary basins where dams might be appropriate.[44]

The strength of Ellet's book was intuitive, and this strength was to be visible mainly in retrospect. While Humphreys committed himself to the "levees only" thesis, Ellet viewed the levee system as no better than a necessary evil.[45] He saw the river controlled by a complex of different means, mutually supplementing one another. Levees, reservoirs, and artificial outlets, working together, could control the river, he thought; no single engineering work, by itself, could accomplish that goal. He discerned the fact that the levee system would raise flood heights, and he warned against optimistic efforts to gloss over a serious danger.[46] Later generations would give Charles Ellet very high marks indeed as a prophet.

Appearing 10 years after Ellet's work, the *Physics and Hydraulics* of Humphreys and his new associate, Lieutenant Henry L. Abbot, used the earlier work as a foil and often took the form of an adversary document.[47] In some matters, it should be noted, the two reports were in substantial agreement. Both opposed the creation of cutoffs, on the ground that they raised flood heights below the cuts while lowering those above. Both failed to see the possibility of a controlled outlet for the river—the modern floodway or spillway—for use only in time of great floods. But these agreements did not obscure a basic contrast in methods, conclusions, and style.

For the *Physics and Hydraulics* was strong at almost every point where Ellet was weak, and correspondingly weak where he was strong. The book's claims were large, and they

were made without hesitation:

> A plan of investigation was adopted far more extended than any previously attempted upon any river.... The operations necessary to carry out this plan, it was conceived must furnish the mass of material essential to establish the fundamental principles of river hydraulics .... All knowledge requisite to accomplish the objects of the present investigations has been secured.[48]

As in the Gospel, people listened to Humphreys and Abbot at least in part because they "spoke as one having authority." But this authority was based upon measurements of a rigor, comprehensiveness and ingenuity that helped to establish a new standard for engineers, not only in the United States but abroad. Abbot and his civil and military assistants measured the intricate effects of the swamp-drains, and discerned the importance of rainfall in the Valley itself in causing floods. They produced a descriptive analysis of the river's bed and cross sections, of the behavior of its sediments, of the effects of crevasses, that had never been approached for thoroughness. They tried to sum up the behavior of the river in a comprehensive equation that would provide a basic tool for improving all large streams. Their work became a monument in engineering literature, and in the efforts of Americans to understand, so that they could control, the Father of Waters.[49]

Nevertheless, the very importance of the *Physics and Hydraulics* perpetuated its errors as no lesser work could have done. Humphreys and Abbot believed that the bed of the Mississippi was not ordinary alluvium, but an ancient blue clay laid down in a previous geological epoch, and, most important, that a levee system would itself protect the Alluvial Valley from floods. Neither assertion was true, but inclusion in the *Physics and Hydraulics* guaranteed perpetuation of these errors. Finally, the distinguished career that lay ahead of Humphreys—as a hero of Gettysburg and the Wilderness, and as Chief of Engineers after the war—would give the father of the *Physics and Hydraulics* the power, the opportunity, and the temptation to try to make his work an official dogma rather than a scientific study. How he succumbed to that temptation will be recounted in the next chapter.[50]

By comparison with the great surveys of the Topographical Bureau, the early history of the Corps of Engineers in the Gulf region was a record of beginnings rather than of mature achievements. Nevertheless, in the decades before the Civil War the Engineers evolved a mode of organization, built or completed fortifications that were to play a great role in the war, and made significant beginnings in several important public works near New Orleans, including efforts to clear the passes of the Mississippi.

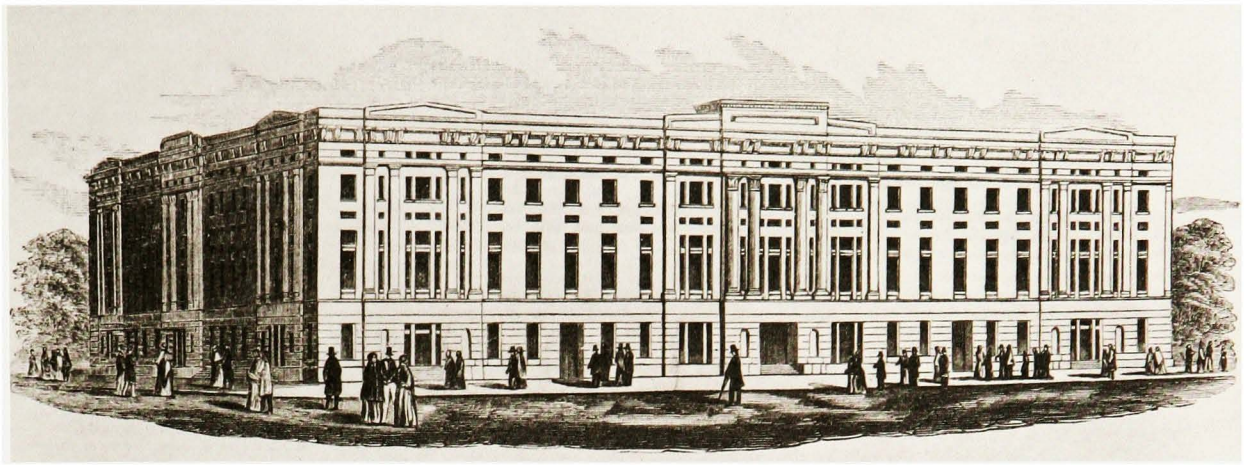
Until 1828 the Superintending Engineer for the Gulf of Mexico Frontier—Captain (later Major) William H. Chase—resided at New Orleans. In that year the government's decision to fortify Pensacola caused Chase to move his headquarters to the site of the work. The Corps attached great importance to the future of Pensacola, with its fine natural harbor, and Engineer officers investigated the possibility of connecting it with Mobile Bay, the Mississippi Sound, Lake Pontchartrain, and the Mississippi River by a protected waterway paralleling the coast.[51] Pensacola became the center of military activity in the Gulf, and it was from this spot that Chase exercised general supervision of the whole "frontier" until the 1850's. Apparently no officers were permanently stationed at New Orleans between 1834 and 1839, but in March 1840 Captain John G. Barnard arrived to superintend the construction of Fort Livingston on Grand Terre Island in Barataria Bay. In September he received an assistant,

Second Lieutenant Henry L. Smith, who was to serve consistently in the area until his death in 1853. A year after Barnard's assignments, First Lieutenant Pierre G. T. Beauregard was sent to New Orleans on temporary duty from Pensacola, where he had been Chase's assistant. This native Orleanian apparently liked serving at home, for he contrived to remain there pretty consistently except when called away to war. In May his temporary duty ended when he was assigned to superintend Forts Pike and Wood (later called Macomb), the guardians of the Rigolets and Chef Menteur. Barnard meantime had undertaken repairs of Fort Jackson and the old French Fort St. Philip on the Mississippi River.[52] Thus the organization of the Gulf Coast emerged as a prototype Engineer division, with headquarters at Pensacola and resident officers at New Orleans and other important points.

Though the "division" was at first concerned only with fortifications, its members gained experience in both field service and civil works during the decades before the Civil War. The approach of the Mexican War brought Chase and Barnard assignment to a special Board of Engineers to "examine the Gulf Coast with reference to defense." When fighting broke out, Beauregard was sent to Tampico, while Barnard remained at New Orleans until 1847, when he was ordered to report to Captain Robert E. Lee, chief engineer with Winnfield Scott's army. Six months later the war was over, and Barnard and Beauregard returned to New Orleans to resume their regular duties. Beauregard, however, won the rank of brevet major for his work in Mexico, and after some shuffling to and fro, he emerged in 1852 with responsibility for the forts formerly under Barnard's command. At about the same time he undertook, on orders from Washington, an ambitious though short-lived program of civil works as well.[53]

The Mexican War had caused a flareup in the quarrel between North and South, as the sections debated the future of slavery in the conquered territories. But in 1850 the dispute was apparently settled by compromise. With a Whig President in the White House, a brief revival of interest in Federally-financed internal improvements took place in 1852-1853. Beauregard examined a site for a proposed harbor on Lake Pontchartrain, directed the construction of New Orleans' new Custom House for the Treasury Department, and attempted to open a ship channel from the Mississippi into the Gulf. In addition, a variety of river and harbor works in Mississippi and Louisiana—and, shortly afterward, in Texas as well—were assigned to First Lieutenant Henry L. Smith. When Smith died of yellow fever at Madisonville during the epidemic of 1853, Texas was turned over to Beauregard and later to his assistant Second Lieutenant Walter H. Stevens. These endeavors of the early 1850's were a preview of future duties of the New Orleans Engineer Office.[54]

At the time, however, they were premature. The period of civil works activities under Millard Fillmore was short-lived, like his Presidency. In 1853, Franklin Pierce, a strict constructionist with a cabinet dominated by states-rights advocates, came to power. Not only did appropriations for civil works almost cease in 1854, but well-established policies for the congressional appropriation for snag boats, and his secretary of war—Jefferson Davis, future president of the Confederacy—sold the boats in 1855 for about one-fifth of their cost to the firm of Eads and Nelson, of St. Louis. James Eads, future builder of the Mississippi jetties, and his partner then offered to contract with the government for the clearance of the Mississippi, Missouri, Ohio, and Arkansas Rivers, guaranteeing as a condition of payment that the number of steamboat wrecks caused by snags would be reduced by 30 percent within 5 years.[55] The proposal passed the House but died in the Senate. The results were



The New Custom House, at New Orleans.

disastrous. In their last working year, ending 30 June 1854, the boats removed over 56,000 obstructions from the river. When operations were resumed a decade later the Mississippi would have become a maze of snags and wrecks, including wartime casualties of the fighting that marked the passage of Farragut and Grant. The Federal Government then would have the job of replacing the boats at greatly inflated postwar prices.[56]

By the mid-1850's all national concerns were being pushed aside by the renewal of sectional conflict. As if to signal the end of an era, Major William Chase, the pillar of the Engineers in the Gulf region since the 1820's, was reassigned in 1856, and resigned from the Corps in October of the same year. On 9 April 1857 the Corps created a Board of Engineers for the Gulf Coast, of which Beauregard was ranking member, the others being Stevens (New Orleans and Galveston), Captain John Newton (Escambia Country—that is, Pensacola—Florida), and Captain Danville Leadbetter (Mobile). Corps organization in the region remained in approximately this form until the eve of the Civil War.

In November 1860 Beauregard was appointed superintendent of West Point, and on 5 January 1861 was relieved of his duties at New Orleans by Brevet Second Lieutenant William H. McFarland. Within a week the works near New Orleans were "wrested from the U. S. by insurgents." Beauregard returned to New Orleans on 25 January and resigned his commission effective 20 February 1861. Stevens followed his example.[57] Already old comrades were taking up arms against each other. In April, Beauregard, as a Confederate officer, directed the bombardment of Fort Sumter. An era characterized by brick forts, major surveys, and tentative essays at civil works was ending. The war that would end the age of localism had begun.

CHAPTER TWO

THE FEDERAL COMMITMENT

The decade of the 1860's was the worst the Delta had yet endured. As everywhere in the South, war meant great loss of life and uprooting of population; then came the revolutionary destruction of black slavery, overthrow of the old ruling class, and the beginning of a troubled journey toward a new kind of society. For the Delta, the decade was also one of recurring natural disasters. The ruin caused by the flood of 1858 had not been repaired when war broke out, and new floods followed in 1862, 1866, and 1867, any one of which would have been a serious calamity in time of peace. The return of peace found the people of the Mississippi flood plain in a truly desperate situation, improverished yet obliged to undertake the costly job of restoring the levees before the recovery of agriculture—on which everything else depended—could begin.[1] Ironically, the Delta ultimately found salvation at the hands of the very agency that had played so large a part in devastating it—the Federal Government.

The reconstruction of the Mississippi Valley meant two things: reopening the channel of the river to navigation, and protecting the land against floods. In some ways these problems were intimately related, in some ways quite different. To New Orleans, reopening the river and clearing the Passes meant economic revival for a city whose life depended upon trade. To farmers of the northwestern United States, a reopened river seemed to promise an opportunity to force lower rates upon railroads by the competition of cheap waterborne transport. For people who lived in the flood plain, the emphasis was quite different: transportation was important, but flood control was a matter of life or death. Northern business interests that invaded the South in the wake of the armies had their own concerns. Buying into commercial real estate and agricultural lands, eastern capital acquired a growing practical interest in the progress of flood control—an interest which became greater as railroads built their vunerable trackage across the flood plain. The political and economic tributaries of the Mississippi ramified even farther than its tributary streams. The New York Chamber of Commerce, Jay Gould's railroad empire, the Granges of Illinois and Wisconsin, the cotton and sugar growers of the flood plain, and the commercial houses of New Orleans all had their own special needs. All pressured the Federal Government to secure action that would favor themselves.[2]

The government's reaction to these pressures was equally complex. Transformed by the Civil War, Washington wielded powers that Americans had never conceded to it before. While constitutional questions would continue to be raised for decades to come about its right to spend money for flood control, the

debate would take place against a new factual background. The war that had wrecked the Delta had so strengthened the Federal Government that a comprehensive national policy for the Mississippi had for the first time become possible.[3] Yet action came slowly. Washington began by moving along familiar grooves—surveying the problem, making reports that brought no action—while embarking on programs very similar to those that had existed before the war. Then, gradually, and by ways no one could have foreseen, it moved toward major new programs of channel maintenance and flood control. Old habits died hard, and 14 years elapsed between the war's end and the first decisive break with the past.

Beauregard's resignation from the Corps in 1861 and that of First Lieutenant Henry L. Smith the following month left no Army Engineers in the Gulf region, except one at Key West and one at Fort Pickens in Pensacola Harbor.[4] From this low point the number of Corps personnel began to rise as New Orleans became the objective of Federal strategy aimed at conquering the Mississippi Valley and cutting the Confederacy off from its western supply bases. In 1862, a Department of the Gulf was created under Major General Benjamin F. Butler.[5] Lieutenant Godfrey Weitzel, who had worked on New Orleans' defenses from 1855 to 1859, became the first Chief Engineer of the new department.[6] After the rapid conquest of New Orleans in April the Federal army headquarters there became his duty station. At the end of 1862 Major David C. Houston replaced Weitzel, but the following month responsibility for the permanent fortifications of New Orleans was turned over to Captain John C. Palfrey, who commanded at Ship Island. In November 1863 his duty station became New Orleans and in March 1864 the forts at Pensacola were added to his command.[7] Thus two distinct commands emerged, one attached to the army and serving its needs, the other concerned with the immobile fortifications of the region.

From the Department of the Gulf evolved the Engineer District. In June 1865 Major Miles D. McAlester became Chief Engineer in time to see the department pass out of existence. For a time he bore the title "Chief Engineer of the Department of Louisiana," while another officer[8] took over Engineer duties with Major General Philip Sheridan's army of occupation. In December 1865 the defenses of New Orleans and Ship Island were given to McAlester, and by March 1866 he was described as being in charge of "Engineer operations on the Gulf of Mexico." By a curious game of musical chairs McAlester had now moved into a position closely resembling Major Chase's old command. In his new role McAlester soon began to undertake civil works very similar to those of prewar days. An Engineer letter of July 1866 charged him with "improvements of mouth of Mississippi River," and by January 1867 he was dredging Southwest Pass. His report from New Orleans of 29 March 1867 bore the heading "United States Engineer Office," and with the adoption of this title the evolution back to a peacetime resident Engineer was complete.[9] The continuity with prewar days was plain. Yet changes wrought by the war made possible a continuous expansion of civil duties that contrasted strongly with the tentative and sporadic efforts of earlier times. Within a decade, the Engineer Office at New Orleans would take responsibility for a melange of such works, including the maintenance and improvement of New Orleans and Galveston harbors, surveying for an Intracoastal Waterway, and improving a host of minor harbors, rivers and streams stretching from the Pearl River to the Rio Grande.[10]

Opening the Mississippi was the first major Federal problem. At war's end the river was in

an appalling state. Snag boats had not operated since 1854, and dozens of wrecks, including some left by the war, encumbered the channel. Caving of forested banks had added the usual quota of "planters" and "sawyers" to the streams. Urged on by many pressures—including a memorial sent to Congress in 1866 by the politically potent Union Merchants' Exchange of St. Louis[11]—the Federal Government began to move into an area where its authority was traditional, and political pressures made action necessary. By mid-1867 the Engineers had established an Office of Western River Improvements and under Colonel John N. Macomb the rebuilding of the snag boats began.[12] To deal with wrecks, "submarine armor, diving-bells, and electro-magnetic batteries for exploding torpedoes" were added to the snag boats' more conventional fittings. After more than 10 years the Federal Government was back in the business of channel clearance. But this was only a beginning.

Farmer agitation against rates charged by the railroad trunk lines grew rapidly in the years following the Civil War. The attractions of the Mississippi as an alternative route to market—cheap, well adapted to the transport of bulk goods, a water highway "free for every man to run his boat and where no corporation should own the track—"[13] were very great, as a succession of national river improvement conventions made plain. But if the river was to become once again a main road of commerce, New Orleans must be made a satisfactory port for transshipment of goods. This meant clearing from the Passes of the Mississippi the bars which were obstructing trade. All the commercial and farming interests of the Mississippi Valley wanted this improvement, and the opening of the Passes, plus snagging, represented the least action that Congress felt it could safely take to free the Mississippi for navigation. In March 1867 Congress authorized the Secretary of War to build and operate two steam dredge boats to open navigable channels through the bars of the Mississippi.[14] In June the Secretary of War passed on the job to the New Orleans Engineer Office.

After the duties of war and the confused transition to peace, the Engineer Office at New Orleans had received an old assignment, backed by a new urgency. In struggling to open a channel through the Passes, McAlester and his successor, Major Charles W. Howell, found themselves at a critical point in the evolution of the Corps and its civil works responsibilities.

At each of its mouths the Mississippi lost velocity as it met the waters of the Gulf, and dropped its burden of silt and the "bedload" of heavy sand and sediment that was pushed along the bottom of the river. These sediments piled up forming a bar which gradually obstructed the river mouth. At the crests of its bars, the Mississippi oftentimes ran only 8 to 12 feet deep in the major passes. By the late 1860's it was not uncommon for oceangoing ships to require 25 feet of water, and the Port of New Orleans was becoming more and more isolated from the most profitable forms of commerce.

Attacks on the bars had their own history. In 1726 the French attempted to loosen the bar at Southwest Pass by dragging an iron harrow across it.[15] In the next century and a half, a number of devices were tried: a bucket drag in 1837; harrowing again at Southwest Pass, which opened a temporary channel in 1852; privately constructed jetties of board and pilings in 1857; and a final try at "stirring up" between January and August 1860.[16] Successes were temporary at best. Though many other rivers were afflicted by bars—including the Rhone, Danube, and Vistula—the Mississippi was distinguished by its size (fourth largest river in the world) and the fact that it discharged into the sheltered Gulf of Mexico where tidal action was weak.[17] In addition, the Mississippi was exposed to tropical hurricanes

during half the year, which meant that any solution to the problem of the Passes had to be one that the next storm surge would not destroy. Few more perplexing problems faced the hydraulic engineers of the 19th century than this, and careers were made or wrecked on the bars of South Pass, Southwest Pass, and Pass a Loutre.[18]

Federal action began in June 1866 when Congress voted $75,000 to improve the mouth of the Mississippi—first such appropriation since the Civil War.[19] In July an Engineer order specified use of a private contractor, and McAlester engaged Horace Tyler, who had an imaginative new idea to offer.[20] Tyler adapted a double-ender steamboat with conical four-bladed screw propellers below the keel, and an auxiliary harrow at each end. Functioning as drills, the screws proved capable of tearing up the bar material. But the adapted steamboat was a jerry-built affair which suffered many breakdowns, while Tyler offered McAlester increasingly imaginative excuses. Finally in May 1867 the contract was cancelled, when it appeared that the contractor was "likely to accomplish no results."

Meantime, in March 1867, Congress had authorized the Secretary of War to build and operate two steam dredgeboats on the Mississippi. McAlester now submitted plans and specifications for building an elaborate improvement upon the principle of Tyler's dredge. Sixteen-foot screw propellers at each end of the boat and iron scrapers were to do the work of harrowing the bar. His plans were approved in June, and a Boston firm entered the low bid of $223,000 for the work. By October McAlester was in New York "perfecting plans, etc.—for Steam Dredge for Mouth of Mississippi River." His assistant Lieutenant David Payne went to Boston to oversee the work, which was long and difficult.[21] Not until July 1968 did the new-christened *Essayons* undertake the sea voyage to New Orleans, where she arrived without serious accident.[22] By October marked success was being claimed for the new craft, which was gnawing at the bar of Pass a Loutre.[23] Yet disillusionment followed and the whole question of the Passes had to be reopened. What had gone wrong with the *Essayons*?

> She was commanded (stated a report of the New Orleans Engineer) by competent and disinterested officers of the Federal Navy. These men performed their duty faithfully. The dredge-boat was repaired and altered without regard to expense, and the experiment of dredging has been conclusively made. It has failed to maintain permanently a much greater depth of water than that which nature has prescribed as the regimen depth on the bar. Dredging has, therefore, proved a failure. To deepen the bar at the season when there is little current is not very difficult. (But) the whole labors of a season have been, and may be again, destroyed in a night.[24]

It was against the background of this expensive failure that McAlester's successor, Captain Charles W. Howell, received orders in 1871 to make surveys and estimates for a ship-canal to connect the Mississippi River with the Gulf of Mexico.[25]

The origin of this idea went back at least to 1837, when Major William Chase explored the possibility in a report to the Chief of Engineers. Chase favored the idea, but no action was taken to implement it.[26] In 1852 an act appropriated $75,000 for "opening a ship channel between the Mississippi and the Gulf," and a board of one Naval and three Engineer officers convened to decide how the appropriation should be spent.[27] Beauregard was a member of that board, which concluded that the limited funds available made impractical any course other than stirring up the bar at Southwest Pass. But in its report, the Board went on to discuss four methods of opening the Passes, in increasing order of difficulty and expense: stirring up, stirring up assisted by dredging, contraction of the river by jetties, and closing

the useless passes.[28] If all else failed, they recommended consideration for a ship canal as a "plan to fall back upon." Howell took the position that all else had failed, and that, expensive as it was, the ship canal could be justified by its benefits to navigation. Following Chase's proposal, Howell recommended in 1874 that the canal be built near Fort St. Philip, where the river was separated from the Gulf only by a narrow strip of marshy land. The canal was to be protected by a lock, and would open into Breton Sound, where adequate depths of 30 to 40 feet were to be found on a stable bottom of firm clay.[29] Once built, the canal would provide a permanent solution to the recurrent problem of the Passes.

In making this proposal, Howell could count on strong backing. The prestige of ship canals was high since the completion of Suez in 1869. The most famous military engineer in the New Orleans area was Pierre Beauregard, and Beauregard had come to favor the canal. The business community of New Orleans had inspired the original investigation by Chase, and took up the plan anew in the 1870's. Finally, the idea was embraced by Brigadier General Andrew Humphreys, and Humphreys was not only *the* expert on the river, after July 1866 he was also Chief of Engineers.[30]

Yet there was opposition from the start. Howell's estimate of the cost of a canal was $7.4 million, and he admitted that this did not include "amounts required for engineering, superintendence, and contingencies." A later estimate by Humphreys raised the cost above $10 million. Perhaps a solid front in the Corps of Engineers might have succeeded in putting over the canal, but the Corps itself was divided. In June 1873, an Engineer Board met at Washington to consider the canal and approved it with one significant abstention. Colonel John G. Barnard, President of the Board, who once had shared the responsibilities at New Orleans with Beauregard, entered a minority report. He declared that defense problems and the possibility of storm damage to ships waiting in Breton Sound made the canal a dubious idea. Instead he suggested that thought be given to a jetty system. Prophetically, he rejected Southwest Pass and Pass a Loutre as the proper site for jetties, and pointed instead to South Pass: narrow, relatively straight, yet entirely adequate, when cleared, for the passage of large ships.[31] Doubts caused by the high cost of the canal—intensified by the severe depression that struck the country in 1873—were reinforced anew by this division among the Engineers. At about the same time as the Engineer proposal, Congress began to consider an alternative put forward by civil engineer James B. Eads of St. Louis.[32]

Eads had already won considerable fame as a shipbuilder for the Navy during the Civil War, and as an able engineer both before the war and after it. He had salvaged wrecks in the Mississippi, using a diving bell of his own invention, and in 1874 was building a steel bridge of original design across the river at St. Louis. Gifted in a variety of ways, Eads was not only an engineer, but an organizer, at home in office or field, able to rule a mob of immigrant laborers or confront a congressional committee with equal skill. He knew how to get the backing of moneyed men, and he had a gift for self-advertisement, a flair for propaganda. In many ways he resembled his Robber Baron contemporaries, but without their dishonesty and technical ignorance. He was no mean opponent, as the Chief of Engineers was to discover.[33]

According to his own statement, Eads first urged the jetty plan upon a group of Congressmen visiting the mouth of the river in May 1873. Shortly before the end of the year he made a formal proposal to open Southwest Pass by means of jetties for a payment of $10 million. Debate began in Congress, and at first the proponents of the canal prevailed; in June

1874 the House appropriated $8 million to begin construction of the canal.[34] But a Senate committee rejected the bill. In view of the conflict over the two plans, Congress then set up a mixed board of experts composed of three Army Engineers, three civilians, and one member of the Coast and Geodetic Survey. Its report, in January 1875, emphasized the division within the Corps and two Engineers—Brigadier General Cyrus B. Comstock and Brigadier General Barton S. Alexander—voted with the three civilians and the Coast and Geodetic Survey officer to approve the jetties and recommend South Pass for the experiment.[35] The House, sensitive to political pressure in the West and ready to approve any plan that gave a promise of working, promptly voted to pay Eads $8 million for opening Southwest Pass, with an annual maintenance grant of $150,000. During debate the Corps was both attacked and defended, but probably Missouri Congressman Edwin O. Stanard, who reported the bill, gave the best statement of why Congress accepted Eads' proposition; the Engineers had so far failed, the Treasury was in no good state, and Eads offered to get results first and charge the government later.[36]

The Senate drove a harder bargain. First it insisted on South Pass instead of Southwest. Barnard had already recommended this pass for engineering reasons, but the Senate was influenced by the fact that the pass was entirely worthless as it stood, with only 8 feet of water over the bar. Construction work would not obstruct navigation, and, if Eads failed, he would leave things no worse than they had been before.[37] The Senate also determined to pay Eads only $5.25 million, in a series of payments as successively deeper and wider channels were attained. Maintenance and interest on retainage, however, raised the total to $8 million over the 20 years that the contract would run. Eads was to get his own backing and was to be paid nothing until the specified channels had been achieved and certified by officers of the Corps of Engineers.[38] The job of checking Eads' work was given, not to Howell at New Orleans, but to Brigadier General Cyrus B. Comstock, who had voted for the jetties on the board of 1874.[39] After Eads had established his base of operations, First Lieutenant Charles E. B. Davis was sent there to check his work. In 1876 Captain Micah Brown took over his duties. Under this setup, Eads began the work of giving New Orleans a permanent passage to the sea.

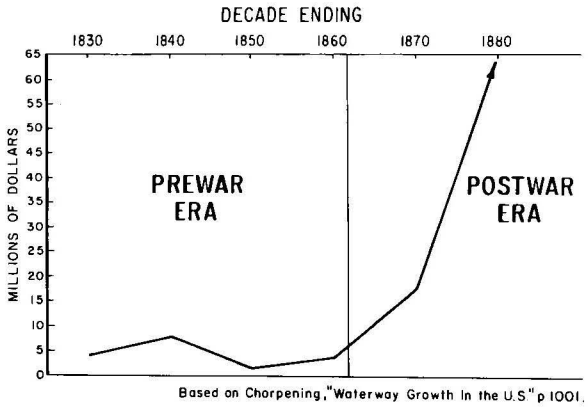
Eads' struggle proceeded on three levels simultaneously. Engineering work began as his workmen built Port Eads on the bank of South Pass and ran a telegraph line to New Orleans. At Port Eads material was accumulated, and the workmen, supervising engineers, and the Army Engineer officer assigned to observe the work had their quarters.[40] On 14 June 1875 work got under way on the alteration of South Pass. This involved two separate operations, one at the mouth of the Pass where the jetties were being built, and one at the Head of Passes, where South Pass was further obstructed by a shoal. Structure of the jetties was simple. To a line of pilings willow mattresses were attached and sunk with broken stone. On this foundation, alternate layers of broken stone and fresh mattresses were laid. When the surface was reached, a railroad line was run out on piers laid over the pilings and concrete poured from dump cars into wooden molds. The east jetty proceeded directly out from East Point, the extremity of the land; the west jetty, since it stood within the old mouth of the Pass, was connected to the west bank by a structure known as Kipp Dam. Most complex and demanding work came within the Pass, where wing dams were built to increase scour, and at the Head of Passes, where structures described as "T-dams" redirected the flow of water to scour away the shoal. Additionally, sill dams were constructed across Southwest Pass and Pass a Loutre to reduce slightly the flow of

"Walking on the Water." Evenly distributed crushed rock gradually sinks a willow mat beneath the water. *(Photo by C. Fortier)*

water into the main passes and force it through South Pass.[41]

Eads' second struggle was his continuing fight for money. Congress was slow to pay, and the government's leisurely methods drove the engineer to distraction. Large debts had to be incurred, and excursions were instituted for visiting capitalists to enable them to examine the works for themselves.[42] Every effort was made to paint the most encouraging picture of the jetties' progress, and every possible pressure brought to bear on a reluctant Congress to secure easier terms. Eads claimed that the channel prescribed for the final payment, 30 by 350 feet, was too large for South Pass to bear, and he lobbied vigorously for alterations in the bill, getting one change in 1878 and another in 1879.[43] Thus the financial and political war went on beside the engineering work.

Intimately involved with the success of this fight was Eads' third battle—with the Corps of Engineers. Eads portrayed himself as a David fighting the Goliath of the Corps, a picture which contained both truth and falsehood. The Engineers were by no means unified in



Federal appropriations for waterways development.

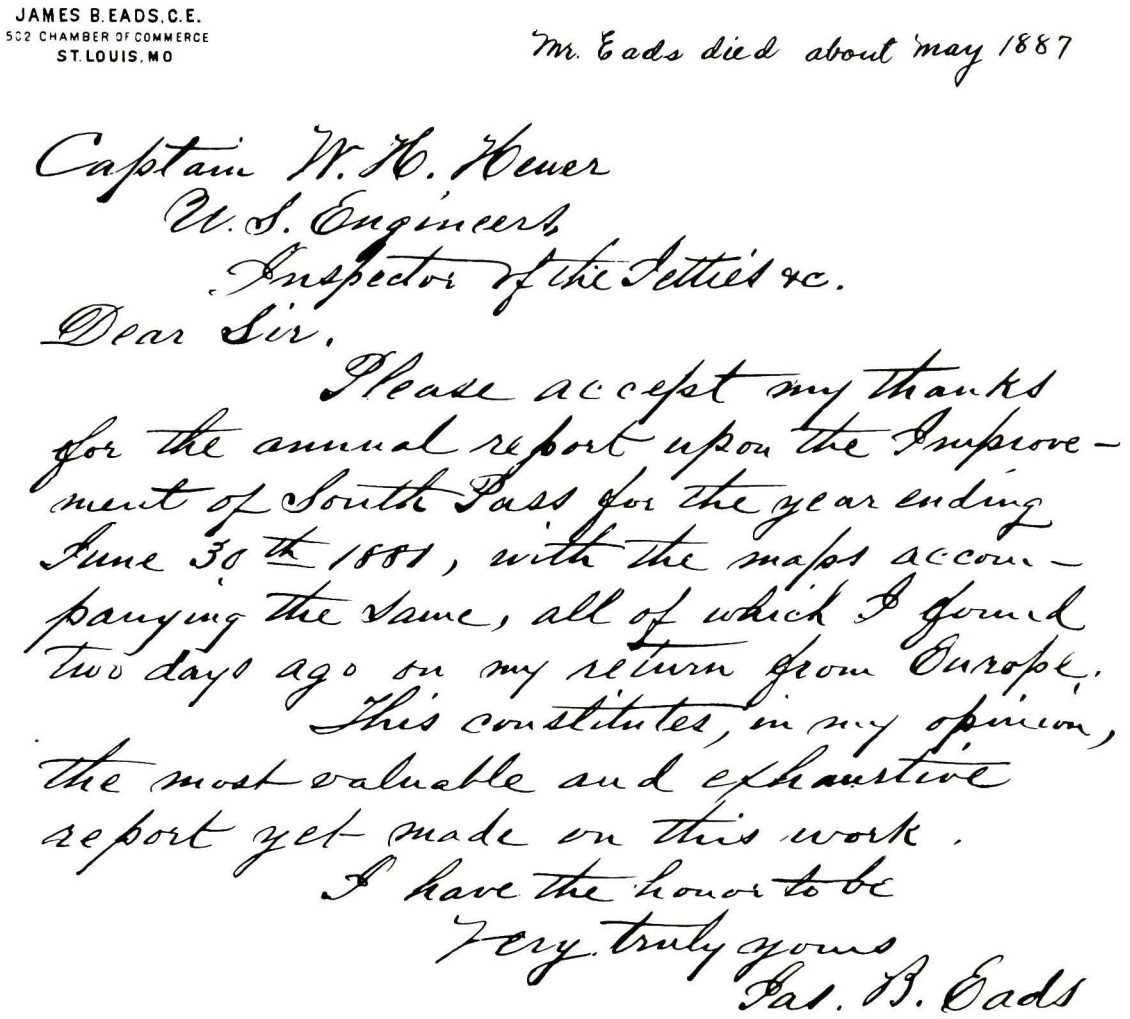
opposition to the jetties, but Chief of Engineers Humphreys fought them relentlessly.[44] The Corps was his life, and Congress' action in giving Eads so important a work as opening the Passes struck him as being an attack on the organization—a feeling which the remarks of some members of Congress may have encouraged.[45] Egotism also played a role. Humphreys had become a captive of his own classic, a theologian defending his own Holy Writ. The *Physics and Hydraulics* said that jetties could not succeed, for a new bar would form, requiring them to be lengthened year by year.[46] As reports of his own officers piled up, showing that the bar was not reforming, Humphreys in no way changed his position; he seemed to feel that anybody who supported the jetties was impugning his own status as the final authority on all aspects of the Mississippi River. In taking this line, he increasingly set himself in opposition to national policy as established by Congress.

Howell seconded his chief's hostility. He took surveys which showed—surprisingly, in view of what was actually happening—that the Gulf just beyond South Pass was shoaling as Humphreys said it would.[47] He then leaked the results of his surveys to potential investors in the jetties and to the New Orleans newspapers.[48] The surveys of Captain Micah Brown were sent through official channels, eventually winding up in Humphrey's hands. Eads was not able to see them until they had been printed in the report of the Secretary of War, by which time, of course, they were long out of date. The officers Eads approached for survey results told him that their reports could only be shown to their superiors.[49] Meantime Howell made his opposition public. "I know," he wrote in an open letter to two New Orleans newspapers, "that... seaward of the outer end of (Eads') jetties the Gulf has shoaled at a rate which, if continued, will in eighteen high-water seasons bring the Gulf bottom to the surface, and necessitate the prolongation of the jetties at least seven and a half miles.[50]

But Eads was a vigorous partisan as well as an engineer, and he had potent backers who were not inclined to lose their investment. A bribe bought the backing of General Beauregard for the jetties. An open letter to the Secretary of War brought an order to Comstock to allow Eads access to the surveys.[51] As the facts of the surveys came to light, they gained added weight from the accurate and extensive work that Captain Brown was doing at Port Eads. He found a channel forming which, despite many changes in the alluvial bottom, was clearly growing wider and deeper. Brown painstakingly measured the depth of the sea on radial lines fanning out from the jetties, and sent to Washington charts which proved conclusively that no new bar was forming.[52] Running between its artificial banks of piling and willow mattresses, crushed stone, and poured concrete, the Mississippi was hurling its sediment down the continental slope into water so deep that Eads' own estimate of two generations as the lifespan of his jetties would prove to be too short. By 1877 oceangoing ships of the largest size were regularly entering the Mississippi by the smallest of the major passes.[53]

But General Humphreys was not content to admit error. His last fight was against the creation of the Mississippi River Commission, in which he saw a plot to advance the fortunes of Eads.[54] On 22 June 1879 the President approved the bill setting up the Commission. It was widely understood that he would appoint Eads one of the civilian members. Eight days later Humphreys retired from the Corps of Engineers. He was 69 years old, and covered with well-deserved honors. But his last years of power had been embittered by a controversy in which he showed the worst, instead of the extraordinary best of himself.

The triumph of the jetties played a significant part in the creation of the



Mississippi River Commission that followed. Congress had dared to ignore established precedents, had put a representative of the country's growing body of civil engineers in charge of building of a great public work, and had been justified by the results. With one success to its credit, Congress was more ready to listen to those who claimed that, for political, economic, and humanitarian reasons, it was time to adopt a comprehensive national policy for the protection and development of the Mississippi Valley. This would mean coming to grips with the intertwined problems of navigation and flood control, and the constitutional limitations which appeared to allow the Federal Government to act on the former but not the latter. It was high time that the effort was undertaken, for the record of floods in the Mississippi Valley since the Civil War was a grim one.

The postwar Federal Government began to interest itself in the flood problem in December 1865 when Secretary of War Edwin M. Stanton ordered Humphreys' to make a tour of inspection of the ruined levee system. Humphreys' report was gloomy. In the Delta alone he counted 59 crevasses, one of which was 2 miles long and flooded thousands of fertile acres at every rise in the river. A million and a half cubic yards of earth,

Humphreys estimated, would be necessary to fill the gaps, let alone bring the levees up to necessary grade. Humphreys' report was notable for his statement that the Federal Government—"some authority entirely beyond the influence of local interests," as he expressed it[55] must intervene to build the great mainline levees which he considered necessary if the Valley were ever to realize its potential.

But the government, though ready in 1865 to take surveys, was far from ready to take action. Humphreys' report was printed by the Senate, but nothing else was done. In early 1869, Abbot reported on progress since Humphreys' survey, and found the picture discouraging. He noted that "the State of Louisiana alone seems to have made a determined effort to close the breaks in the levees," but that, despite an expenditure of $2.7 million, "the early flood of 1867 caused immense destruction throughout the States."[56] The depression of 1873, followed immediately by the disastrous flood of 1874, capped the misery of the Valley. Alarmed at reports from the impoverished, flooded districts, Congress created yet another mixed board, generally called the Levee Commission, which was to "investigate and report a permanent plan for the reclamation of the alluvial basin of the Mississippi River subject to inundation...."[57]

The Levee Commission's report was impressive both for its analysis of what was wrong and for its recommendations on what was to be done. The Commission found 143.4 miles of crevasses south of Commerce, Missouri. It found the local levee boards desperately poor, without credit, and often incompetent in their methods of building levees. As a result of inadequate heights and erosion of the river's banks, 107.5 miles of levee had been destroyed in Louisiana alone since the end of the Civil War. Comprehensive reforms in construction methods, height and standard grade were needed. Above all the localism of the flood control system must be ended. "The army of defense," wrote the Commission, "has been content to remain a simple aggregation of independent companies, with here and there a battalion under the command of a board of officers. That victory has not more frequently perched upon their banners is surely not surprising."[58] Recommendations were revolutionary. Each of the six great drainage basins from Cape Girardeau to the sea should have "a chief engineer, armed with ample powers." These should include plentiful funds, the right of eminent domain in obtaining rights-of-way, and the power, in times of emergency, to draft for labor every able-bodied man within "a reasonable distance" of the levee. Policy decisions should be taken by a "general board of commissioners composed of a president and the several district chiefs with a permanent organization and stated times of meeting." This board should have no superior but "the supreme authority from which it derives its legal existence...." Whether this should be the Federal Government or some mutual compact of the riparian states, the Levee Commission did not presume to say.[59]

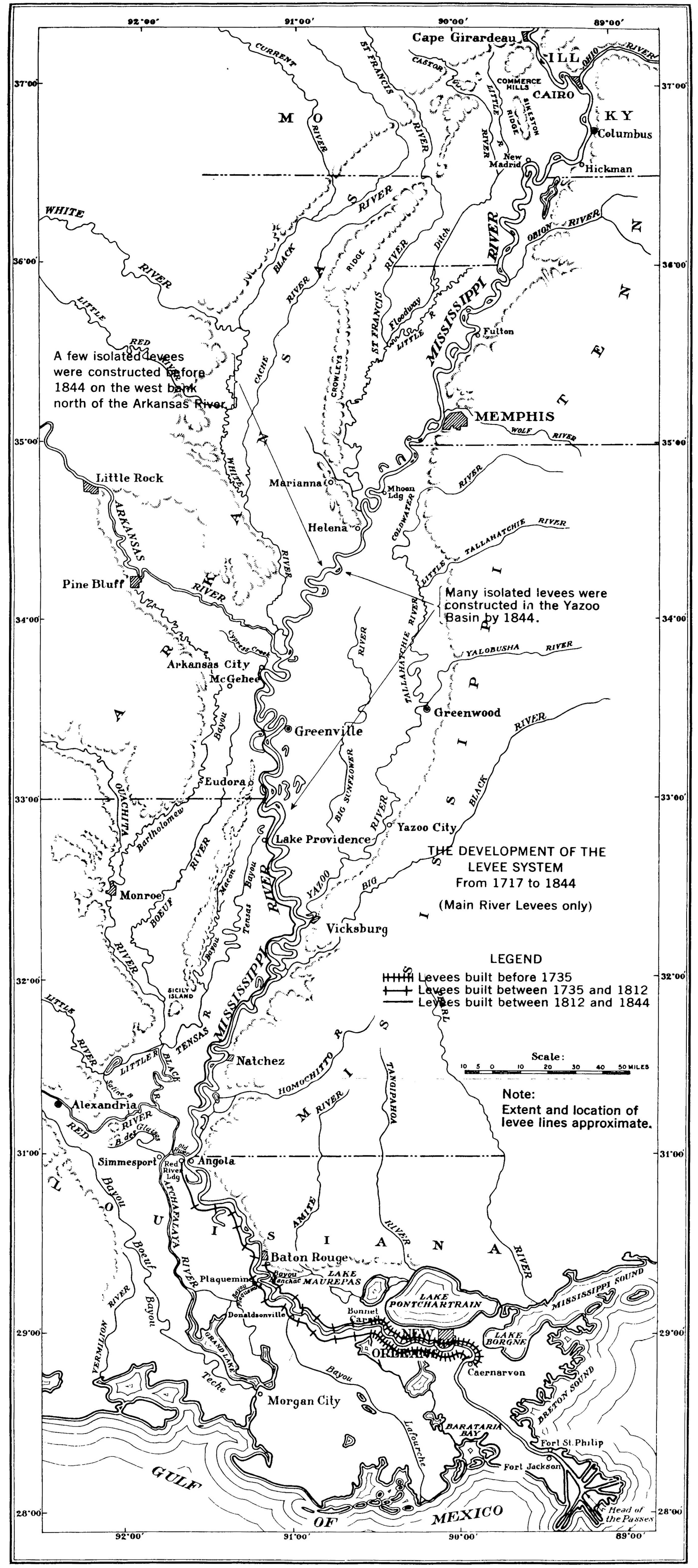
Such a plan was, to say the least, politically premature and was never acted upon. Yet as a sign of the times it was by no means unique. In the decade following 1874,[60] three major river conventions met to demand unified political action among all the people of the Valley.[61] Events forced the river into national attention. As Reconstruction ended, southern strength in Congress rose. Eads built his jetties to the accompaniment of wide publicity. The river's fame increased as some of the best books ever written about it appeared, ranging from the 1876 reissue of the *Physics and Hydraulics* to Mark Twain's three popular classics, *Tom Sawyer*, *Huckleberry Finn*, and *Life on the Mississippi*.[62] Amid rising Delta power and quickening public interest, Congress began the serious work of developing a national policy for the river.

In March 1879 Representative Randall L. Gibson of Louisiana brought before Congress a plan to create a permanent body, organized along the lines of the mixed commissions of 1874 and 1878, with broad but ill-defined powers to deal with the river. The lack of precise definition was essential to avoid constitutional restrictions on Federal action, and also to avoid collision between the advocates of navigation and those of flood control. Representatives of the Valley and their allies were quite willing to have the ultimate role of the Commission decided by the Commission itself, and by the course of events. The House of Representatives accepted Randall's bill creating a five-man Commission. Three members were to be Army Engineers, two were to be civilians, and the president was to be chosen from the military.[63] The alternative plan for a seven-man Commission, with only three Army Engineers, three civilians, and one member from the Coast and Geodetic Survey, was worked out by the Senate Select Committee on the Improvement of the Mississippi River and its Tributaries. Senator Samuel J. R. McMillan, in debate, put his finger on the conflict between civil and military engineers underlying these changes when he said:

> It is not to be concealed here that this (Senate version) is a part of the extension of the improvement by jetties at the mouth of the river, and this plan is but a continuation of those jetties. Now, while I concede the engineering ability of Mr. Eads I do not believe that the survey authorized by this bill should be under the control of influences outside the Engineer Corps of the Army...[64]

Under the leadership of Senator Lucius Q. C. Lamar of Mississippi, however, the Committee's bill prevailed. Attempts by the Corps' friends to restore the House version and efforts by Eads' supporters to allow President Hayes to choose the Commission's president from the civilian members were both defeated by large margins. The final version, in which the House acquiesced, was in essence the compromise measure that Lamar wanted.[65] He took the pragmatic view that, since the Army Engineers would do most of the practical work of the Commission, its president had better be chosen from among them.

With the creation of the Mississippi River Commission the Federal commitment to solve the problems of the river began.[66] The act creating the Commission was the egg from which a new era would hatch, both for the people of the Valley and for the Corps. The possibility that this might be so was clearly understood both by the proponents and the enemies of the new organization. The ill-defined powers of the Commission suggested that the men who created it deliberately framed the law in such a fashion that its constitutionality would be difficult to challenge, while the way was left open for the Commission, once in business, to enter the field of flood control.[67] The New Orleans District had been the site of many of the events which shaped the new national policy. Now the Commission was to reshape the nature and duties of the District, to say nothing of reshaping human life throughout the Alluvial Valley as well.


THE DEVELOPMENT OF THE
LEVEE SYSTEM
From 1717 to 1844
(Main River Levees only)
LEGEND
Levees built before 1735
Levees built between 1735 and 1812
Levees built between 1812 and 1844
Scale:
10 5 0 10 20 30 40 50 MILES
Note:
Extent and location of
levee lines approximate.
A few isolated levees
were constructed before
1844 on the west bank
north of the Arkansas River.
Many isolated levees were
constructed in the Yazoo
Basin by 1844.
92°00′
91°00′
90°00′
89°00′
37°00′
36°00′
35°00′
34°00′
33°00′
32°00′
31°00′
29°00′
28°00′
Cape Girardeau
ILL
CAIRO
KY
Columbus
Hickman
New Madrid
COMMERCE HILLS
SIKESTON RIDGE
CROWLEYS RIDGE
MO
ARKANSAS
TENN
MISSISSIPPI
LOUISIANA
MEMPHIS
Fulton
Little Rock
Pine Bluff
Marianna
Helena
Mhoon Ldg
Arkansas City
McGehee
Greenville
Greenwood
Eudora
Lake Providence
Yazoo City
Monroe
Vicksburg
SICILY ISLAND
Natchez
Alexandria
Simmesport
Red River Ldg
Angola
Baton Rouge
Plaquemine
Donaldsonville
Bonnet Carré
NEW ORLEANS
Caernarvon
Morgan City
Fort St. Philip
Fort Jackson
Head of the Passes
LAKE MAUREPAS
LAKE PONTCHARTRAIN
LAKE BORGNE
MISSISSIPPI SOUND
BRETON SOUND
BARATARIA BAY
GULF OF MEXICO
MISSISSIPPI RIVER
OHIO RIVER
WHITE RIVER
BLACK RIVER
CURRENT RIVER
ST FRANCIS RIVER
CASTOR
LITTLE RIVER
LITTLE RED RIVER
CACHE RIVER
ARKANSAS RIVER
OBION RIVER
WOLF RIVER
COLDWATER RIVER
TALLAHATCHIE RIVER
LITTLE TALLAHATCHIE RIVER
YALOBUSHA RIVER
BIG SUNFLOWER RIVER
YAZOO RIVER
BIG BLACK RIVER
Floodway
Ditch
Cypress Creek
OUACHITA RIVER
Bartholomew
BOEUF RIVER
Bayou Macon
Tensas
TENSAS R
LITTLE R
BLACK R
Saline B
RED RIVER
B. des Glaises
Old River
ATCHAFALAYA RIVER
Bayou Boeuf
VERMILION RIVER
GRAND LAKE
Teche
Bayou Lafourche
Bayou Manchac
Bayou Plaquemine
HOMOCHITTO R
AMITE RIVER
TANGIPAHOA RIVER
PEARL RIVER

CHAPTER THREE

LEVEES AND FLOODS

The early history of the Mississippi River Commission was in large part the story of its growing preoccupation with the levee system. The evolution of the so-called "levees-only" policy was complex in detail, but comprehensible in terms of the physical and political facts of life in the Mississippi flood plain.

The first question to be faced by the new-fledged Commission was exactly what its own functions were to be. The organic law had not defined them with any degree of distinctness. The law had, however, committed the MRC to fix, enlarge, and deepen the channel of the river—no easy task considering its size and the shifting alluvial sediments in which it flowed. An early and fundamental disagreement arose among Commission members over whether a levee system would, by confining the water, help to scour out a deeper channel. James B. Eads thought that it would; future President Benjamin Harrison and the Corps' Brigadier General Cyrus B. Comstock disagreed.[1] Hence the years 1879-1881 were a time of uncertainty. The Commission's only unquestioned duty was to take over surveys of the river, previously carried out by an Engineer board.[2] While Congress and the MRC's members debated the effects of a levee system, the Commission also began a program of channel improvement by permeable contraction works and mattress revetment.[3] Pioneered on the middle Mississippi by the Corps of Engineers, this program aimed to narrow the river to an approximately uniform 3,000 feet. Typical works were longitudinal dikes constructed of pilings with waling strips on both sides filled with brush.[4] Connected to the banks by transverse dams, and revetted, these structures were designed to produce deposition, narrowing and ultimately deepening the channel, as the law required.

Beyond these works, the Commission felt considerable uncertainty about its future, its duties, and the way it would function. It did not want to be an executive body, yet it was obliged to handle details of maintenance and construction until Corps officers took on the work in 1881.[5] At that time, Commission members still looked to the year ahead as a time of experimental work dealing with contraction of the river.[6]

The flood of 1882, which overwhelmed the levees—and, very often, the remaining credit of the levee districts as well—changed the picture entirely. Alarmed by the suffering and ruin in the alluvial valley, Congress decided on an important change in policy. After instructing the MRC to engage in flood control, lawmakers had shied away from voting money for levees; now they reversed themselves again, by voting in ambiguous terms to allow the Commission to build levees if doing so would make navigation easier and safer. By decision

of the Secretary of War, the river below Cairo was divided into four administrative districts, each in charge of an officer of the Army Engineers, under whose direction all work for improving the river was to be carried on.[7] In time these District Engineers would be directed to meet as a board to recommend the distribution of Commission funds. The Commission retained overall powers—under the Secretary of War—to set policy and amend the recommendations of the Board of District Engineers.

These administrative changes gained their meaning from the new national policy set by Congress in the 1882 act. Not only was the Commission authorized to build and repair levees,[8] but the act also appropriated $4.9 million for the Commission, and gave it charge of all Federal work for improving the harbors of Memphis, Vicksburg, Natchez, and New Orleans, plus the rectification of the Red and Atchafalaya Rivers, which had previously belonged to the Memphis Engineer Office.[9] The process of gathering of all Federal work on the Mississippi into the hands of the Commission advanced with this act. At the same time the job of executing Commission policy had been placed in the hands of the Engineers. Most important of all, Congress had given tacit approval to levee work, provided it were properly justified.

Delegations from the local levee district argued their cases before the Commission at its meetings in August and November 1882. They spoke with pathetic detail of the impoverishment of their people, of their own exhausted credit, and the helplessness of private initiative and local government to deal with the repeated disasters. Senator Lamar of Mississippi—manager of the bill that created the Commission—signaled the intentions of levee advocates in Congress when he urged the Commission to build levees first "where obstructions to navigation are the greatest." The point of this approach was the claim that crevasses caused shoaling of the main channel. Following this line, the citizens of Greenville, Mississippi, argued that the caving of the riverbank before their town was destroying navigation by the "correspondingly rapid formation and growth of the already extensive sand bar upon the opposite side" of the river. A petition of 11 parishes of Louisiana called the Ashton crevasses "the immediate cause of bad navigation at this point." On 16 August 1882 the Commission entered upon the work of levee building.[10]

Major Charles R. Suter of the Corps of Engineers made a motion that the Commission divide the river into four districts.[11] He also moved that $1.5 million be allotted to the levees, and, amended to $1.3 million, the motion was adopted the next day, with only Comstock recording himself in opposition.[12] Suter's districting motion was then adopted. The Commission, in the course of 2 days, had emerged from its chrysalis and embarked upon the work that was to transform middle America.

The development of the levee system that followed was marked by enormous advances in technique and organization. The *how* of levee building was enormously advanced—when it was not created from scratch—by the Commission. Proper selection of levee sites—often considerably back from the river, to the dismay of riparian landowners—complete clearance of the soil, removal of stumps, construction to specified height and cross section, sodding of the levees with Bermuda grass, forbidding cuts and drains, outlawing the use of levees as roadways—all became elements in a comprehensive set of standards enforced by the Commission's power to grant or withhold Federal money.[13]

Commission improvements were not confined to levee building. It carried out the first complete surveys of the low river, and systematically studied all aspects of the stream's behavior. It sponsored innovative

work on revetment, adapting the willow mattress for bank and levee protection.[14] Progress in organization also marked the Mississippi River Commission's work. The Commission pressed for cooperative Federal and state efforts in the field of flood control. Its efforts resulted in the emergence of a limited but coherent national policy on the Mississippi backed by the best scientific information that the contemporary state of the art would allow.

Typical was the work of the Fourth Mississippi River Commission District, headquartered at New Orleans. District Engineers headed a complex system in which river improvement was financed largely by the state levee districts but guided and coordinated by Federal experts. Some levees were Federal, many private, but most were built by the six levee districts of Lower Tensas, Atchafalaya, Lafourche, Barataria, Pontchartrain, and Lake Borgne with some Federal assistance. Guidance came from the District headquarters, originally in the New Orleans Custom House but later moved to No. 1 Prytania Street at the river. Here the District Engineer, his military assistant, and a force of male civilians, clerks, and assistant Engineers, had their offices. All but the clerks, however, spent much time in the field. Mainline levees were divided into sections, and a junior or senior Engineer walked each section at least once a month. Levee construction was carried out by prime contractors who subcontracted 200- to 300-yard "station" to itinerant construction men or "humpers" who often worked on levees during the fall and winter and on northern railroads during the summer. Simplest construction method was by wheelbarrow—the usual way until the 20th century. More efficient were team outfits using mules to drag wheeled scrapers, a method that prevailed from about 1900 to 1910. Then the great volumes of earth that had to be moved led to development of levee machines—A-frame derricks with wooden booms 50 to 75 feet long at the end of which hung 2-cubic-yard orange-peel buckets. As work went forward, the machines were moved on two parallel planked

Bank protection—old style. Weaving of a giant willow mattress.
(Photo by C. Fortier)

runways by means of skids and wooden rollers. From these machines evolved steel draglines with 3.5-yard buckets, and large drag scrapers of 8 to 10 yards capacity. New Orleans Engineers also used a locomotive crane that moved upon 16-foot track sections bolted to heavy frames which the crane itself raised from behind and moved in front of its path of operations. Levee machines continued work until the appearance of mobile earth-moving equipment.

Work on the levees was hard, "all muscle," with wages (in 1890) of $2.50 a day for a "master laborer." Work gangs hired on the open market rather than by contractors had the benefit of superior working conditions. A crew at work was a little army of 150 to 500 men, black and white. Most of the laborers and many supervisors and skilled artisans were Negroes, while other supervisors, Engineers, and Army personnel were white. The men lived on quarterboats while working, sleeping in dormitories and devouring gargantuan meals. When the river rose, even harder work impended. Engineers walked the levees daily, took charge of the Federal, state, and private labor that swarmed out to help in the flood fight, and tried to hold up under a protracted strain that one officer compared to the rigors of the battlefield.[15]

A flood fight overrode all barriers. In time of danger, the depot maintained by the New Orleans Engineer Office supplied equipment, while Commission Engineers coordinated the work of state and private interests. In the 1897 flood, District Engineer Major George McC. Derby counted "six independent forces which assist in the work, the individual planter, the railroads, the parish, the levee district, the State and United States."[16] A civilian assistant Engineer recounted that in the Pontchartrain levee district "about 95% of the supervisory personnel was (sic) unpaid civilians and officials of the Railroads, Levee Boards, Louisiana State Highway Commission, the Standard Oil Company at Baton Rouge, officials of the Sugar Refineries, Oil Refineries, Saw Mills... and from practically every manufacturing plant and farm in the district." Short sections of the levee line were placed under Engineers from the Louisiana Highway Commission. Planters and foremen of mills turned out to supervise the work of their employees on the levee, and afterward submitted payrolls from the time rolls of their foreman. Derby expressed surprise that "so large a measure of success can be achieved by such unsystematic efforts." Yet by the end of the 19th century, hope was growing that ruinous floods might become a thing of the past. "For the first time in the history of the river," reported the Mississippi River Commission in 1897, "a great flood passed between banks from Red River to the Gulf. The whole sugar country, where inundation means destruction, was saved from overflow."[17]

It is against the background of these achievements in technique and organization that the most controversial aspect of Federal policy—its commitment to flood control by levees only—must be viewed. "Levees only" did not mean that the only activity of the Mississippi River Commission was building levees. It did mean, however, that by the early 1890's levees had come to be accepted—by the majority of the Commission, by the levee boards, by Congress, and apparently by the people of the Valley—as a complete answer to floods, as the only major control work that should be attempted, and as the *raison d'etre* of the Commission itself. The reasons for this policy shift were complex.

A common explanation of "levees only" held that it was advocated by Humphreys and Abbot, and that their influence combined with the forces of organizational inertia to secure the policy's adoption and preclude change.[18] However, the conventional explanation left much unexplained. For one thing, the Commission did not hesitate to oppose

Humphreys and Abbot whenever it wished to do so, holding, for example, that crevasses caused shoaling of the main channel, a point which the *Physics and Hydraulics* specifically denied.[19] Again, the Commission maintained during the 1880's that the Mississippi, if its banks were stabilized, would scour a deeper channel for itself, while Humphreys and Abbot had declared that the bed of the Mississippi was a tenacious clay, as difficult to scour as marble.[20]

The real source of the "levees-only" policy was to be found not in Humphreys and Abbot, but in the political and economic facts of the situation faced by the Mississippi River Commission. Fundamental was the pressure of Valley residents for immediate and local rather than long-range and comprehensive protection against floods. By the mid-1880's Congress and the War Department had become disenchanted with the works of channel improvement. Senators from the riparian states urged the Commission to exercise its powers upon levees and let other works take second place. Congress disapproved spending for contraction works in 1886, and the Commission applied the money to levees. On 30 June 1887 Senator Randall L. Gibson of Louisiana "congratulated the Commission upon the fact that their recommendations had not been approved by the Secretary of War. The sentiment of the two Houses was opposed to revetment. The contraction of the river by levees is the proper method of procedure."[21] The flood of 1890 brought in renewed applications from local groups for assistance in completing their levee lines. Local officials, pleading that the burden of debt was too great to bear, often made no effort to justify their requests by the navigation plea.[22] Congress, in the River and Harbor Act of 19 September, for the first time omitted the proviso against building levees for flood control.[23] Though the prohibition later reappeared in one act, the effects of this flood on levee policy were decisive.[24] In its *Proceedings* the Commission recorded the claim of the railroads to levees as protection for their lines; the emphatic support of Congress; and the backing of levees by eastern capital, as the vice-president of the New York Chamber of Commerce led a delegation before the Commission to urge that "one half the whole appropriation" be spent in preventing inundations in the lower valley. One member of the Chamber "explained his conference with the President of the United States, on the alluvial valley problem. He thought himself that every dollar practicable should be applied to levees."[25] As important as the political facts was a physical fact—a decade of effort had shown that the river would not scour its bed except locally and temporarily. Furthermore, Humphreys and Abbot had been proved right on one important issue, and Eads wrong: levees raised flood heights, requiring a constantly rising levee line to contain them.

Faced with these dilemmas, the Commission in 1891-1892 turned to dredging as a means of giving water transport its all-year channel.[26] At the same time, the MRC, faced with revetment costs which had soared to $30 a linear foot, began to limit bank protection to endangered areas and shift money from channel works to levees threatened by rising floods.[27] By 1896 the Commission was ready to declare in effect that its original policy had proved economically unjustifiable and that "the practical results contemplated by the Act organizing the Commission... can be attained with greater economy and probability of success, and in less time by the dredging of obstructing bars in low water and the maintenance, in cooperation with the State and local authorities, of an effective levee system." Revetment was to be placed in selected reaches to prevent cutoffs and to protect harbors and threatened levees of "exceptional importance." When, on 3 June 1896, Congress enacted a new Rivers and Harbors Act over President Grover

Cleveland's veto, the opening of a 9-foot channel by dredging "from Cairo down" became national policy. Earlier hopes for a narrowed, self-scouring river were abandoned. A minority in the Commission, led by Lieutenant Colonel Amos Stickney, fought to have the allotment for bank revetment and channel work increased, but was defeated by a 4-4 vote.[28] Channel improvement works other than dredging and revetment were now abandoned.

Thus, "levees only" reflected a mixture of physical fact and the political wishes of those who had the ultimate power—of Congress, the War Department, powerful private interest groups, and the people of the Alluvial Valley. As the Valley developed economically, flood control came to enjoy powerful backing throughout the eastern United States as well as in its old alluvial and western centers of power. Levees were simply the best established and most politically remunerative form of flood control. They were works that meant immediate protection for homes, businesses, and railroads. Under limited appropriations, any diversion of funds meant loss of protection for someone; at the same time, other modes were experimental, lacked public and Congressional support, and were condemned by the leading authorities. "Levees only" became public policy because Congress wanted it, and, in fact, because almost everybody of influence in the Mississippi Valley wanted it.

Until 1926 the development of the Federal program was a matter of extension, definition, and elaboration of existing policy rather than the introduction of new ideas. Levees were to hold out floods; dredging was to open an all-year channel; the District Engineers at St. Louis and Vicksburg carried on a program of snagging; the Corps was engaged in building a system of reservoirs at the headwaters of the Mississippi.[29] Add to these the programs of surveys and mapping, and the result was what might have been called the classical form of Federal river policy. Compared with anything that had been done in the past, this program was profoundly impressive. Under it the levee system reached a condition of completeness never before known.[30]

Yet the levees that protected the land against ordinary high water continually raised the crests of the great floods. As agriculture and industry prospered behind the walls of earth, the possible losses from flood increased as well. The number of human lives that a great flood would endanger rose with the water. Political and economic facts had led the Commission to adopt levees as a cureall for floods in the Valley. Since in fact they were not a cureall, total dependence on them represented a grave, though mostly hidden, danger.

The gradual buildup of floodwaters within the leveed channel was noted both inside and outside the Commission. Threats were occasionally made by riparian landholders to sue the Commission on account of flood heights raised by its work. Following the record spring flood of 1903, a bulletin of the United States Weather Bureau estimated that the levees erected since 1882 had raised the floodwaters at Memphis "between 7 and 8 feet, the latter figure probably being more nearly correct."[31] After 1903, an increasing number of independent experts on the river began to demand some revision of the "levees only" policy, and citizens' groups were formed to push for change.[32] Yet the strongest flood-control associations, the levee districts, and the Commission kept to their established course.[33] By 1926 the Commission felt that the flood problem had been nearly solved by the levees, and that maintenance and bank protection would be the concerns of the future.[34]

In the autumn of that year, however, signs began to appear indicating that the levees were to be subjected to another test. In October, Major John C. H. Lee, the newly appointed District Engineer at Vicksburg, noted that the

river had risen to 40 feet on the Vicksburg gage.[35] He began to study the history of the gage, and found that it had reached 30 feet in October only six times in 54 years, and each time the spring following had brought extremely high water. He began a series of staff meetings to mobilize the resources of his district against the expected emergency.

The new year opened ominously, with a minor flood in January, and a somewhat higher one in February. In early March the waters fell somewhat, but toward the end of the month the seasonal rises of the Ohio, Missouri, and Tennessee showed not only a magnitude but also a degree of synchronization that plainly warned of a major flood on the way.[36] The first three weeks were taken up with a slow rise culminating in disaster. From St. Louis to New Orleans the levees swarmed with men, struggling against the water in the north, and, in the south, building up emergency supplies against what the New York *Times* warned might be "the greatest and most damaging flood in the history of the valley."[37] The worst sign of all was the weather. Spring rains, especially in the middle Valley, were exceptionally heavy,[38] and on the night of 15 April New Orleans had a deluge of almost Biblical dimensions—14.01 inches.[39] On 18 April the river stood at 56.2 feet at Cairo, and the lowlands were flooding rapidly; there were 25,000 homeless, and at least 12 dead. The worst sufferers were Missouri, Arkansas, and Mississippi, with lesser areas inundated in Illinois, Kentucky, Tennessee, and Louisiana.

Near New Orleans armed guards patrolled the levees. The rule in great floods had always been *sauve qui peut*, every man for himself: everybody feared that his own levee might be dynamited by his neighbors to ease the pressure of the water. At Poydras, below New Orleans, four men approached the levee in a skiff one night. When they failed to answer a guard's challenge he fired. One man was killed. "Residents," noted the *Times* laconically "had been warned not to approach the levees after dark."[40]

Cloudbursts fell in southern Kansas, raising the Arkansas, which broke through the levees in Pulaski County and flooded 15,000 acres of Arkansas' richest land. The Red Cross appealed for funds. Refugees poured into Cairo, St. Louis, and a hundred lesser spots. New York investment bankers, "fearing property which forms the basis of bond issues, might have been damaged by the waters," rushed inquiries to St. Louis. They were reassured to learn that the business district of the city was safe, and that the riverfront was "covered with small buildings" only. The reports did not say who, if anybody, lived there.[41]

Following the cloudburst of the 15th, New Orleans enjoyed several days of sunshine. The New Orleans Engineer District and the Fourth District labored to strengthen and raise levees in the area. But the river was rising at every gage from New Orleans to St. Paul, and every major tributary except the Cumberland and the Tennessee was also rising. On 20 April the gage at Carrollton stood at 20.2, up 0.1 foot from the day before.[42] The reports from upriver were an excruciating mixture of good and bad news. Whenever the Mississippi broke its levees the danger to New Orleans from the gigantic flood crest moving downriver was lessened to some degree. And as the crisis of 21-30 April began, there was little to be heard but of this sort of tragic blessing. Non-Federal levees upstream were being overwhelmed, and for the first time in history a mainline levee of full Commission grade failed at Mound Landing, Mississippi, flooding an area 50 miles wide and 75 miles long.[43]

On the 20th the river reached 44.7 feet at Memphis and the levee broke at Clarendon, Arkansas. Miss Rosa Gibson, the town's telephone operator, watched from an upper window of her office building as houses, animals, and river craft were washed down

Clarendon's main street.[44] Recalling the night of 20-21 April, Major Lee wrote, "No steamer was able to stem the current.... So, we rushed in sacks (for sand bags) by airplane, by small boats braving the swirling current of the Arkansas south of Pine Bluff. Labor consisted of white volunteers, of drafted Negroes, of National Guardsmen, and of convicts from the state farm. All worked side by side just as they would fight in a trench. They held this levee ten days and nights through wretched weather, cold and wet, until another attack developed just below and the forces had to be divided. It was then that the crisis came and South Bend went out. Defeat after a fight like that is bitter."[45]

Some refugee camps were flooding, and epidemics of mumps, measles, and whooping cough broke out among survivors. At Little Rock, a train loaded with coal was parked on a steel bridge across the Arkansas to give it added stability. The bridge began to vibrate so intensely that the coal caught fire from the friction. Shortly afterward, bridge, train, and burning coal toppled into the water.[46] At New Orleans, Corps employees and volunteers worked all night, by electric lights or lanterns, with the rain and chill of an unseasonal cold front blowing on them. Though levees about the city itself were stronger than ever before, and despite the relief given by crevasses upstream, Engineers at New Orleans were already considering desperate measures. The Corps of Engineers reported to President Calvin Coolidge that the flood would be the worst in a generation, and George C. Schoenberger, chief engineer of the State of Louisiana, said publicly that a mainline levee break somewhere in the state had become inevitable.[47]

Meantime the Federal Government mobilized its resources to minimize suffering along the river. Major General Edgar Jadwin, Chief of Engineers, went to Memphis to take personal charge of the floodfight; a presidential commission under Herbert Hoover, the Secretary of Commerce, was set up to deal with the disaster; the President appealed for $5 million needed by the Red Cross; and activities of seven agencies of the Government were integrated in a massive effort at relief. But the greatest question of the flood remained unanswered: what would happen to New Orleans when the crest reached it?

To visitors the city seemed unchanged. Despite storing of food and other signs of the approaching crisis, noted the *Times*, "New Orleans, sitting serenely between the river and Lake Pontchartrain, with virtually the entire city of half a million below the river level, went calmly and unhurriedly about its ordinary work."[48] Much of this was appearance; tension rose as the crisis approached, but the city's work went on.

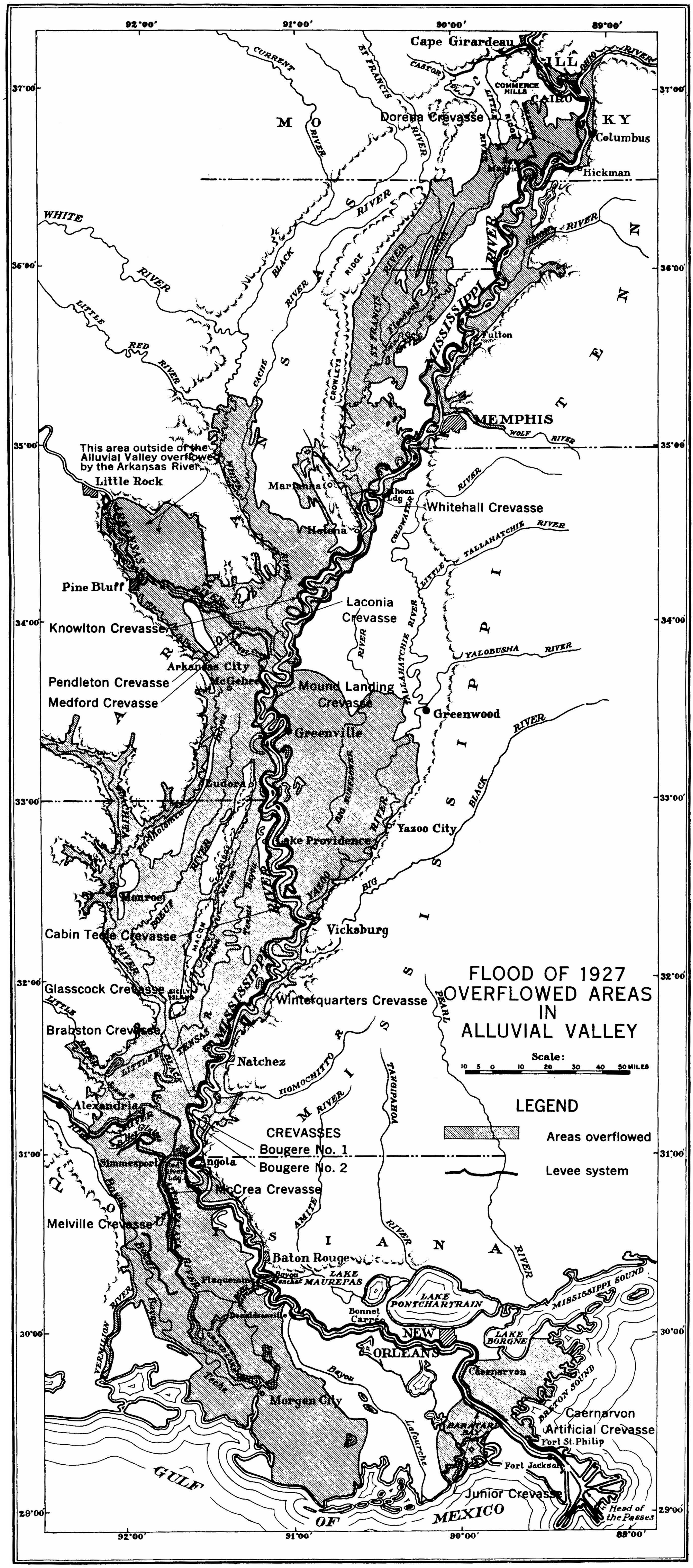
On 26 April, late in the evening, Governor Oramel H. Simpson ordered the levee to be cut at Poydras Plantation, below the city. One hundred thousand acres were expected to be flooded, the water eventually to find an outlet through natural drains into Lake Borgne and the Gulf of Mexico. The evacuation of lower St. Bernard and Plaquemines Parishes had already begun. "The breach," reported the *Times*, "will probably be made by the engineers of the State with approval of the engineers of the War Department. The step was recommended by the Mississippi River Commission."[49]

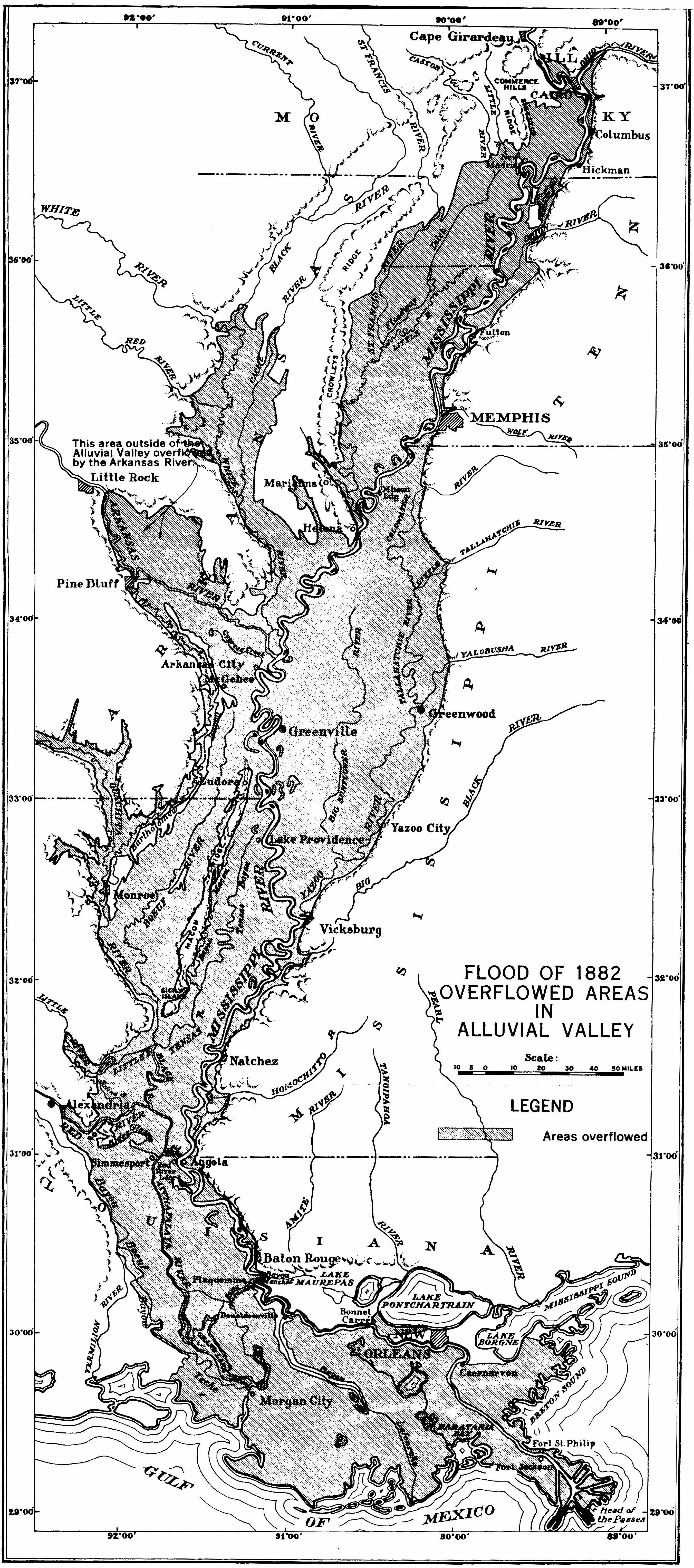
The finale went with a bang—and a fizzle. Trappers and farmers from the area to be flooded were reported guarding the levee with "machine guns, riot guns, rifles and pistols," but were expected to submit when the time came. Riotous public meetings were held, and state authorities made the expected promises of compensation. Meantime, in New Orleans, 500 "pump guns" were issued to patrol squads to guard against possible reprisals. An embargo was placed on dynamite sales, and

400 National Guardsmen camped about the city.

On 29 April six successive charges of dynamite breached the Poydras levee. Though 1,500 pounds had exploded, a reporter wrote angrily that the "awe-inspiring spectacle that had been promised was lacking. There was no gigantic torrent.... There was the muffled sound of exploding dynamite, earth and stones shot into the air, and there was silence. The water seeped slowly, almost reluctantly, through the comparatively small holes and spread placidly over the land on the other side. Prosaic picks and shovels were called into play.... News photographers and motion picture camera men registered intense disgust."[50] Hours passed before the crevasse slowly grew to the needed dimensions.

Yet the levee was the least that the ineffectual dynamite had blown up. Coming at the end of that extraordinary April, when much of the levee system had been overwhelmed, 200 people killed, 700,000 driven from their homes, and $200 million in property losses recorded, the blast at Poydras was more significant than it seemed. A policy had been breached, and the pouring waters were sweeping an era away.[51]


FLOOD OF 1927
OVERFLOWED AREAS
IN
ALLUVIAL VALLEY
Scale:
10 5 0 10 20 30 40 50 MILES
LEGEND
Areas overflowed
Levee system
92°00'
91°00'
90°00'
89°00'
37°00'
36°00'
35°00'
34°00'
33°00'
32°00'
31°00'
30°00'
29°00'
Cape Girardeau
ILL
KY
CAIRO
COMMERCE HILLS
Columbus
Hickman
Dorena Crevasse
MEMPHIS
Fulton
This area outside of the Alluvial Valley overflowed by the Arkansas River
Little Rock
Pine Bluff
Marianna
Helena
Whitehall Crevasse
Laconia Crevasse
Knowlton Crevasse
Arkansas City
McGehee
Pendleton Crevasse
Medford Crevasse
Mound Landing Crevasse
Greenville
Greenwood
Eudora
Lake Providence
Yazoo City
Monroe
Cabin Teele Crevasse
Vicksburg
Glasscock Crevasse
SICILY ISLAND
Winterquarters Crevasse
Brabston Crevasse
Natchez
Alexandria
CREVASSES
Bougere No. 1
Bougere No. 2
Simmesport
Angola
McCrea Crevasse
Melville Crevasse
Baton Rouge
Plaquemine
Bayou Manchac
LAKE MAUREPAS
Bonnet Carré
LAKE PONTCHARTRAIN
NEW ORLEANS
Donaldsonville
Morgan City
LAKE BORGNE
MISSISSIPPI SOUND
BRETON SOUND
Caernarvon
Caernarvon Artificial Crevasse
Fort St. Philip
Fort Jackson
Junior Crevasse
Head of the Passes
BARATARIA BAY
GULF OF MEXICO
M O
A R K A N S A S
T E N N
M I S S I S S I P P I
L O U I S I A N A
CURRENT RIVER
ST FRANCIS RIVER
CASTOR
LITTLE RIVER
OHIO RIVER
WHITE RIVER
BLACK RIVER
LITTLE RED RIVER
CACHE
CROWLEYS RIDGE
MISSISSIPPI RIVER
WOLF RIVER
COLDWATER
LITTLE TALLAHATCHIE RIVER
TALLAHATCHIE RIVER
YALOBUSHA RIVER
BLACK RIVER
BIG SUNFLOWER
YAZOO
BIG BLACK
BOEUF RIVER
TENSAS
MACON
Bartholomew
OUACHITA
LITTLE RIVER
HOMOCHITTO R
AMITE
TANGIPAHOA
PEARL RIVER
VERMILION RIVER
Bayou Teche
Lafourche
Bayou



FLOOD OF 1882
OVERFLOWED AREAS
IN
ALLUVIAL VALLEY
Scale:
10 5 0 10 20 30 40 50 MILES
LEGEND
Areas overflowed
This area outside of the Alluvial Valley overflowed by the Arkansas River
Cape Girardeau
Cairo
Columbus
Hickman
New Madrid
Fulton
MEMPHIS
Little Rock
Marianna
Helena
Pine Bluff
Arkansas City
McGehee
Greenville
Greenwood
Eudora
Lake Providence
Yazoo City
Monroe
Vicksburg
Natchez
Alexandria
Simmesport
Angola
Baton Rouge
Plaquemine
Donaldsonville
Bonnet Carré
NEW ORLEANS
Caernarvon
Morgan City
Fort St. Philip
Fort Jackson
Head of the Passes
COMMERCE HILLS
CROWLEYS RIDGE
LAKE MAUREPAS
LAKE PONTCHARTRAIN
LAKE BORGNE
MISSISSIPPI SOUND
BRETON SOUND
BARATARIA BAY
GULF OF MEXICO
MISSISSIPPI RIVER
OHIO RIVER
WHITE RIVER
BLACK RIVER
CURRENT RIVER
ST FRANCIS RIVER
CASTOR
LITTLE RIVER
LITTLE RED RIVER
ARKANSAS RIVER
WOLF RIVER
TALLAHATCHIE RIVER
YALOBUSHA RIVER
BIG BLACK RIVER
YAZOO
BIG SUNFLOWER
OUACHITA
BOEUF RIVER
TENSAS
HOMOCHITTO
AMITE
TANGIPAHOA
PEARL RIVER
RED RIVER
ATCHAFALAYA RIVER
VERMILION RIVER
LITTLE
KY
TENN
M O
ARKANSAS
MISSISSIPPI
LOUISIANA
37°00′
36°00′
35°00′
34°00′
33°00′
32°00′
31°00′
30°00′
29°00′
92°00′
91°00′
90°00′
89°00′

CHAPTER FOUR

PROJECT FLOOD

The flood of 1927 confirmed the worst fears of opponents of the "levees only" policy, and brought bitter criticism of the Mississippi River Commission.[1] Working under great pressure, Major General Edgar Jadwin, the Chief of Engineers, found a way through the tangled scientific, political, and economic difficulties which surrounded the question of flood control and gave direction to a Congress and a public, angry over the past and confused by conflicting proposals for reform.

The plan proposed by Jadwin utilized work done by the Commission in developing its own scheme for a reformed system of flood control, and in many features the two programs were identical. The ideas of the Commission were, however, modified in important ways by conclusions of four Engineer boards working for the Chief, and the new plan was infused with Jadwin's energy, clarity of expression, and political astuteness.[2] Adopted through the work of a commission created by Congress in the Flood Control Act of 15 May 1928, the plan provided the key to the modern system of flood control at a price Congress was willing to pay.[3] Success of the plan marked an era in the history of the Mississippi Valley.

Fundamentally, what Jadwin proposed was to restore to the river by artificial means the capacity that the levee system had taken away. First he defined a "project flood"—the flood that the Weather Bureau called the "maximum possible" and the Commission the "maximum probable" that could occur in the Valley. Resulting from perfect synchronization of the highest known rises of the tributary systems with the most unfavorable recorded rainfall conditions in the Valley itself, this apocalyptic event would bring flood heights of 66 feet on the Cairo gage and 74 feet at Arkansas City, with a flow of 3 million cubic feet per second below the mouth of Red River. By this yardstick all proposals for flood control were to be measured. Despite changes in detail, the concept of the project flood retained 40 years later the critical function that Jadwin assigned it.[4]

The superflood could not be met by strengthening the levees. As Jadwin's successor, Major General Lytle Brown, was to write a few years later:

> The cost of levees on the Mississippi increases more rapidly than the square of their height, and the destructiveness of a crevasse increases almost in like proportion.... levees are not fixed...they must, on occasion, be rebuilt in new positions due to bank erosion. Consequently, they must not be too costly. All conditions demand levees of limited height, and the limit is soon reached.[5]

Jadwin planned to strengthen and raise slightly the existing levees, but he also planned a system of floodways and spillways to

duplicate the effects of the swamp reservoirs and natural outlets. "... the river needs more room," said Jadwin, "which should be given to it laterally rather than vertically." In Missouri, a floodway between Birds Point and New Madrid would draw floodwaters away from the meeting place of the Mississippi and Ohio at Cairo, Illinois, and return the water to the mainstream below. The Arkansas River similarly would be relieved by a floodway in the Boeuf River basin, a natural channel of escape which local interests had closed off with levees. Finally, the Delta would be protected by a floodway that made use of the natural distributary of the Atchafalaya. At Old River the project flood would be divided into halves, with 1.5 million cubic feet per second passing down the basin of the Atchafalaya to the Gulf. The special problem of New Orleans would be met by a spillway above the city at Bonnet Carré, where another 250,000 second-feet would be guided out of the main channel and into Lake Pontchartrain north of the city.[6] As envisioned by Jadwin, the floodways would increase the carrying power of the river, protect vulnerable areas, and split up the superflood among three outlets.

Jadwin thought the floodways would not be too expensive.[7] He proposed to control entry of water by "fuse-plugs"—low levees designed to stand against ordinary stages of the river but crevasse in great floods.[8] Once within the floodways, the water would be guided by lateral earthen levees. Only at Bonnet Carré did Jadwin contemplate the use of an artificial control structure. In the 12 years or so that usually elapsed between great floods, the land within the floodways would be available for a variety of uses, including cattle raising and many types of farming. The residents of these unfavored areas would have no valid reason for complaint, in Jadwin's view, since the proposed floodways were all natural outlets which went under water anyway during great floods. Economically and politically, as well as in the engineering sense, Jadwin saw diversion into the floodways as a line of least resistance.[9]

His plan contained other improtant elements. He recommended that 80 percent of the cost of the project flood system be borne by the Federal Government.[10] He proposed to unify the chain of command by making the Mississippi River Commission an advisory body and requiring that the offices of president of the Commission and Division Engineer, Lower Mississippi Valley, be held by the same officer. Since this officer would be a brigadier general in the Corps of Engineers and the executive officer of the Commission, power both to initiate and to veto flood control projects on the Mississippi would be lodged in the Office of the Chief of Engineers.[11] Finally, Jadwin recommended the creation of a hydraulic laboratory under the Commission, to coordinate field data and experiment with small-scale models of the river. Old themes of the river's history—the scientific inquiry that had begun with the Delta Survey, the expansion of Federal power, the concentration of that power in the hands of the Chief of Engineers—were carried a long step further when the Jadwin Plan became law.

Before describing how the plan was put into effect, some background must be given on the development of flood control policy in the United States in the twentieth century. The flood of 1927 could hardly have provoked such a comprehensive answer as the Jadwin Plan if the American people and their government had not matured considerably in their attitude toward their natural resources in general and the needs of the Valley in particular.

The early decades of the century had seen a succession of great floods, each of which provoked new demands for action.[12] But Mississippi River Commission response was limited by the "levees only" concept, and consisted largely in the Commission raising again and yet again the standard grades for levees along the river.[13] Yet the floods also

produced new thinking in and out of Congress, without, however, bringing significant change in policy until after 1927.[14] Instead, the authority of the Commission was gradually extended over the entire lower and middle river from the Head of Passes to Rock Island, Illinois, and up the tributary systems as far as the backwater curve of the Mississippi affected them.[15] This extension and unification of authority provided the organizational base for the new flood control plan when it came into being.[16]

Deeper changes were at work, too, altering the American people and transforming their concepts of government, as the Civil War had changed them in the past. From the turn of the century to the First World War, the American political scene was dominated by recurrent demands for reform in almost every aspect of national life. The Progressive Era was dramatized by Theodore Roosevelt and resulted in the enactment of far-reaching reforms under Woodrow Wilson. Under the Progressive impulse, new demands were heard for conservation and development of resources, and these were combined with flood control to produce the first programs of comprehensive waterways development. At first the Corps was hostile to multiple use planning, but in 1925 shifted its stance and began to study the comprehensive development of American river basins.[17]

Congress passed landmark laws in three successive decades.[18] In 1917 the first flood control act committed the nation to prevent overflows on the Mississippi and Sacramento Rivers. Though this law in no way represented the real entry of the Federal Government into the field, it was important for two reasons. First, it swept away any lingering pretense that levee building was intended only to benefit navigation, and proclaimed openly that flood control was a proper activity of the national government. It did not begin the era of Federal flood control, but it did end the era of Federal subterfuge. Second, the law established standards for Federal-state division of costs, providing that one-third the cost of flood control works should be paid by the Federal Government and two-thirds by local interests. Shortly afterward, for defense purposes, the Federal Government began a program to encourage the rebirth of trade and commerce on the Mississippi. Waterways played an important role in the nation's war effort and a major rebirth of waterborne commerce took place.[19] In both navigation and flood control the Woodrow Wilson administration was a time of progress, reborn effort, and new ideas.

Indicating the bipartisan nature of the new approach, the next decisive changes took place under that stern Vermont conservative, Calvin Coolidge. The Rivers and Harbors Act of 3 March 1925 opened the way to comprehensive planning for waterways development.[20] Flood control, navigation, power production, and irrigation were declared to be interdependent aspects of waterways development, which must be considered together in planning for the use of the nation's rivers and lakes. Under Coolidge, too, the integrated response of seven Federal agencies to the crisis of 1927 foreshadowed future methods of disaster relief. The President apparently intervened at several points in the evolution of the Jadwin Plan, and ultimately proclaimed it as the guide to the nation's new flood control program. Many of the concepts of the Jadwin Plan were adopted in the Flood Control Act of 1928, passage of which was accelerated by the losses of lives and property generated by the 1927 flood. Basically, the 1928 Act set up the all-important "Mississippi River & Tributaries Flood Control Plan." The plan was then carried into effect under those bitter political and ideological rivals, Herbert Hoover and Franklin D. Roosevelt. By the 1930's, practically anything about Federal flood control might become a political issue, except the basic principle itself. Flood control had

become the nation's business, and so it remained.

A fourth important law was the Flood Control Act of 22 June 1936, which extended Federal flood protection to the nation at large, and established the cost-benefit ratio as a yardstick for determining whether specific works should be undertaken. Specifically, the law declared that flood control improvements could be carried out if the benefits, to whomsoever they accrued, were in excess of costs.[21] This standard provided the Corps with its most important yardstick for judging new projects until the environmental movement more than 30 years later modified it. A classic liberal device to secure the greatest good for the greatest number, the ratio at the time it was devised indicated a broad, new concept of the duties of the national government to "promote the general welfare."

Clearly the country had come a long way since the Commission justified closing crevasses on the ground that breached levees constituted a danger to navigation. The new approach had its own inadequacies, of course. The standards which Congress set for the Engineers were exclusively economic. Competitive goals of recreation, conservation, and the enjoyment and use of nature for noneconomic purposes were left in the air, to be settled piece-meal by Congress or by power struggles among competing Federal agencies. Yet at the time they were adopted, and in the years since, these changes in organization, standards, and fundamental law brought far more benefit to the United States than many a victory on the battlefield.[22]

The adoption of the Jadwin Plan brought extensive responsibilities to the New Orleans District. It did not, however, bring any real organizational changes. The old Fourth District of the Commission, after passing through a brief rechristening as the New Orleans River District, was renamed the Second New Orleans District and placed under the Mississippi River Commission, with headquarters in Vicksburg. The former New Orleans Engineer District became the First New Orleans District, remaining subject to the Gulf Division with headquarters at New Orleans. The task of building two great works under the Jadwin Plan—the Bonnet Carré Spillway and the Atchafalaya Floodway—fell to the Second District.[23] Bonnet Carré enjoyed top priority since it promised New Orleans' large population immediate relief from floods. The Atchafalaya Floodway—a truly gigantic job—was also undertaken rapidly, but its ramifying complexities delayed effective solution. The Boeuf Floodway lay outside the New Orleans District in northeastern Louisiana, and no full account of its troubles can be given. It may be noted, however, that this was the area where the Jadwin Plan encountered the most determined opposition from local interests, that plans for the Boeuf were set aside in 1935 in favor of the Eudora Floodway east of the Macon Ridge, and that the whole project was abandoned in 1941, when the Engineers' cutoff program made it possible to lower flood crests on the Mississippi with far less political opposition.[24]

Bonnet Carré was a notorious bend of the Mississippi about 30 miles above New Orleans.[25] Here the east bank of the river had a history of persistent crevasses, including great ones in 1871 and 1874.[26] The idea of creating an artificial outlet to Lake Pontchartrain where nature seemed anxious to force a natural one had early occurred to students of the river. William Darby described the possibility in 1816, and his idea continued to attract attention throughout the 19th century. Humphreys and Abbot went at some length into the proposal, only to reject it for fear that the river would make the outlet its main channel, or would silt up Lake Pontchartrain. Ellet viewed such an outlet as a last resort, for similar reasons.[27] The concept of a controlled outlet, however, promised an answer to these

objections. First proposed by the Corps' General Comstock in 1893 and cautiously endorsed by the Mississippi River Commission's Richard Taylor in 1913, the concept was vigorously promoted by New Orleanians anxious over rising flood heights which endangered the wharves of the city. Responding to pleas by the city's Safe River Committee of One Hundred, Congress on 17 April 1926 passed an act requiring the Secretary of War to make surveys and cost estimates for controlled spillways between Point Breeze and Fort Jackson, Louisiana. To insure the fresh look at river policy demanded by spillway advocates, the work was given, not to the Mississippi River Commission, but to a group of Engineer officers known as the Spillway Board.[28] By the time their report was ready, the flood of 1927 had occurred, and Jadwin incorporated their proposals into his own plan for the river. Though some technical changes were made in the process, the Spillway Board had the unique experience of seeing the essence of their proposals enacted into law within a few months.[29] On 21 November 1928 President Coolidge approved the final site, 6 miles south of LaPlace, Louisiana.[30]

The new urgency of the project was attested by the speed of the usually deliberate Federal establishment in carrying through the work. By 15 December 1928, "equipment had been placed on the site for the driving and testing of piles, the drilling of test holes and for carrying out of all other necessary foundation tests; in addition, the first unit of a hydraulic laboratory (had) been constructed for the purpose of making the required hydraulic experiment."[31]

The land at Bonnet Carré was typical of the Delta region. From the natural bank of the river 14 feet above Gulf level, the land sloped away to an elevation of 1 foot at the shore of Lake Pontchartrain. The last 5 miles of the floodway were virtually level, swampy land, covered with cypress, gum, ash, and cottonwood trees, and with a dense semitropical undergrowth. As defined by its side levees, the floodway was to be shaped somewhat like a broken fan, expanding from a width of 1.5 miles at the spillway control structure to about 2.4 miles at Lake Pontchartrain. The natural levee was "generally cleared and...susceptible to cultivation," while the swamp was worthless as farmland. A dense, almost impervious clay overlay the land, while underneath a mixture of clay and sand permitted the percolation of ground water at a slope roughly even with that of the surface, the water not finding its level until it emerged into Lake Pontchartrain. Three railroads passed over the site—the double-tracked Illinois Central, and the single-tracked lines of the Louisiana Railway and Navigation Company and the Yazoo and Mississippi Valley. There was one important road, the Jefferson Highway.[32]

The gateway that would control the flow of river water into the spillway closely resembled an irrigation dam. Though construction of such a work "in the dry" was in some ways an unusual problem, the principles involved did not differ essentially from other dams which the Corps had already built elsewhere, and a study of existing structures throughout the country preceded work on Bonnet Carré. The prime scope for ingenuity lay rather in working out the hard details under conditions where theory had to anticipate practice. Working under the direction of Major Elroy S. J. Irvine and Senior hydraulic engineer I. A. Winter, the Second New Orleans District undertook the construction of ingenious models to represent in miniature the complex forces of the river in spate. Their experiments were the key to the success of Bonnet Carré, as well as being fascinating examples of the art of the engineer.[33]

A field laboratory was established at the site. The questions to be answered were the best

form for the dam, the best means of quieting the tumultuous entry of the floodwater to a uniform flow, and effects of that flow upon the floodway itself. Two flumes were constructed, one to contain a 1/6-scale model of a spillway gate and the other a 1/20-scale model of a unit of 22 spillway gates. Even the forest was reproduced. The number and size of the trees in a typical acre were established by surveys, and a scale model of the forest was built, with wires for saplings and wooden pegs for trees. Then a work model of the entire project was made—weir, floodway, levees, forests, railroads, highways, and a section of Lake Pontchartrain. The Engineers determined that, except for an eddy formed at the first turn in the lower levee, the full width of the floodway would be an effective channel, and even the troublesome eddy would disappear before reaching the forest. By these means, the most effective form of the spillway was worked out to very high standards of accuracy and the way prepared for actual construction.[34]

Meantime other tests were being carried out. In building the spillway, as in all large structures designed for the Delta, the ability of the soil to bear heavy weights and of pilings to endure soaking in the saturated subsoils were matters which required the fullest examination. Pilings were driven and loads of up to 120 tons were tried upon them to test the rate of sinking. As usual, no stratum was found for the piles to rest upon—their "bearing value" was entirely frictional. Consequently loads had to be very exactly balanced to prevent failure of a foundation that was, in effect, floating in the soil. On the other hand, untreated wooden pilings proved to be extraordinarily durable, provided that no air was allowed to reach them. In the neighborhood of Bonnet Carré timber foundations were found, half submerged in ground water, which had been "in existence for almost a century without the slightest sign of decay." The Engineers opened the base of the Lee Monument in New Orleans and found much the same story. In 50 years, the timber and piling buried in moist earth were sound, while at a higher level, timber surrounded by dry earth showed clear evidences of decay. While these tests were carried out in the field, soil permeability was being tested at the laboratories of Tulane University. Models, test pilings, field examinations, and laboratory work gave an extraordinarily comprehensive picture of the region, and of the most promising form for the engineering structures to be erected there.[35]

As finally projected, the weir was a concrete structure resting upon timber piles 65 to 70 feet long. On the river side, a line of interlocking sheet steel piling prevented lateral flow of the soil caused by the weight of the weir and also prevented percolation of water through the porous subsoil. Baulks of wood ("needles") formed the weir gates; in time of need these could be removed one by one to take off the crest of the flood. Behind the spillway weir was a stilling basin, consisting of a concrete apron with baffles to break the inflow of water which might otherwise endanger the weir and floodway behind it. Riprap covered by articulated concrete slabs completed the structure by preventing undermining from the rear.

Work was begun at once and by 10 February 1931 the spillway weir stood complete.[36] The summer of 1932 saw the guide levees on both sides of the spillway brought to final grade, except for gaps at the highway and railroad crossings. Work now began on the bridges that were to carry the rail and highway traffic across the spillway, and by the midsummer of 1936 the crossings had been completed and the gaps in the guide levees closed. The end of the year saw the completion of work on the Mississippi levee that fronted the weir, to protect the forebay from driftwood. Lowered in the conventional "fuse-plug" pattern, dressed, and sodded with Bermuda grass, the

correction of the levee formed the last element in the work, and in December 1936 the Chief of Engineers was able to announce that the entire floodway project stood complete. The timing was theatrically close. In January 1937 one of the greatest of all recorded floods started on its way down the Mississippi.[37]

Very heavy winter rainfall in the Ohio River Valley produced the truly gigantic flow of 1.85 million second-feet at Cairo. Fortunately, this immense crest moved alone; an earlier flood on the White had already passed, and the upper Mississippi reserved its waters until May. Still, the Ohio flood was met at Cairo by a flow of 164,000 second-feet from the upper river, which meant that over 2 million second-feet were moving down the Valley in January.[38] Gage readings frequently exceeded those of 1927. To save Cairo, the Birds Point-New Madrid Floodway was opened by dynamiting the fuse-plug after it failed to crevasse.[39] Cairo was saved, and though levees had to be sandbagged and backwater areas were badly flooded, the mainline levees held. Local misfortunes and suffering occurred, requiring the Red Cross and the National Guard to be called out, and the Public Works Administration and the Civilian Conservation Corps provided labor forces for sentry and maintenance work along the levees. But there was no comparison with the ruin of 1927. Men might begin to hope—cautiously—that a single decade had solved the flood problem of centuries. One test remained, however, in the Delta, where all the upstream waters must be funneled safely past New Orleans and discharged into the Gulf of Mexico. The fresh sod on the levee at Bonnet Carré would have no chance to root itself after all.

The Natchez gage recorded the highest in history. As they had upstream, local and Federal agencies turned out to sandbag levees which had not yet been raised to the 1928 grade. There were gaps in the Atchafalaya levees that had to be hurriedly filled, and plank revetment to be laid down along the mainline levees of the Mississippi for protection against the extreme pressures and very high current velocities. The broad, deep channel of the lower river accommodated the flood well enough that the fuse-plug levees at the head of the Atchafalaya did not go out. But when the water rose to the mark of 20 feet on the Carrollton gage, the Bonnet Carré Spillway was opened for the first time. The drawing of the needles continued until, on 18 February, 285 of the 350 bays were flowing. A week later the flow reached its maximum peak of 211,000 second-feet—well within the capacity of the floodway, but an awesome sight for those who saw it.[40] Trees were uprooted and swung like flails against the forest. A thousand men worked around the clock, clearing drift from the floodgates, laboring on the guide levees and deflection dikes and maintaining a constant watch over the first man-made outlet of the Mississippi. An elaborate information-gathering service was set up, with 153 gages extending from the weir forebay to Lake Pontchartrain. Radio and telephone maintained constant contact among the work parties, the patrols, the spillway control points, and the Second District office. As the waters began to fall, gradual closing commenced on 7 March, and continued for nine more days, holding the Carrollton gage stationary.[41]

When the last needle fell back into place on 16 March 1937, an extraordinary moment in the river's history had passed. It passed quietly, as important moments so often do. The report of the Mississippi River Commission recounted the event without rhetoric. Among other developments, it described the successful passage of "The High Water" of 1937.[42] No more than that seemed necessary.

The Atchafalaya Basin was a part of the flood control system that presented the Engineers with unique problems. The greatest

1937—The first Mississippi River water passes through Bonnet Carré Spillway en route to Lake Pontchartrain and the Gulf.

of all distributaries of the Mississippi, the Atchafalaya, was in Fisk's words:

> A complex stream which flows partly in its own channel, partly in a channel inherited from other streams; which possesses a single channel for only part of its length; which builds a delta into a lake system along its course; and which finally flows from the lake system into an arm of the sea through several channels.[43]

The Atchafalaya was so complex largely because it was a new stream still in process of creation, and one which had been shaped to an extraordinary degree by the human activities which surrounded it for a great part of its existence.

Created during the fifteenth century A.D., the Atchafalaya took form when an enlarging loop of the Mississippi, later called Turnbull's Bend, broke into the basin of the Red River. Water from the great river was forced down a small distributary of the Red which flowed south into a marshy valley between the Teche and Lafourche ridges. In the valley was a large lake formed by the drainage from the ridges, a lake which had already found an outlet to the sea through the channel later named the "lower Atchafalaya."[44] When the first Europeans arrived, they found the Atchafalaya a well-defined distributary flowing out of Turnbull's Bend a few miles south of its confluence with the Red. The distributary was so placed, however, that it became a trap for drift timber brought down by the two rivers that fed it. By 1778 a great raft had formed near the head of the stream, effectively blocking its further enlargement.[45]

At this point human beings began to tinker with the Atchafalaya. As settlement proceeded, the obstruction of the raft became increasingly burdensome to farmers, and during the drought of 1839 settlers set fire to it and burned it to the waterline. The next year the State of Louisiana began clearing out the underwater logs with snag boats. Though the raft periodically re-formed, it was just as

persistently broken up again. By 1880 the Atchafalaya was permanently clear and rapidly enlarging. Unhappily for the people of the valley, it enlarged from north to south, flooding out long-established plantations and farms, whose owners used up first their profits and then their capital in "building and raising levees to restrain the augmenting floods from above."[46] Much of the land returned to nature, bankrupting those who had sought to make the river a navigable stream. And there was a further danger in what was taking place, though few remembered that in 1804 the officer who took possession of upper Louisiana for the United States had written:

> ...the channel of the Chafalia, a few miles only from the head of (Red River), is completely obstructed by logs and other material. Were it not for these obstructions, the probability is that the Mississippi would soon find a much nearer way to the Gulf than at present, particularly as it manifests a constant inclination to vary its course.[47]

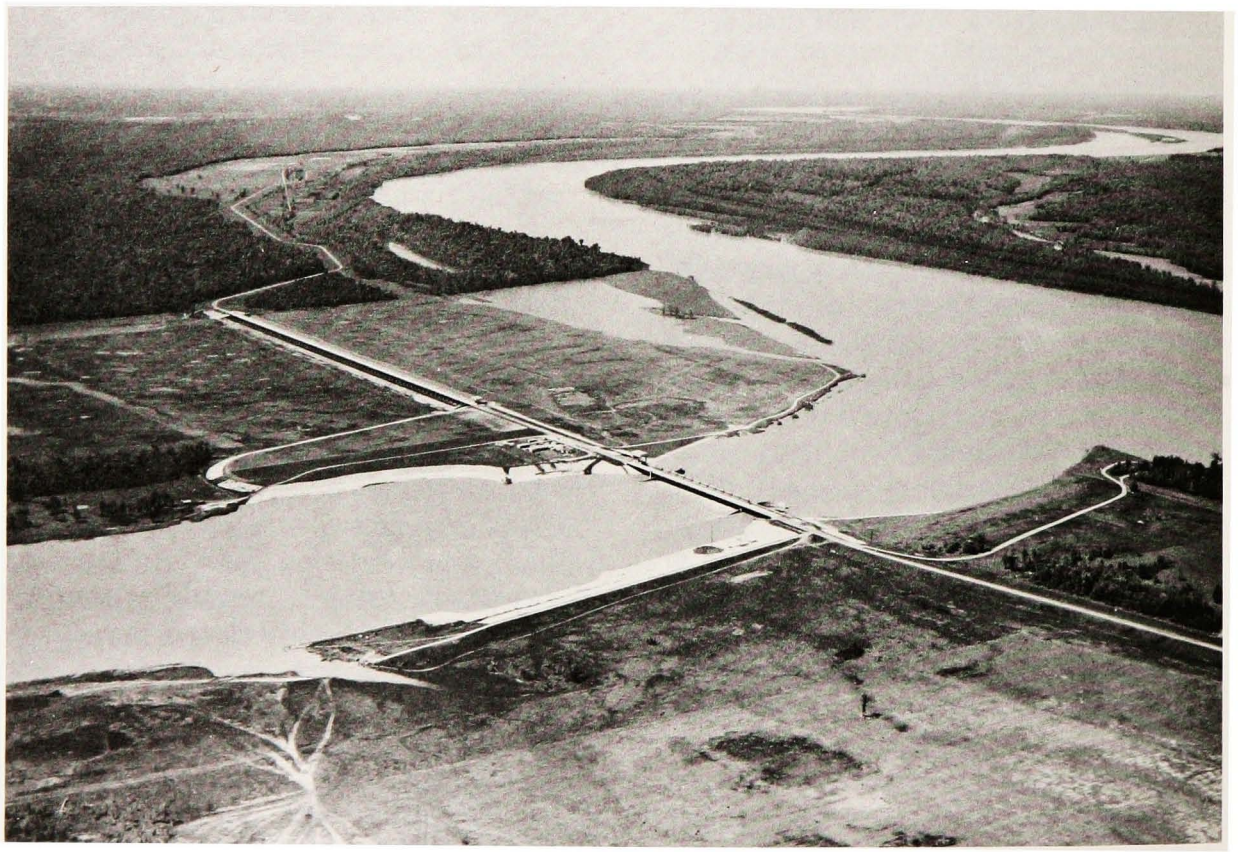
Meantime, in 1831, Henry M. Shreve cut off Turnbull's Bend.[48] The abandoned bend, whose arms were known as Upper and Lower Old River, showed the customary tendency to silt up, and in fact first the southern and then the northern arm did close. Both the channels would eventually have become permanently filled if left to themselves, and the Red-Atchafalaya would have formed a single river running parallel to the Mississippi.[49] Here again, however, human beings took a hand, dredging out the lower channel in order to maintain navigation and trade. The Mississippi River Commission considered and rejected a variety of plans for dealing with the region. Inhabitants of the region were bitterly divided, as was the Commission itself; James B. Eads resigned in a dispute over the proposed closure of Old River. In 1885-1889 the Mississippi River Commission built three sill dams to slow the Atchafalaya, but at the urging of steamboat interests dredged Old River, where current now flowed west or east according to relative stages on the Mississippi and the Red.[50] The Jadwin Plan, however, contemplated using the great distributary for three converging floodways[51] that were to carry half the project flood out of the main channel to protect the Delta. The Mississippi River Commission sill dams were allowed to decay and were finally destroyed in 1939-1940 as part of the program to open an efficient channel down the Atchafalaya.[52] A variety of other measures were undertaken to make the river a better floodway: a single channel was dredged through the Delta above Grand Lake, levees were straightened and extended, and a new outlet was created between lower Grand Lake (Six Mile Lake) and the Gulf. All these measures were necessary to the flood control plan, but they contributed to the ever-increasing diversion of the Mississippi.

By 1940 the Atchafalaya was providing the great river a route to the sea with a three-to-one advantage in slope over the old channel past New Orleans. Any need to dredge Old River had long since ceased. The channel was rapidly enlarging, while the Mississippi just below Old River was beginning to fill—a loss of cross section that spoke plainly of the decrease in current velocity caused by the Old River diversion. The last year in which significant eastward flow was observed was 1942, when the current moved toward the Mississippi for a total of 9 days.[53] A study conducted by Commission geologists in 1951 indicated that the capture of the Mississippi by the Atchafalaya channel was only a matter of time.[54] As it had done so often in the past, the Mississippi was preparing to find a new, shorter and steeper route to the sea.

In 1953 a team of geologists directed by Harold N. Fisk reported to the Commission that the change would reach a critical stage during the decade 1965-1975, when 40 percent of the Mississippi's flow would be diverted and

deterioration of the main channel would become irreversible.[55] There would be no great danger to the Port of New Orleans in the event of a diversion of the Mississippi, but the problems of drinking water and waste disposal in a tidal estuary were sobering. The elaborate flood control apparatus, erected over the course of two centuries on the lower Mississippi, would become useless. The Atchafalaya Basin would face the danger of disastrous floods. And the Old River channel could not merely be blocked off, for the Atchafalaya was still essential to control the project flood. All in all, the diversion threat represented a problem of extraordinary complexity.[56]

Corps studies resulted in a Federal law of 3 September 1954, which provided for control structures at Old River, in effect transforming the Atchafalaya into a gigantic controlled floodway/spillway system. Congress authorized an overbank structure resembling the spillway weir at Bonnet Carré to control the passage of floodwater into the Atchafalaya, and a low sill structure in a dredged channel paralleling Old River to regulate flow during periods of low water. A navigation lock was provided to make the Red-Atchafalaya accessible to river traffic from the Mississippi, and when this work was completed the mouth of Old River was sealed off. Meantime, a control structure at Morganza had been finished in June 1956, completing the work on the eastern channel of the floodway. By these works the Atchafalaya—most complex of all the floodway projects—was prevented from



Old River control project, overbank and low sill structures.

capturing the Mississippi yet preserved as an efficient and dependable temporary channel for the great river in time of flood.[57]

As might be expected, the existence of so vast a structure as the Atchafalaya Floodway caused problems. Like any other alluvial stream the Atchafalaya continued to build land and change its own course. The inefficiency of its lower channel caused constantly rising stages upstream, and soil instability made maintenance of levee grades exceptionally difficult. But the development of a stable channel was only one of the continuing problems of the region. Levees blocked streams and obstructed natural drainage. In consequence, the Engineers diverted fresh water through drainage structures at Bayous Courtableau and Darbonne.[58] South of the distribution structures, drainage from the region west of the floodway which formerly entered the Atchafalaya flowed by a continuous chain of borrow pits to Charenton drainage and navigation canal, or by Bayou Teche through Wax Lake Outlet into the Gulf. Similarly, on the east of the floodway, drainage moved by Grand or Bell River to Lake Palourde or Verret and thence to the Gulf Intracoastal Waterway and the Gulf. Thus, the whole drainage pattern of the region was rearranged.

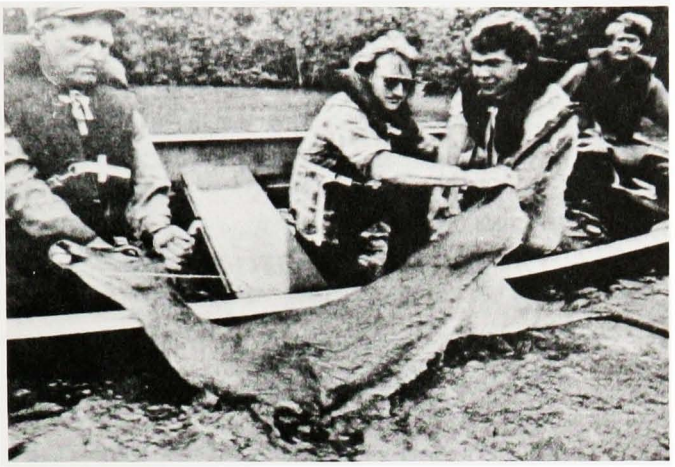
Finally, the basin—especially the West Atchafalaya Floodway—attracted fishermen, hunters, and farmers, causing the District to draw up a master recreation plan for the region. Despite the floodway easement written into all deeds for which the Federal Government paid out considerable money, whole communities of farms and camps sprang up, some representing heavy investments. People who invested would, of course, exercise maximum pressure to prevent the floodway from being used for the purpose for which it was intended.[59] The complexity of maintaining and using the floodway was almost as great as the difficulty encountered in building it; yet when tested the system proved to be worth its cost.

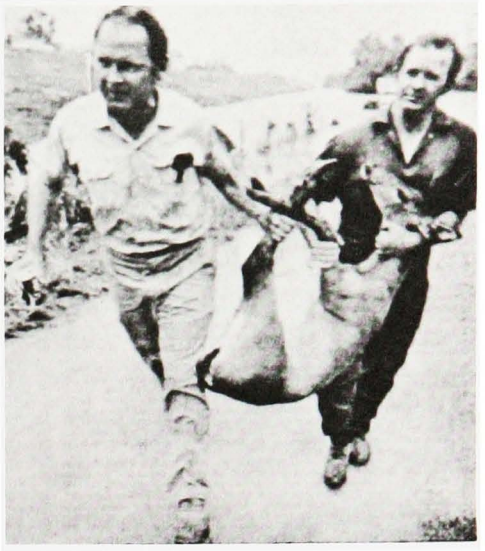
The test came in 1973. Serious flood emergencies in 1945 and 1950 brought new openings of Bonnet Carré, but not of the Atchafalaya system, though dynamite was ready in 1945 and the decision not to breach the fuse plugs was "a matter of tenths of a foot."[60] Almost a quarter of a century elapsed without further need to use either spillway or floodway. Then, in April 1973, floods again swept the Mississippi Basin, killing 16 people.[61] As hundreds fled their homes in the Alluvial Valley, the New Orleans District girded for a dangerous crest worsened by heavy rains. The town of Montz just north of Bonnet Carré was partially evacuated and bulldozers began to throw up a setback levee to protect an area with a long record of caving banks.[62] Vessels in the lower Mississippi were warned to slow down to minimize wave-wash damage to the levees.[63] As incessant rains continued, Lower Mississippi Valley Division Engineer Major General Charles C. Noble ordered Bonnet Carré opened on 8 April, citing unfavorable forecasts and potential levee damage from a flow that had reached 1.4 million cubic feet per second.[64] While aircraft buzzed overhead, a crown of 4,000 in a holiday mood watched Senator Russell B. Long mount a small crane on the weir and pull the first needle.[65] District Engineer Colonel Richard L. Hunt ordered the opening to be spread out over three days, preventing surges, minimizing scour, and reducing flood heights at New Orleans by 1.5 feet. "The metropolitan New Orleans area," declared a local paper, "is in the midst of discovering the true effectiveness of its flood protection system . . . ."[66]

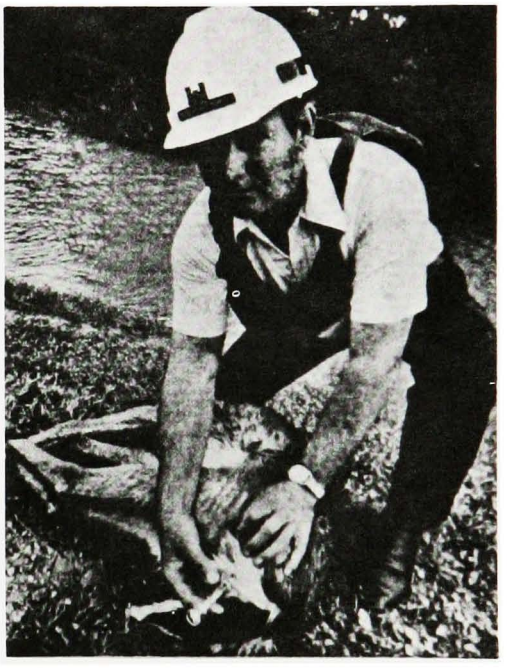
A fuller demonstration was to come. Huge masses of water moving at great velocity undermined the Old River low sill control structure. A week after the opening of Bonnet Carré, a wingwall protecting the structure collapsed. Evacuation of families in the

Carrying Mississippi River flow into Lake Pontchartrain through Bonnet Carré Spillway—1973.

Morganza Spillway's first opening—1973.

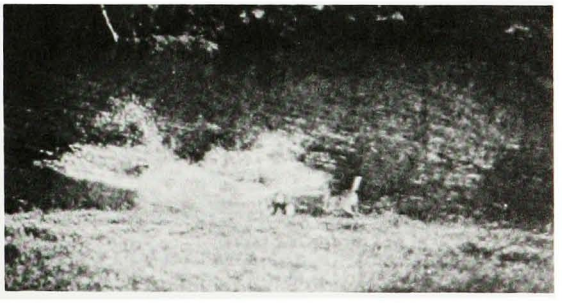






RESCUE OPERATION—State and Federal wildlife personnel estimate that more than 600 deer were rescued from the water which covered the East Atchafalaya Floodway when the gates of the Morganza Spillway were opened 17 Apr 73. The Louisiana Wildlife and Fisheries Commission is now surveying the area to try to determine the extent of the mortality to wildlife. Pictured here are some of the deer rescue operations. Many animals were pulled from the rising water, tagged, given shots of antibiotics, and released across the levee. Many other deer crossed the levee to safety at night. Armadillos, rabbits, wild turkey, and many other species of wildlife were also endangered. Some, like the armadillo shown here, escaped.

(Photos by Charles Gerald)



Morganza floodway began at once, and at dawn on 17 April the Engineers opened the first floodgate. As river water rushed "in white fountains of foam...across the grassy floodway,"[67] District personnel opened 42 of the 125 gates, beginning the diversion of 60,000 cubic feet per second to lessen pressure against the Old River structure 20 miles upstream. "This is not a routine high water," General Noble told the press. "We are confronted with river conditions which, if not controlled, could cause more loss of life and property than this valley experienced in the 1927 flood."[68]

Governor Edwards and Colonel Hunt at Morganza Floodway.

The situation continued to be grave throughout the month. New rains threatened. Louisiana Governor Edwin Edwards called out additional National Guardsmen. Residents of Morgan City, Jena, Marksville, Jonesville, and Opelousas were warned that they might have to evacuate their homes. The Red Cross set up shelters throughout the state.[69] Guardsmen, local citizens, and the Corps worked to bolster the Morgan City levees.[70] Then news began to improve. A sudden drop in the Atchafalaya enabled the Engineers to declare that crisis past.[71] The levees held. As the Office of Emergency Preparedness reported 3,000 families displaced in Louisiana, President Richard M. Nixon flew over part of the flooded region with Senator John C. Stennis of Mississippi. On 27 April, Nixon added Arkansas and Louisiana to the list of disaster area states.[72] But by mid-month, the river, though still above floodstage, was falling slowly, leaving $420 million in damage and 27 dead from Illinois to Louisiana.

Slowly the state dug out. The Engineers dredged to reopen navigation channels at Morgan City and began to raise 260 miles of mainline levee as a precaution against further flooding.[73] Yet even as valley residents met to demand expanded flood protection,[74] Corps spokesmen could point to the immense job accomplished by the existing system. One of the great floods of history had passed, overwhelming local levees and devastating backwater areas. Yet the mainline levees had held and the diversion channels had worked. "The real story of the great flood," said a national magazine, "is not the damage done but the massive destruction that was prevented."[75] An Engineer estimated damages averted below Cairo at $6 billion, those above at $1.5 billion.[76] Nevertheless, the flood gave a formidable warning to the nation. Senator Stennis demanded higher priorities for flood control work,[77] and the inherent danger posed by uncontrolled urban occupancy of flood plains was made painfully clear. "If we had had proper flood-plain regulations 10 years ago," declared a Corps spokesman at Vicksburg, "over one-third of the $128 million in property damage in Mississippi this year would not have occurred."[78]

To the New Orleans District, aftermath of the flood included extensive dredging, repair, and disaster relief activities. Scour holes beneath the low sill structure had to be filled, the wingwall replaced by a rock dike, flowlines revised in the Atchafalaya Floodway and levees raised. Various pumping stations were enlarged; the Charenton Floodgate in the West Atchafalaya Protection Levee was modified. Study of the masses of data gathered during

the flood promised improved protection for the future. But none who lived through it would easily forget the great flood of 1973.

As a result of the program inaugurated by the Jadwin Plan and carried out by the Corps of Engineers in the 40 years since, the ancient theme of the Mississippi in flood tended to lose its atmosphere of crisis and tragedy. Great floods in 1937, 1945, 1950, and 1973 were passed successfully to the sea. Hundreds of millions of dollars invested in flood control were repaid many times over in a multiplying population, industry, agriculture, and the development of recreational opportunities in the lower Valley. Furthermore, the way was opened to a broader development of the Mississippi and its tributary systems for human use and enjoyment. Conquest of the great floods brought the river and its people into a new "regimen" in which the works of man successfully and harmoniously supplemented those of nature. But in view of the extreme complexity and unpredictability of the river system, complacency could not be justified. The river was not to be "bullied"—Mark Twain's word—but to be lived with. The flood control story would have no real end.

CHAPTER FIVE

CROSSING THE T

From 1882 to 1901 the work of the Fourth District on the Mississippi overshadowed the New Orleans Engineer Office. At one time, under Howell, the Engineer Office had taken charge of a broad range of projects, not only in Louisiana but in Texas. There had been no distinction between the work on the Mississippi River and that on the lesser streams, tributary and nontributary; the Office had handled it all. But when the work at South Pass was given to Eads (and later to his executors, who remained in control until 1901) and the Mississippi River above the Head of Passes to the Mississippi River Commission, the Engineer Office was left with drastically curtailed responsibilities. From 1882 until 1901, it concerned itself almost entirely with improvement of local waterways, with such special problems as control of the water hyacinth, and with the difficult but useful tasks of surveying and mapping a region that generally included southern Louisiana, eastern Texas, and the Homochitto River in Mississippi. Between 1895 and 1900 District Engineer Major James B. Quinn also directed construction of modern coast-defense batteries to protect New Orleans, Barataria Bay, and Sabine Pass.[1]

In organizational terms, the Engineer Office—unlike the Fourth District—was completely integrated into the Corps' civil-works structure. Though the Chief of Engineers in 1892 acquired the power to veto work proposed by the Mississippi River Commission, he remained unable to initiate projects. The Engineer Office, reporting directly to the Board of Engineers in New York, had no such autonomy. Instead, a measure of autonomy developed after 1888 within the Corps itself, as the organization decentralized, grouping its local offices under Division Engineers.[2] At first purely an administrative device, this new level in time would assume the significant tasks of project review, setting of priorities, and budgetary control, freeing the Engineer Offices—or Districts, as they were formally renamed in 1915—for day-to-day executive action. With this change, the national civil-works structure took on its matured form. Yet, despite clear distinctions between the Engineer District and the Fourth District, Mississippi River Commission, there was much trading of manpower between the two organizations. The New Orleans Office was at first assigned to the Southwest Division whose chief was president of the Mississippi River Commission. For a few years in the 1880's, Lieutenant Colonel Amos Stickney headed both the Engineer Office and the Fourth District. When in 1901 the Gulf Division was set up, the Division Engineer, Lieutenant Colonel Henry M. Adams, also served as Engineer Officer at New Orleans. As time went on, however, the duties of the

different organizations and levels of organization were more accurately defined, and such overlapping became rare.[3] The Engineer District represented the national civil-works system in New Orleans, while the Mississippi River Commission and its districts formed a special case operating under unique legislative authority.

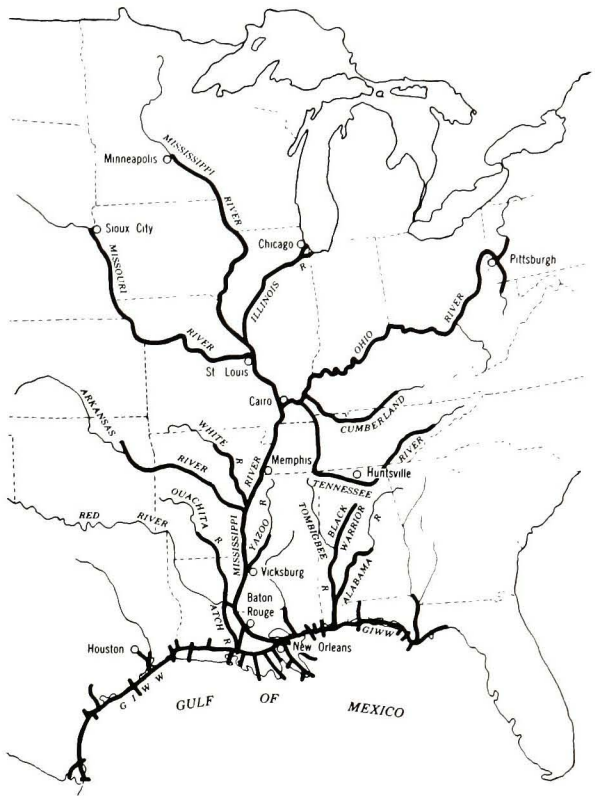
In 1901 the Gulf Division was set up, with headquarters at New Orleans, and the New Orleans Engineer Office placed under its control. In effect, Major Chase's old command was brought back into existence, except that its headquarters was now at New Orleans, instead of Pensacola. Thus, by the turn of the century, the Engineers at New Orleans were linked to the Mississippi River by one chain of command, which ran from the Fourth District to the Commission, and thence through the office of the Chief of Engineers direct to the Secretary of War. A second chain of command linked the New Orleans Engineer Office to the Gulf Division, and thence to the Chief of Engineers. If the commercial pattern of the Mississippi-Gulf system is thought of as an inverted T, with its point of intersection at New Orleans, the vertical bar fell under the Commission, the horizontal bar fell under the Gulf Division. The setup was entirely logical.[4]

With the coming of the twentieth century, the Engineer Office began once more to undertake large, significant civil works. The expiration of the maintenance contract with Eads' heirs brought South Pass back under its jurisdiction. To this was added, in 1902, the immense job of providing a jetty system for

SS Manhattan outbound in Mississippi River.

Southwest Pass.[5] Not completed until 1923, the huge jettied channel (35 by 1,000 feet), would provide the broadest gateway yet into the Mississippi Valley. Finally, the decision of Congress to undertake the long-discussed Gulf Intracoastal Waterway led to extensive resurveys of the region, and finally to the construction of the Waterway itself. This was the most important work the District would undertake: by crossing the T of trade in the Mississippi Valley it helped to transform the economy of the region its served.

The concept of a protected waterway along the Gulf Coast originated, like so many other Engineer projects, early in the 19th century. Acquisition of Florida in 1819 created an ideal situation for east-west regional trade. The aim of connecting the Atlantic Ocean, Pensacola, Mobile, and New Orleans with its immense hinterland in the Mississippi Valley attracted planners throughout the century that followed. In 1826 the Board of Internal Improvements under Brigadier General Simon Bernard surveyed the new frontier of the Gulf Coast and considered, among other topics, the problem of east-west trade. The Engineers concluded that a proposed "Canal across Florida" was not practicable, except with a system of locks, but recommended that coastwise traffic from Florida to New Orleans be rendered "secure, safe, and commodious" by various improvements, including a connecting canal between Mobile and Pensacola Bays and between Lake Pontchartrain and the Mississippi at or near New Orleans.[6] In 1832 Congress appropriated $3,000 to survey portions of the eastern end of the route.[7] Surveys for a ship canal below New Orleans were made in 1852, and in 1873 Howell at New Orleans and Damrell at Mobile drew up plans for connecting the Mississippi to Mobile Bay by a canal 7 feet deep.[8] In 1876 Humphreys discussed anew the question of connecting the Mississippi with the Atlantic via inland and protected waterways.[9] Appropriations, however, were not made on any work directly associated with the eastern leg of the waterway until the twentieth century.[10]



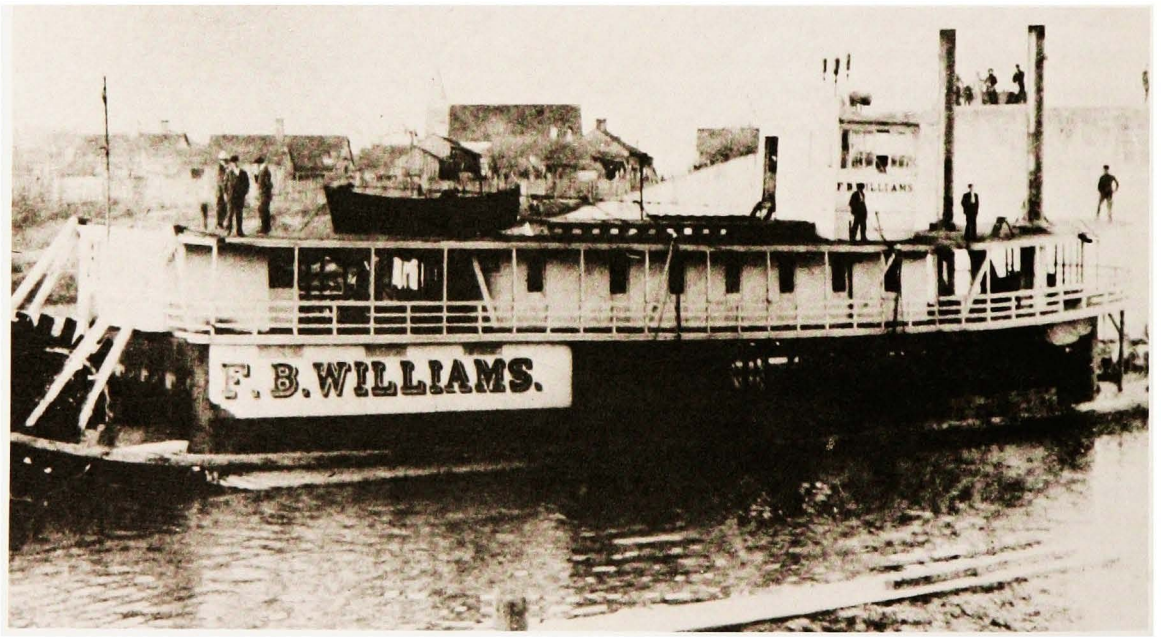
Mississippi River Navigation System.

The project for a western intracoastal waterway had a shorter history but was prosecuted with more vigor. The River and Harbor Act of 3 March 1873 provided $20,000 "For connecting the inland waters along the margin of the Gulf of Mexico from Donaldsonville, in Louisiana, to the Rio Grande River, in Texas, by cuts and canals. . ."[11] Humphreys assigned the work to Howell,[12] and the work was concluded just about the time their feud with Eads got well underway. Taken too soon and completely overshadowed by the Eads affair, the survey was forgotten for a generation.[13] Nevertheless, an important beginning was made. Extensive field work was

carried out by civilian assistants J. A. Hayward, H. C. Ripley, and J. S. Polhemus. The stretch from Galveston to Sabine Pass was surveyed in 1873, and the remaining work completed by 1875, Hayward working west from the Mississippi, Ripley moving east from Sabine Lake, and Polhemus west from Galveston.[14] They found the whole route desolate and difficult to traverse. Working in the hot season, on land that was partly swamp and partly desert, under a meager appropriation "the young gentlemen," as Howell called them, "suffered hardships rarely met in the line of their profession."[15]

The route which Howell proposed on the basis of this survey would have begun at Donaldsonville, where Bayou Lafourche was to be dammed and ships transferred from the Mississippi by means of an inclined plane and turntable. The route would have left the Lafourche by an existing waterway called the Attakapas Canal, which would have been extended to Lake Verret, and thence through Flat Lake to Brashear (Morgan) City. From that point Howell proposed alternate routes, to be adopted according to the amount Congress was ready to spend. The cheaper simply went down the Lower Atchafalaya and west along the coast through Atchafalaya, Cote Blanche, and Vermilion Bays. The costlier involved the use of Bayous Teche and Cypre Mort to provide an inland route to Vermilion Bay. West of this point the route would have been cut across the *prairies tremblants* through White, Grand, and Calcasieu Lakes to Sabine Lake and the Texas border. Howell proposed to make use of bayous which he believed to be the remnants of natural connections among these bodies of water, but he admitted freely that the cost of maintenance was likely to be high.[16]

Indeed, cost was the whole trouble with Howell's waterway. His justification for the work rested almost entirely upon economic development which might result from the waterway itself. For Congress to accept such justifications was by no means unknown, even



First passage through Plaquemine Lock on opening day, 9 October 1909. Steamer *F. B. Williams*, master and owner, Captain Joseph Chotin.

in the nineteenth century, but only in the case of projects with glamor and powerful backing. The proposed waterway possessed neither of these advantages. Reports of the civil assistants left an impression of a potentially rich but desolate region, with swamps giving way to sandy wastes and then to grey cactus-covered prairies. On the whole, it was not surprising that the project lapsed for 30 years, until a growing population, the discovery of oil in 1901, and the beginnings of the sulfur industry in 1903 enabled regional leaders to revive it.

The River and Harbor Act of 3 March 1905 gave the long-moribund project a new lease on life by providing for fresh surveys in Louisiana and Texas.[17] Donaldsonville was still regarded as the eastern terminus, and four sections were defined for survey purposes, three in Texas, and one in Louisiana. Major Edgar Jadwin, future Chief of Engineers, reported upon the Louisiana segment, citing coal, rice, oil, sugar, lumber, and cotton as products which the waterway was likely to transport.[18] However, since the Federal Government was then engaged in clearing and providing a lock for Bayou Plaquemine, he recommended that this waterway be utilized instead of Bayou Lafourche. Jadwin's proposal would have greatly benefitted Baton Rouge (and, in fact, a branch following a similar route was later added to the waterway) but at the time was unsatisfactory to New Orleans. By 1910 routes were being proposed that led directly to the city's back door: the first by the privately constructed Harvey Canal from Bayou Barataria to the Mississippi, the second by another private waterway, the Company Canal, from Lake Salvador southwest of New Orleans to the river.[19] Yet, cost still prevented adoption of any overall plan. The Board of Engineers for Rivers and Harbors decided that prospective through commerce was still not great enough to justify building the entire waterway. Instead, it suggested building a section here and there, and, if economic growth continued, adding others in time.[20]

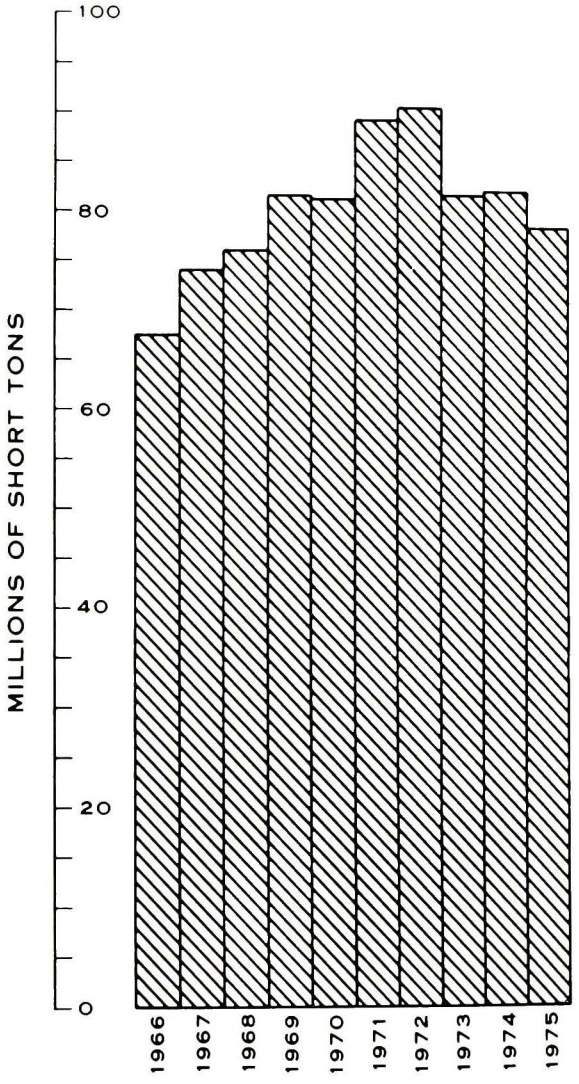
Thus the building of the waterway was like the forging of a chain. Nature had provided some of the links, but they lay scattered on the ground. A few connecting links would be added by men; the segment of the chain would be tested, and, if found satisfactory, another few links might be hammered out in time. "After careful consideration" the Board recommended that the Mermentau River be connected to the Teche at Franklin and Congress adopted the project on 2 March 1907.[21] Once work began in 1908, regular appropriations permitted the first segment to be completed in a few years. It provided a maximum draft of 5 feet at low water and a bottom width of 40 feet.[22] The next part of the waterway—from the Mermentau to the Sabine River—was approved in 1910, on condition that local interests contribute the right-of-way and make up a cost differential of $27,000 between this and an alternate route.[23] Organized as The Interstate Waterway League of Louisiana and Texas, local leaders secured the rights-of-way with the assistance of the New Orleans Engineer Office. Provision was also made for expanding the dimensions of the waterway.

Best news for the waterway, however, was a declaration of policy that Congress wrote into the River and Harbor Act of 3 March 1909.[24] Historians have called the first decades of the twentieth century the "Progressive Era"—a vigorous time of nationalism and sweeping demands for reform. Under the leadership of Theodore Roosevelt and Woodrow Wilson, the nation made new beginnings in many fields, among others in the conservation and development of national resources. There was a general revolt against domination by the railroads, and new demands for a balanced transportation system. Under these impulses Congress wrote the charter of the coastal waterways, providing for a continuous

protected route from Boston to the Rio Grande. Implementing such a gigantic project was, of course, gradual and subject to the vagaries of fiscal rain and drought. But from this time forward it was an acknowledged national goal.[25]

World War I interrupted work but also provided a stimulus to water transport that later benefitted the intracoastal waterways. In 1916 defense needs led to creation at Washington of a Committee on Inland Water Transportation chaired by the Chief of Engineers. This body and its successors—the Inland and Coastwise Waterways Service and the Inland Waterways Corporation—provided critical Federal aid to revive water transport injured by railroad rate-fixing abuses. As barge traffic increased and terminal facilities were erected, transport boomed on the Mississippi, stimulating tie-in routes like the GIWW. Surveying was resumed in Louisiana when peace returned,[26] and an act of 3 March 1923 authorized and directed another full-scale survey from the Mississippi to Corpus Christi.[27] By this time, too, Congress had authorized the dredging of channels from New Orleans to Bayou Teche via the Harvey Canal-Lake Salvador route; from Franklin on the Teche to the Mermentau River; from the Mermentau to the Calcasieu; and from the Calcasieu to the Sabine. Engineers admitted, however, that "no complete project.... exists for the proposed waterway."[28]

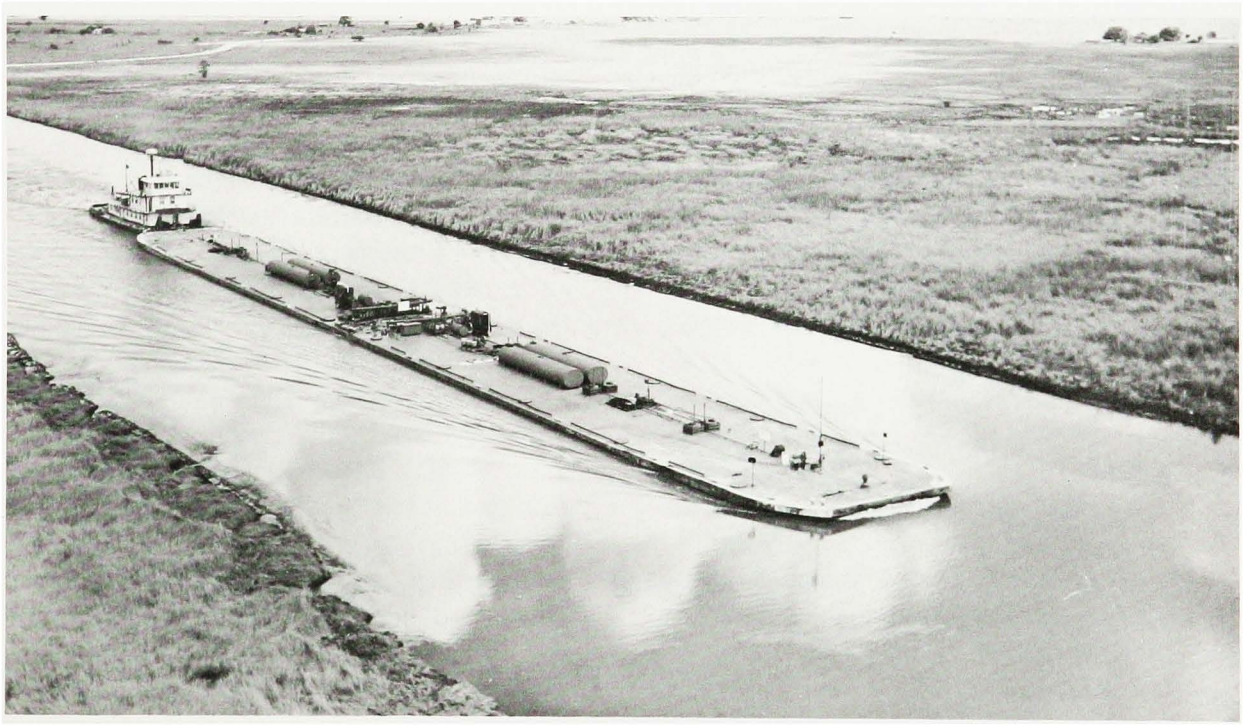
The report of the Board of Engineers for Rivers and Harbors which made this admission in 1924 was basically a plea for a comprehensive program. The Board pointed out the advantages of connecting the western Gulf region, with its rich resources of oil, sulfur, timber, and agricultural products, to the Mississippi-Ohio River system. The rapid growth of the area provided strong arguments to the friends of the waterway. The decade of the 1920's was a miraculous one for Houston, to name only the most obvious case. In 1920 Houston was a rambunctious town of 138,000; in 1930 it was reaching for 300,000 and was well started on its career as a southwestern Chicago. The critical economic fact, of course, was the growing importance of the great southwestern oilfields in the decade that saw mass-produced automobiles turn America into a nation on wheels.[29] And Houston was only the most obvious case in a picture of regional growth, based on petrochemicals, sulfur, and other resources, that changed the waterway from a dream to an inevitability.



Waterborne commerce, 1966-1975, Louisiana section.

Under the direction of the Gulf Division Engineer at New Orleans, the new routes laid out for the waterway avoided the shallow tidal bays along the coast, where storm and tide contradicted the basic purpose of providing a protected slack-water route for commerce. In successive plans the waterway migrated inland, changing its form as the Engineers dredged whenever possible in straightline segments across the swamp, instead of following the tangled skein of natural waterways. At the same time, more local canals were incorporated, since they had already been built where they could serve some profitable local trade.[30] The increasingly heavy private investment in terminal and handling facilities was sufficient to reassure even the administration of Calvin Coolidge that the government was not likely to lose money invested in the region. In 1924 the Board of Engineers for Rivers and Harbors confidently predicted "a general commerce of at least 500,000 tons per year between New Orleans and points west."[31] In fact, the trade would swell to 100 million tons in 45 years.[32]

The Board's report led Congress in 1925 to authorize the expenditure of $9 million to build the Louisiana and Texas Intracoastal Waterway, from the Mississippi at or near New Orleans to Galveston Bay, Texas.[33] In 1926 the Gulf Division Engineer was ordered to begin surveys for the eastern leg of the waterway as well.[34] In 1930, projects connected with this part of the waterway were authorized in the River and Harbor Act,[35] and construction was under way the next year.[36] The way was now open, and the national need to provide work for the victims of the Depression brought new support for this project as for many others. Ultimately the



Traffic on the Intracoastal Waterway. A football game could be played on some of the immense tows that pass through the waterway.

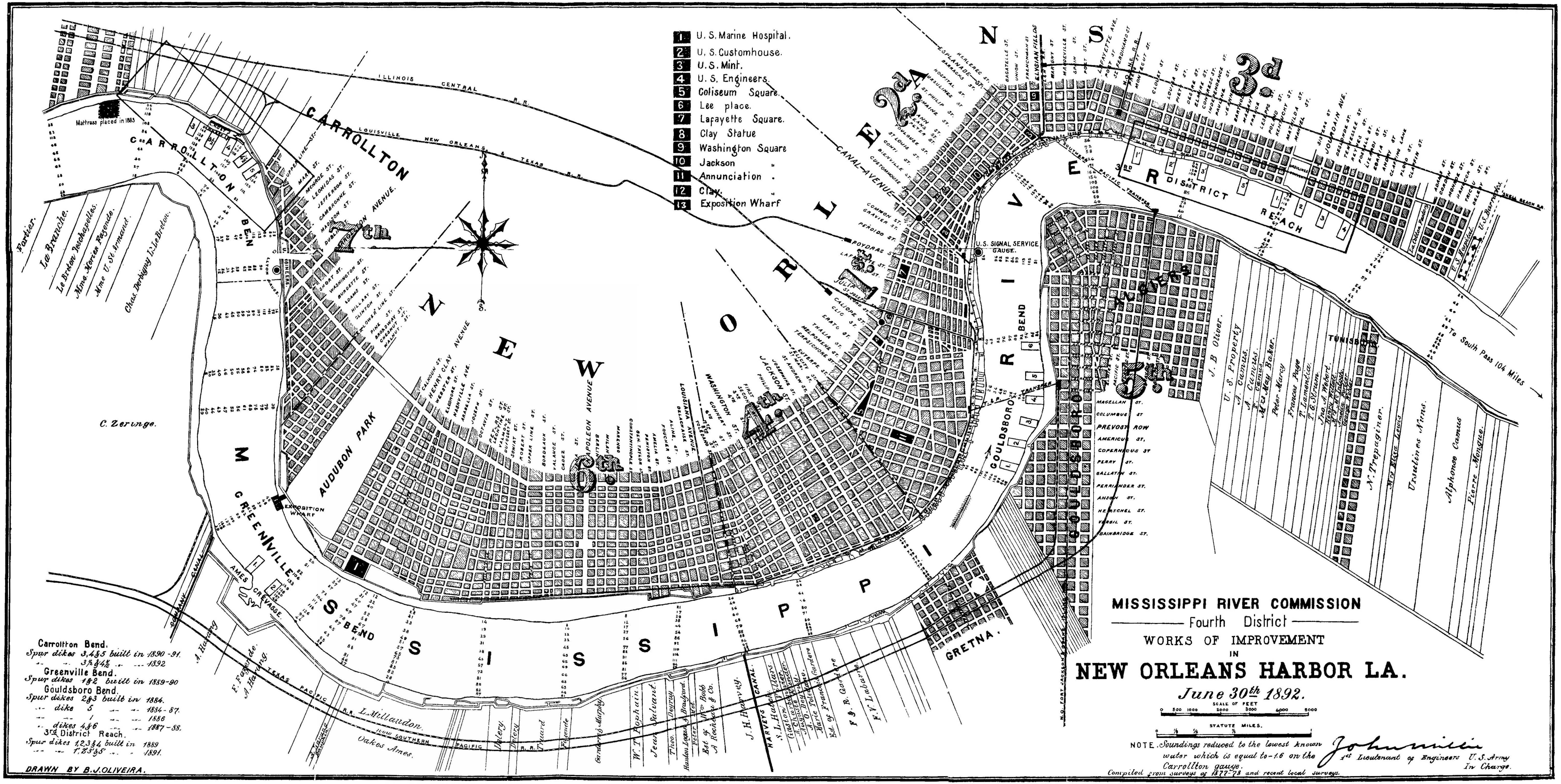
(Photo by C. Fortier)

waterway grew to provide at least 12-foot depths from Brownsville, Texas, to Apalachee Bay, Florida.

This was, however, by no means the end of the story. Engineers expected the segment within the New Orleans District to be ultimately 384.1 miles long, 16 feet deep, and 150 to 200 feet wide.[37] The 1970's brought a new outlet for the waterway, dimensioned to the needs of the offshore drilling platforms, in the 84- by 600-foot lock and channel through Freshwater Bayou to the Gulf of Mexico. For a water highway which, in 1968, carried 42 percent as much cargo as the whole Mississippi River,[38] continued growth seemed assured. Long prepared and slowly put together, the canal that crossed the T of trade in the Mississippi Valley was one of the most protracted, arduous, and successful regional achievements of the Corps of Engineers.

Post-Civil War efforts by the Federal Government to help the Port of New Orleans aimed entirely at improving the Mississippi.[39] The central figure in early harbor work was Captain Charles W. Howell. Born in Indiana and possessing an excellent record with the Army of the Potomac during the Civil War, Howell came to identify himself to a surprising degree with the interests of New Orleans. Enjoying strong local support for his planned St. Philip Canal, he was joined by local businessmen in his opposition to Eads' jetties. Though his life was short and his projects largely unsuccessful, he was a key figure in contemporary efforts to improve the network of trade at New Orleans and throughout Louisiana.[40] He hoped to secure riverbanks at New Orleans with mattress revetment, to prevent wharves from being undermined by the current. In 1878 at the request of the New Orleans City Council, a board of engineers convened "to examine and report upon the means necessary to protect the wharves and harbors from the incursions of the river."[41] This board recommended "brush matting" made in immense continuous carpets 200 feet wide and from 2,000 to 9,200 feet long. An act of 18 June 1878 appropriated $50,000 to commence the work.[42] In his report of 30 September 1879, Howell described his experiments with mattresses of "fishpole" cane, which he attached to pilings and sank with a ballast of "wornout boiler-tubes filled with sand."[43] He admitted that he was "not prepared to venture an opinion as to the permanence of the work," and, in fact, the cane mattresses proved too frail for the swift current complicated by the traffic of a busy port. Like other experiments tried by Howell, this one was given up within a few years, and the reorganization of 1882 saw the Port of New Orleans, along with Vicksburg and Natchez, turned over to the Fourth District of the Mississippi River Commission.[44]

Taking over the work, the Commission decided to maintain navigation and revet banks, but declined to aid in maintaining levees at New Orleans. Construction and maintenance ought to remain a local responsibility, reasoned the Commission, since valuable city property provided the Orleans Levee Board something rare in the experience of levee districts—an adequate tax base.[45] Instead, the Commission concentrated its efforts on protecting the concave bends of the river, where erosion was the worst. New Orleans had more than its share of these bends: it was not called the Crescent City for nothing. The current struck the east bank of the Carrollton Bend above the city, and crossed to the west bank of the Greenville Bend opposite Audubon Park where the Ames crevasse occurred in 1891. The west bank of the Gouldsboro Bend at Gretna was the next spot of attack, and then the current recrossed to strike the east bank again along "downtown" New Orleans at a spot called the Third District Reach. Between Gretna on the west bank and the Third District Reach across the river, the Algiers Point jutted out, an area of heavy



MISSISSIPPI RIVER COMMISSION
Fourth District
WORKS OF IMPROVEMENT IN
NEW ORLEANS HARBOR LA.
June 30th 1892.
SCALE OF FEET
STATUTE MILES.
NOTE. Soundings reduced to the lowest known water which is equal to -1.6 on the Carrollton gauge.
Compiled from surveys of 1877-78 and recent local surveys.
1st Lieutenant of Engineers U.S. Army In Charge.
DRAWN BY B.J.OLIVEIRA.
1 U.S. Marine Hospital.
2 U.S. Customhouse.
3 U.S. Mint.
4 U.S. Engineers.
5 Coliseum Square.
6 Lee place.
7 Lafayette Square.
8 Clay Statue
9 Washington Square
10 Jackson
11 Annunciation
12 Clay.
13 Exposition Wharf
Carrollton Bend.
Spur dikes 3,4 & 5 built in 1890-91.
3½ & 4½ 1892
Greenville Bend.
Spur dikes 1 & 2 built in 1889-90
Gouldsboro Bend.
Spur dikes 2 & 3 built in 1884.
dike 5 1884-87.
1 1886
dikes 4 & 6 1887-88.
3rd District Reach.
Spur dikes 1,2,3 & 4 built in 1889
1,2,3 & 5 1891.
NEW ORLEANS
MISSISSIPPI RIVER
CARROLLTON
CARROLLTON BEND
GREENVILLE
GREENVILLE BEND
GOULDSBORO BEND
3RD DISTRICT REACH
GRETNA.
AMES CREVASSE.
AUDUBON PARK
EXPOSITION WHARF
Mattress placed in 1883
U.S. SIGNAL SERVICE GAUGE.
ILLINOIS CENTRAL R.R.
LOUISVILLE NEW ORLEANS & TEXAS R.R.
TEXAS PACIFIC R.R.
SOUTHERN PACIFIC R.R.
CANAL AVENUE
ESPLANADE ST.
NAPOLEON AVENUE
LOUISIANA AVENUE
WASHINGTON
JACKSON
CARROLLTON AVENUE
To South Pass 104 Miles
TUNISBURG
ALGIERS
7th
6th
4th
1st
2d
3d
5th
C. Zeringue.
L. Millaudon.
Oakes Ames.
J.B. Oliver.
U.S. Property
N. Trepaginer.
Ursulines Nuns.
Alphonse Camus
Pierre Mongue.
J.H. Harvey.
HARVEY'S CANAL
Gardere & Murphy
F.Y. Labarre
MAGELLAN ST.
COLUMBUS ST.
PREVOST ROW
AMERICUS ST.
COPERNICUS ST.
PERRY ST.
GALLATIN ST.
PERRIANDER ST.
ANSON ST.
HERSCHEL ST.
VERGIL ST.
BAINBRIDGE ST.
Parker
La Branche.
Le Breton Deschapelles.
Mme Marie Pajeende.
Mme U. St. Armand.
Chas. Derbigny L. LeBreton.

erosion where the land, reported an office, "does not wear away little by little, but at intervals of years caves away in large masses, destroying an acre or two.... at a time."[46] To end this destruction, in 1884 the Fourth District began to build spur dikes protected by willow-mattresses. During the low-water season of 1896-1897 District Engineer Captain George McC. Derby began making mats at the sites where willows were obtained, and then towing them into place. This became standard practice, since the size of the river made towing easy at low water, when the current was not too swift.[47] Protection for the Port of New Orleans improved with the evolving technology of bank revetment,[48] as the 20th century saw the articulated concrete mat gradually replace the willow mattress.[49]

Major new Federal initiatives in developing New Orleans' harbor came in the mid-20th century, focussing on development of an artificial slack-water port for the city. Local interests had long viewed as a mixed blessing New Orleans' dependence on the Mississippi. Wharf facilities rested on the bank of an alluvial river, and the traffic of the port made the job of stabilizing those banks exceptionally difficult. An elaborate system of pilotage was required to bring ocean vessels safely up the winding channel against a strong current. The

Bank protection—new style. Riprap (broken stone) is laid to overlap the articulated concrete mats.
(Photo by S. R. Sutton)

river's course was unstable and constantly shifting near its mouths, and provided a route to the city that was long, slow, and indirect. When air warmed by contact with the Gulf touched the cold river water, dense low-lying fogs developed. Especially during spring and fall the levees defined a river of mist, even on days and nights which were otherwise clear. New Orleans businessmen wished to be free from complete dependence on a powerful and whimsical river, and vowed to create a slack-water port with straightline access to the Gulf.

But the city's efforts to persuade the Federal Government to undertake construction of an artificial port ran into difficulties at Washington. New Orleans' development might bring advantages to the nation, as local interests claimed. Other parts of the country took a less favorable view of the project. In the end, some imaginative work at the local level, the economic development of the Gulf region, and the increasing power of the Louisiana congressional delegation were required to bring the Engineers into the work. The 20th century riverport developed meantime under the Board of Commissioners for the Port of New Orleans, an agency of the state of Louisiana generally called the "Dock Board." Ownership and operation of most of the port's terminal facilities were brought under this public body, while the Public Belt Railroad was created by the city to connect the wharf facilities with New Orleans' twelve railroad trunk lines. The Dock Board built an Inner Harbor Navigation Canal (the "Industrial Canal")[50] at a cost of $18 million, fulfilling schemes as old as the city by providing a 5.5-mile waterway connection between the river and Lake Pontchartrain. In these developments the Federal Government had no part, though the First World War brought a $15 million Army Supply Base to the inner harbor. The work of the Mississippi River Commission was essential to the old riverside port, as New Orleans' Mayor Martin Behrman acknowledged. But the inner port was the work of local enterprise.[51]

A new departure began with an attempt by local interests to recover the money they had invested in the Industrial Canal by having the Federal Government take it over as part of the inland waterway system. The Corps of Engineers was cool to the idea. Though the River and Harbor Act of 1920 required a survey to be made of "Mississippi River, Louisiana, with a view to securing an outlet to deep water in the Gulf of Mexico by the most practicable route for a permanent channel of a depth not exceeding thirty-five feet,"[52] the Corps declined to recommend such a channel, since the river already provided adequate facilities for deep-draft vessels.[53] In 1929 a House committee asked the Board of Engineers for Rivers and Harbors to investigate the possibility of the government taking over the Industrial Canal. The New Orleans District Engineer found "no necessity for an auxiliary route between the Mississippi River at New Orleans and the Gulf," though he did find some merit in the idea of including the Industrial Canal in the inland waterway system. He believed instead that dependable channels could be maintained indefinitely through the mouths of the Mississippi.[54] In effect the Corps of Engineers had come around to Eads' position, while, as in Howell's time, businessmen still pressed, apparently with little hope, for an artificial means of circumventing as much of the river route as possible. In 1930, Major General Lytle Brown, Chief of Engineers, concluded that no action should be taken on the various proposals that New Orleans interests had pressed through the House Committee on Rivers and Harbors.[55]

In all these attempts, three separate proposals were involved: first, that the Federal Government should recompense the builders of the Industrial Canal; second, that the canal should be made part of the inland waterways system; third, that some sort of artificial

channel should be built to give New Orleans a more dependable and shorter route to the sea. The first of these was a forlorn hope. The last two, however, were essential elements in the creation of an inner port.

First success was scored in 1942, as Congress routed the eastern leg of the Intracoastal Waterway through the Industrial Canal—the state maintaining ownership—and via Lake Pontchartrain to the Mississippi Sound. Anxious over the submarine menace, the lawmakers provided for a land cut through the marsh from the Rigolets to a point on the canal about 2.25 miles from the Mississippi River. The passage through the lake, five drawbridges, and about 31 miles were eliminated from the Intracoastal Waterway by this route.[56] Wartime exigencies also caused the House Commerce Committee on 5 May 1943 to request a new report on a Mississippi-Gulf Outlet; the Senate committee had already made a similar request a few weeks earlier. The investigation was authorized by the River and Harbor Act of 1945, and was undertaken at a leisurely pace; completed 3 years later, the report was not transmitted to Congress until 25 September 1951.[57] However, the District's plan now showed the river-Gulf outlet in the form it would ultimately assume—jutting out of the eastern Intracoastal Waterway and running southeast into the Gulf of Mexico across the intervening marshlands. (An alternative route from the west bank direct to the Gulf was rejected when the Dock Board proposed to invest $30 million to develop port facilities along the east bank route.) The linkage of the river, the Industrial Canal, the Intracoastal Waterway, and the Mississippi-Gulf outlet emerged as a mature concept, which, if fully implemented, would make New Orleans quite a different kind of port from the one it had been throughout its history. And quite a different kind of city, too, since trade, industry, and settlement might ultimately move toward wastelands east of the city to cluster around the new connections to the sea.

Nevertheless the costs were shown to be high and the benefits of the outlet were speculative. At 1948 prices an initial investment of $67 million would be required, with annual maintenance estimated at $4 million. Practically the whole direct cost would be borne by the Federal Government, though very broad commitments would be required from local interests toward the indirect costs associated with the outlet.[58] In its review, the Bureau of the Budget found that the channel could not be justified, considered by itself. The benefits to be derived from the expansion of port facilities around the turning basin included as part of the project represented the only substantial savings to commerce. In other words, the ship channel could be justified only in terms of what would later be called the "centroport" feature. Taken together, the channel and turning basin constituted "valuable long-range improvements... to be undertaken as conditions permit." However, no appropriation was to be sought "until such time as the budgetary situation makes possible the initiation of such improvements."[59]

In plain fact, this qualified endorsement meant that not enough political steam had gathered behind the Gulf outlet. Costs were high, and whatever the country might gain indirectly by building New Orleans a slackwater outlet to the sea, the immediate and tangible benefits would accrue to local interests alone. The Louisiana Congressional delegation argued that the expansion of water commerce using New Orleans was steady and was likely to continue; that New Orleans, alone of American ports, served a hinterland of indefinite extent; and that the systematic development of the Mississippi and its tributaries logically demanded an equal development for the entrepot of the whole valley. These arguments gained strength during the early years of the Eisenhower administration. The end of the Korean War,

The Mississippi River-Gulf Outlet east of New Orleans. At lower left is the Intracoastal Waterway; top, the Gulf of Mexico.
(Photo by S. R. Sutton)

the growing strength of the Louisiana delegation, and the precedent established by the heavy Federal investments in other transport projects all contributed, directly or indirectly, to the eventual success of the proposal.

The decade of the 1950's saw heavy investments in the national transportation system. Congress approved such major schemes as the Interstate Highway System and the St. Lawrence Seaway. The Mississippi-Gulf outlet, so significant locally, was a small part of the far-reaching developments in road, water, and air transport that characterized the time. Backing for the project became increasingly well organized and powerful. The New Orleans Public Service, the Dock Board, and private transportation interests developed an effective spokesman in the Tidewater Development Association. Endorsement of the outlet was secured from eleven governors in the primary trade area of the Mississippi Valley. In 1956 strong backing and a favorable atmosphere resulted at last in the authorization of the Mississippi-Gulf Outlet.[61] In terms of the overall trade pattern of the Mississippi Valley and the Intracoastal Waterway, the development of new facilities geared to the waterway at New Orleans—the point of intersection of the T—was likely ultimately to be justified by the overall growth of the region which it served. But heavy local investment all along the artificial waterways of the inner harbor would be necessary to fulfill

the outlet's promise for the future.

Up to 1912, the Annual Reports of the Chief of Engineers listed some 860-odd rivers, bayous, lakes, and passes which the District had surveyed or improved since the end of the Civil War.[62] Once the basic pattern of the T emerged, these minor streams acquired new importance. Still necessary for local trade, they became part of a broad pattern of regional and national commerce as well. Some were incorporated into the inland waterway, supplying it exits to the Gulf, opening water access to the hinterland, or providing alternate routes to major production centers like Baton Rouge. The District built outlets from the Intracoastal Waterway to the Gulf utilizing the Mermentau River, the Calcasieu, Freshwater Bayou, Wax Lake, Bayou Lafourche, and the Lower Atchafalaya. These outlets were of great significance to the offshore oil industry, as well as to the shrimp and fishing fleets and general trade. An important development was the extension of the Intracoastal Waterway up the valley of the Atchafalaya by way of Grand River and land cuts to Port Allen, opposite Baton Rouge.[63] By 1970, new projects involved flood protection for the Mermentau north of the waterway, while channel improvements were planned for Bayous Teche and Lafourche. But the most extensive and complex work on the smaller streams was that undertaken on the Calcasieu River, of which the rapidly expanding city of Lake Charles became the principal beneficiary.

A small river running roughly parallel to the Mississippi in southwestern Louisiana, the Calcasieu's 3,500-square-mile basin was a mixture of low hills, prairie, and marsh. Rich oil and gas fields lay within the 100-mile curve of the upper river. Ricelands surrounded the city of Lake Charles, which lay 34 miles from the Gulf and just south of the point where the West Fork entered the mainstream of the Calcasieu.[64] Here the key to regional growth was the opening of a complex of water links to the ocean, the Gulf coast, and the Mississippi, in which local interests and the Engineers both took a hand. From 1872 on, the New Orleans District maintained a program of snagging and dredging on the Calcasieu.[65] However, the river even when cleared of obstructions was not an efficient route to the Gulf, for it flowed, south of Lake Charles, into Calcasieu Lake, which was only 5 to 6 feet deep, and thence by a pass into the Gulf. The parish undertook to build a deepwater canal to the more navigable Sabine River, which ran parallel to the Calcasieu on the western border of Louisiana. By 1926 this canal was functioning, making Lake Charles a deepwater port. Later the canal was absorbed into the western Intracoastal Waterway, gradually turning Lake Charles into the regional market for a broad arc of rich Gulf lands. In 1937 a program of improvement was proposed by the Engineers to make the Calcasieu useful for commerce.[66] Approved by Congress, the work was begun by the New Orleans District in 1941.[67] Engineers dredged a 40- by 400-foot channel from old Highway 90 at Lake Charles to the Gulf, where existing jetties were enlarged and straightened to enable the channel to maintain itself. An approach channel from the Gulf of Mexico was also opened, to provide ready access to deep water. Further provisions were made for a mooring and turning basin, a ship channel to Cameron, and a salt water guard lock at the intersection of the river and the Intracoastal Waterway.[68] These water links were one key to the phenomenonal growth of Lake Charles from drowsy town to bustling regional port city.

By constructing the Intracoastal Waterway and by aiding the expansion of the Port of New Orleans, the New Orleans District materially assisted regional economic development. In turn, the growth of trade along waterway and river, with its hub at New Orleans, encouraged

Calcasieu River and Pass.

Traffic jam in New Orleans Harbor.

the development of many smaller waterways throughout the Gulf region. In Louisiana this development of the smaller streams was especially noteworthy. No other state had so many miles of waterways. Undeveloped, they were mere obstructions to road and rail; cleared, dredged, and connected with markets, they became highways instead of barriers for economic growth and social development. The overall benefits of this growth would be disputed by few. Everywhere along the T of trade, isolated communities scarred by poverty and ignorance were brought—literally—into the mainstream of American life.

But the success brought its own problems. In their undeveloped state, the bayous of Louisiana preserved a rich regional culture as well as regions of rural poverty and ignorance. As a result of development, game preserves and areas of unique and exotic natural beauty were no longer protected by their remoteness. "Crossing the T" helped to bring the New Orleans District face to face with the most difficult problem of all—to integrate future patterns of economic development with the preservation of human and natural resources.

CHAPTER SIX

NEW DIRECTIONS

The reorganization of 1928 brought no more than a change of names to the Engineers at New Orleans. The old Engineer District became the First New Orleans District, while the Fourth District of the Mississippi River Commission, after a brief rechristening as the New Orleans River District, became the Second.[1] In 1940, however, a decisive administrative change occurred when the Gulf Division was abolished and the First and Second New Orleans Districts were united.[2] The new organization, occupying the Second District complex at Prytania Street and the river, was placed under the Lower Mississippi Valley Division Engineer at Vicksburg. The only trace of the old division of duties survived in the "two hats" worn by the Division Engineer. Henceforth projects dealing with the river were submitted to him for review as President of the Mississippi River Commission, while projects not connected with the river were submitted to the same officer in his capacity as Division Engineer.

The unified command was tested almost at once in military construction work during the Second World War. The period was a difficult one for the newly unified District. Many of its key personnel were called to military service; many were reserve officers of the 337th Engineer Battalion. The District was left to carry on its usual heavy responsibilities, including major flood fights in 1944 and 1945, the second of which required the opening of the Bonnet Carré Spillway.[3] For nearly two years (January 1941 to December 1942) the District carried out an extensive military program as well.[4] Construction of airbases, camps, an ordnance backup depot, seacoast fortifications, a wharf and Engineer depot, and oil and cargo barges to speed the delivery of war materiel to the eastern seaboard—all added to its work. Much credit for bringing the District successfully through the period belonged to George H. Hudson, a civilian employee and an officer of the Army Reserve, who became District Engineer during the war, and to older civilian employees who were not affected by the draft.[5]

As wartime troubles faded, the organization built up its depleted ranks. Many of its former employees returned from active service, and the customary civil works program was resumed. In addition, the years that followed the war saw new duties begin to take form: in hurricane control and disaster relief; in river basin planning; and ultimately, in gearing up old enforcement procedures to carry out a new national policy for improving the environment.

First came the new responsibilities in disaster control.[6] Though hurricanes came late to the District's agenda, the great equinoctial storms had for centuries been one of the insolvable problems of the Gulf Coast. From the tempest of 19 September 1559—the first

Hurricane Betsy—damage before the cleanup began.

tropical storm of record in the Gulf—to Hurricane "Camille" in August 1969, Louisiana was struck by about 160 hurricanes in 410 years. The storms seriously retarded the development of the coast, killing people and animals, destroying homes and businesses, ruining crops, and changing the ecology and even the topography of the land. As cities grew, they proved to be especially vulnerable. Protective levees were damaged, communications destroyed, dense populations endangered by wind and water, and, in the aftermath of great storms, intolerable burdens placed on every form of community service.[7]

Pending development of an effective means for aborting hurricanes (perhaps by "seeding" them at an early stage of growth), more traditional remedies had to be applied to the troubles brought by the big ill winds. The basic resource lay in the people of the region, where long experience and tradition of mutual assistance, served by an increasingly effective warning service, made survival and rapid recovery possible even after the worst storms. Systematic Federal assistance for those caught in hurricane disasters began in the 1950's.[8] As part of a comprehensive scheme of help coordinated by the Office of Emergency Planning, the local districts of the Corps were assigned work appropriate to their special skills. They were to guard the defensive works—mainly locks and levees—to protect the land, and, once a storm had passed, to carry out the immense cleanup job that followed.

After the storms of 1954 severely damaged the Atlantic Coast, Congress instructed the

Hurricane damage cleanup.

Chief of Engineers to begin surveys for protective works in areas endangered by hurricanes.[9] The New Orleans District undertook planning for the Lake Pontchartrain and Vicinity Protection Project, beginning with a scientific study of the region and an outline of the works that would be necessary to protect it. Turning to new account the skills they had learned in dealing with floods, the Engineers charged with the project established two hurricanes to serve as standards—in effect, to play the role that the Project Flood played in the Jadwin Plan. The first of these projected storms (the Standard Project Hurricane) was, in terms of intensity and path, the most severe storm likely to occur in the region; the second (the Probable Maximum Hurricane) was the worst storm assumed to be possible in the region. Lacking any means of protection against the winds (only comprehensive reform of local building codes could be of much value here) the District concentrated on guarding against the hurricane surge or "storm tide" from the Gulf of Mexico. Since most loss of life resulted from these surges, to which the flat coastline offered no obstacle, the District was aiming at a critical point in the work of storm control.

As determined by the Engineers, the Standard Project Hurricane critical to New Orleans would approach from the south, move inland west of the Mississippi's mouth, and curve eastward over Lake Borgne. With a central pressure of 27.6 inches of mercury and a maximum wind velocity of 100 miles per hour at a radius of 30 miles, this hurricane

would inundate about 700,000 acres with depths up to 16 feet. Though about 240,000 acres were marshland east of the city, the District's plan warned that the 460,000 acres remaining included "a major part of metropolitan New Orleans."[10] This grave warning was borne out when, on 9 September 1965, Hurricane "Betsy" struck New Orleans. With higher winds than the Standard Project Hurricane, but describing a path that lacked the ominous eastward curve over Lake Borgne, the storm inundated 531,000 acres in the four-parish New Orleans metropolitan area. Seventy-nine deaths and a half-billion dollars in property damage wrote a grim endorsement to the hurricane protection plan. Above all, the need had been demonstrated for protection against the storm tide, the principal instrument of death wielded by "Betsy."

Congress enacted the District's plan as part of the Flood Control Act of October 1965.[11] Scheduled for completion in 1991, the projected works would eventually provide the city and lakeside parishes with the same protection against storm surges that it already had against floods from the Mississippi. A new levee would protect the south shore of Lake Pontchartrain from Bonnet Carré Spillway to South Point. Steel and concrete floodwalls along the Industrial Canal, levees along the north side of the Intracoastal Waterway, and a connecting link roughly parallel to Highway 11 would protect the developing area called New Orleans East. Storm tides would be checked from entering the lake by a lock and control structure at the Rigolets, and a flood control structure at Chef Menteur. Another structure at Seabrook on the lakefront would

Hurricane surge—its meaning in human terms. The waters of Hurricane "Betsy," 1965.
(Photo by J. V. Crampes)

not only help to check hurricane surge, but would protect the valuable Pontchartrain fishing grounds from changes in the salinity gradient caused by saltwater intrusion. South of the Intracoastal Waterway and west of the Gulf Outlet another ring of levees and floodwalls would inclose the heavily settled suburbs of St. Bernard Parish and the lower Ninth Ward of New Orleans where the storm tide of 1965 did its worst work of destruction. Finally, a floodwall west of the Industrial Canal would prevent any possible danger to the central city. By 1975 floodwalls and levees along the Industrial Canal, the Gulf outlet, and in Chalmette were well advanced, and floodgates at Bayous Dupre and Bienvenue were completed.

The city of New Orleans, however, was not the only area for the Corps to protect. South Louisiana had many rich and vulnerable regions, and the aim of the hurricane protection plan was to safeguard as many of them as possible. Settled areas near Franklin and Morgan City, and in the vicinity of Golden Meadow, needed additional protection. The lower coast of the Mississippi River below New Orleans would be protected under the New Orleans to Venice Hurricane Project. This region was second only to New Orleans in the damages which it had received from hurricanes. Here losses from Hurricane "Betsy" reached $50 million, and those from "Camille" in 1969, $100 million. Not only were important industries growing in the region, but the service industries for offshore oil development would shortly represent an investment in excess of $1 billion. Rich, vulnerable, and often attacked by hurricanes, the protection of this region was one of the most pressing duties of the New Orleans District.[12]

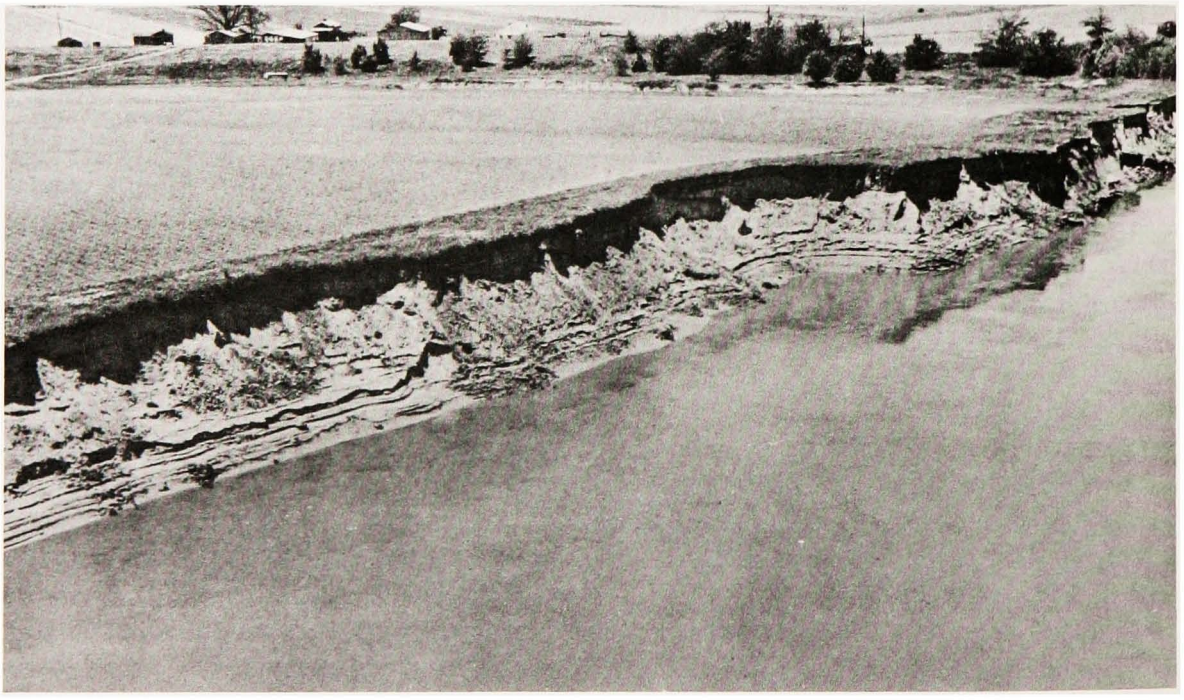
Aside from structural works, the District also took part in saving life and property during storms, and cleaning up the wreckage afterward. These jobs developed as a result of certain laws[13] and regulations of the Corps of Engineers[14] adopted between 1955 and 1970. Priorities established by these laws required local Division and District Engineers to give first attention to the Corp's own flood control works and other facilities; next, to furnish technical assistance to local authorities in protecting Federal works which they maintain; finally, to give direct aid to rescue and supply operations when the local powers had committed their resources, or were unable to cope with the flood or coastal storm situations.[15] Division Engineers were authorized to call upon other elements of the armed forces for emergency support.[16] Liaison was to be maintained with the Office of Civil Defense and the Office of Emergency Planning, the Red Cross, and local interests. After the emergency passed, the Corps—in the event that the President proclaimed a major disaster—might be authorized by the Office of Emergency Planning to survey damage, perform emergency channel clearance and shore protection, clear wreckage and debris, and repair or replace public facilities on an emergency basis.[17] In practice, however, the books were shelved in actual emergencies and a rapid and informal allocation of men and machines was made wherever the need was greatest. For example, while the official schedule was followed during Hurricane "Betsy," government property was so rapidly secured that Corps personnel and boats were the first to enter the flooded areas near the Industrial Canal and begin rescue operations there.[18]

Cleaning up the wreckage after the storm was the last part of the Corps program. Breakdowns in transport and communication needed quick attention. Restoring freedom of movement and an orderly appearance to a stricken city was essential, both to make police protection effective and to restore citizen morale. In this work—especially after "Betsy" and "Camille"—the District contributed equipment and skilled personnel to the

massive cooperative effort in which official agencies and citizen volunteers alike take part. Special problems requiring a high degree of specialized skill and large, sophisticated equipment—clearing roads blocked by boats and houses, or refloating massive barges carried inland by the hurricane surge—particularly required the professionalism of the Corps. In the still unsolved problem of the hurricanes, the New Orleans District became a critical element in disaster control before, during, and after the passage of a storm.[19]

Though important, the hurricane protection program was, in one sense, traditional in nature: it was essentially flood fight against saltwater instead of fresh. It was in the field of river development—in the ancient, basic problems of dealing with alluvial streams—that the boldest new programs of the District began to appear. In comprehensive basin development, the New Orleans District took the most complex forms of Engineer planning activity and applied them to the troubled Red River Valley.[20]

A major tributary of the Mississippi some 1,200 miles in length, the Red River had had a complex history since the Civil War. The part of the river within Louisiana was assigned to the New Orleans Engineer Office under Major Charles W. Howell, transferred to the Memphis Office when Major W. H. H. Benyaurd was in charge, later to Vicksburg, and finally back to New Orleans. For all who struggled with it, the Red was a baffling problem—the more so because its valley promised rich returns in human use and enjoyment if the stream could be controlled. Basic difficulties, however, lay in the river's erratic flow and the sandy soil of its flood plain. Typically, the valley experienced heavy spring rains, with light precipitation for the rest of the



The Red River problem. Erosion, destruction of farmland, the shoaling of the channel that will follow—these are the effects of the undisciplined Red.

(Photo by S. R. Sutton)

year. (This pattern was particularly noticeable toward the western end of the valley.) Floodwater was followed by low water, the highest flow generally coming at the time of year when it was least useful in moving agricultural products to market. Erosion was another curse. Spring floods undermined the banks and saturated the soil. When the river fell, the weakened banks collapsed into the channel. Erosion encouraged shoaling. By mid-summer, the river, so lately a torrent, became so shallow that small boats could scarcely maneuver in some reaches; the caving of forested banks added yearly another mass of dying snags to the stream, which the next high water carried down—if uncleared, to form a raft.

At its greatest extent in 1828 the Great Raft of the Red was 92 miles in length, extending from Loggy Bayou, 65 miles below the present site of Shreveport, to Hurricane Bluffs, 27 miles above.[21] Explosives and steam engines had to be used to open a way through this tough, resilient, matted obstacle that grew with the timber brought down by every high water. As superintendent of improvements on the western rivers, Henry Shreve broke through the lower sections of the raft and established Shreve's Landing (later Shreveport) in 1835.[22] However, the raft periodically re-formed, and between 1828 and 1841 the United States spent over $425,000 for its removal. The decline in Federally financed internal improvements interrupted the work, and appropriations failed between 1841 and 1852. During the brief revival of civil works activities in that year, another $100,000 was appropriated, and the way to Shreveport was reopened. The supply of funds then failed once more, in typical antebellum fashion, and Civil War and Reconstruction had to pass before work could be resumed. New appropriations were made in 1872, but when Federal work resumed, the years of neglect and war had left their mark.

> ...the river above Shreveport, La., was closed by a raft 32 miles long, and growing constantly. Below Shreveport the enlargement of an outlet through Tones Bayou was depleting the main channel and threatening its closure to navigation. At Alexandria, La., the falls were impassable at low stages. Navigation was difficult and dangerous at all places and at all times. The channel shifted frequently, and at flood the river overflowed the entire raft region. The banks were heavily timbered and each flood caused them to cave or slide.[23]

In the face of so many difficulties, the Engineers at first set about securing an effective channel for navigation. The whole economy of the region beyond Shreveport had been transformed by the raft, sometimes in surprising ways. Though the effect on the normal traffic of the river was adverse, the blockage of water had raised water levels in the bayous leading into the Red from eastern Texas. A brisk local trade had sprung up along these bayous, and the cotton of Texas found a way to market at New Orleans by devious streams that paralleled the Red. Ironically, clearing the main river caused the head of water in these streams to fall, cutting off the trade. Hence, the Engineer in charge of the work recommended "Fabian tactics" in clearing the river and reported the destruction of at least one dam by "a body of masked men."[24]

Despite everything, small but regular appropriations enabled a gradual improvement to take place. The raft was broken in 1873 and the major outlets gradually closed off. Scour increased, the channel deepened, and the perils of navigation, which had claimed nearly 200 steamboats up to 1887, steadily lessened.[25] To prevent new snags from getting into the channel, banks were cleared and the worst shoals were dredged. Efforts were begun to stop bank erosion by wing dams and revetment.[26] A period of optimism over the

river's future followed. In 1909, the Vicksburg Engineer Office reported that at high water the river was navigable as far as Denison, Texas—800 miles above the Atchafalaya junction. Between 1890 and 1909 considerable traffic moved on the Red, mostly agricultural and timber products with estimated values ranging from $1.5 to $9 million a year. The Red has not moved equivalent cargo values since that time.

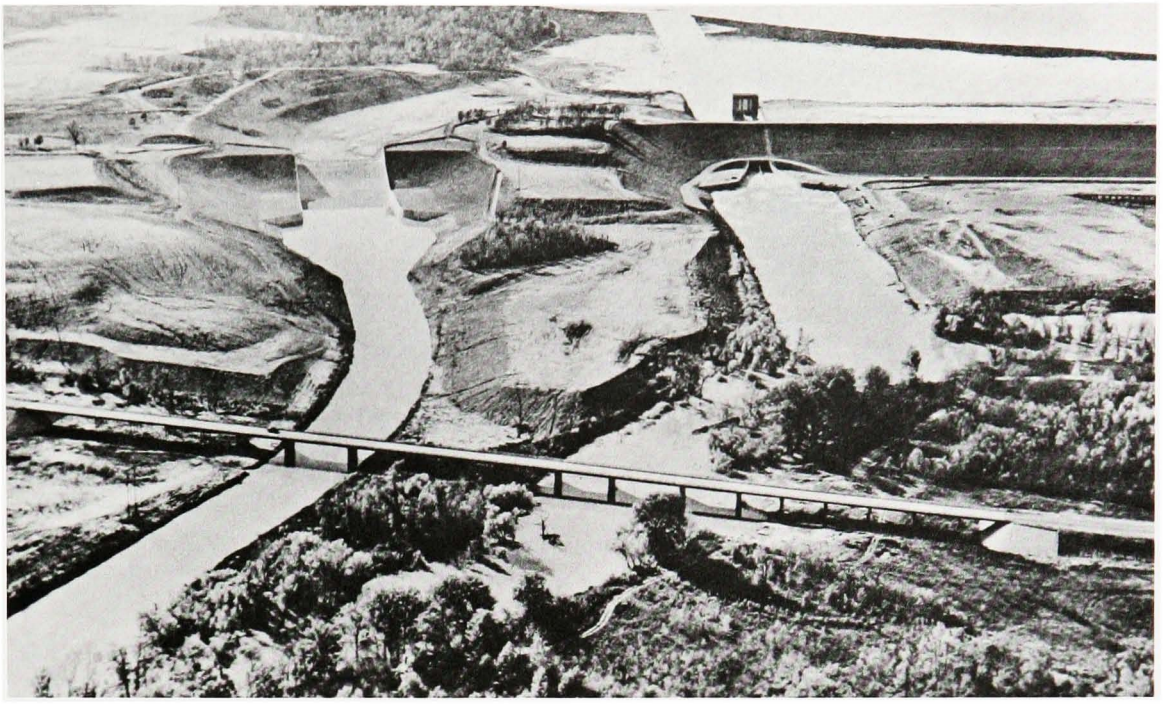
The trouble was that commerce on the Red had never been more than a *tour de force.* Commerce moved on the Red in spite of the river. The limited improvements which were possible under the small appropriations then available—and under narrow conceptions then current of what constituted "improvement"—were just not enough to cure the basic difficulties intrinsic in the nature of the river and of its valley. Railroads were successful in taking over the commerce of the region, and, in contrast to the Mississippi, commerce lost to the Red was lost for good. In 1908 Engineers noted a decline in the value of waterborne cargo,[27] and from that time on river trade fell precipitously until revived by the First World War.[28] Still, average commerce during the war years was only about half that of 1890-1908.[29] If river commerce was to revive permanently—and the land along the banks produced the sort of bulk products which were best adapted for water transport—a whole new approach to the problem must be made.

This need was underlined by the lagging social and economic development of the valley. Before the Civil War, the basin of the Red was sparsely inhabited, with not one town of 5,000 inhabitants. Development after the war was mainly directed to opening land for cotton production, which, by the twentieth century, had begun to produce destructive side effects in soil depletion and erosion. Then discovery of oil began to push the region toward a more diversified economy, and by the mid-20th century, manufacturing, trade, and services employed more workers than agriculture. Yet the valley remained essentially underdeveloped. In 1960 the average per capita income of its people was 40 percent below the national average. A 1968 report by the Red River Basin Coordinating Committee concluded that "the basin lacks the diversity and industrial base required to insure reasonable progress in closing the economic gap."[30]

Modern efforts by the Federal Government to assist development of the Red were varied and complex. In 1936 Congress authorized construction of 297,000-acre-foot Bayou Bodcau reservoir 35 miles northeast of Shreveport and smaller Wallace Lake southeast of the city. Spurred by Senator John Overton, the Flood Control Act of 1946 authorized a project to make the river navigable and authorized 2.65-million-acre-foot Texarkana Reservoir and 842,000-acre-foot Ferrels Bridge Reservoir now called Lake O' the Pines near Jefferson, Texas. These artificial lakes contributed to flood control and municipal and industrial water supply as well as making available major recreational resources to the growing "ArkLaTex" area.

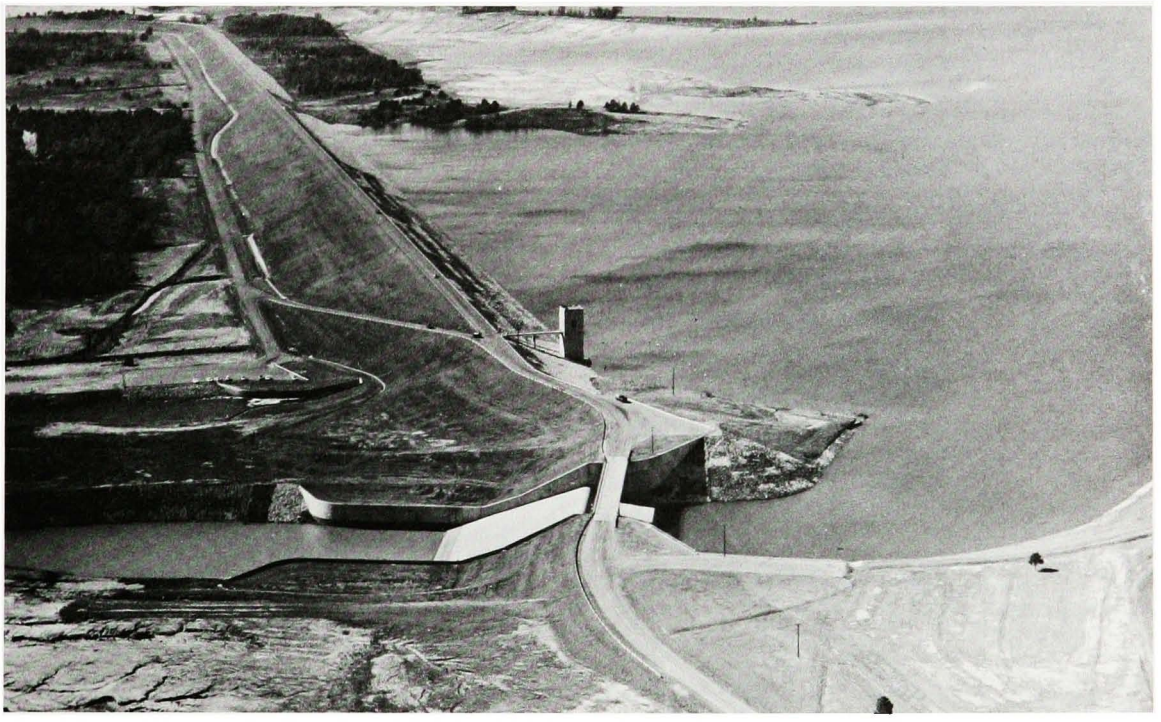
Full plans for basin development followed. Originally devised during the Progressive Era, the concept of developing a whole river valley in integrated fashion for flood control, navigation, power production, and conservation of resources proved after 1925 to be a practical method for improving the nation's rivers. In the Flood Control Act of 1950, Congress applied the idea to the Arkansas-White-Red River systems, requiring a general survey

> ...with a view to developing comprehensive, integrated plans of improvement for navigation, flood control, domestic and municipal water supplies, reclamation and irrigation, development and utilization of hydroelectric power, conservation of soil, forest, and wildlife resources



Lake Texarkana under construction, 1954. This vast artificial lake now provides not only flood control for the Red River Valley but recreation for 2.5 million visitors a year.

(Photo by S. R. Sutton)



Ferrells Bridge and Lake O' the Pines.

> including such consideration of recreation uses, salinity and sediment control, and pollution abatement as may be provided for under federal policies...[31]

Sketching out the dimensions of basin planning, the law also indicated that the job was to be carried out by a mixed committee representing the Federal agencies and the states.

Study by an unwieldy body made up of representatives from seven agencies and eight states showed the desirability of separate plans for the basins.[32] A plan for the Red River below Denison, Texas, was developed by a coordinating committee which represented four states (Louisiana, Texas, Arkansas, and Oklahoma) and six Federal agencies, chaired by the New Orleans District Engineer. An interim report on navigation and bank stabilization was submitted in 1966, and in 1968 an eight-volume study put forward an overall plan for the transformation of the Red River Valley.[33] Meantime, in 1956 Louisiana voters set back development by rejecting a constitutional amendment providing for acquisition of rights-of-way, but in 1964 reconsidered and approved the project. Though Congress in 1968 ordered work to begin, many problems remained, including sharp clashes with environmentalists, especially over the proposed Kisatchie Reservoir. Pressures of the Vietnam War then led to impoundment of funds, which were not released until 1973. On 7 May of that year, the Shreveport *Journal* was able to announce "Big News for the Big Red," as Senator Russell B. Long informed the Red River Valley Association that President Nixon had released $600,000, enabling the Corps to let an initial contract for Dam No. 1.

Guiding work was a plan which gave first priority to navigation and bank stabilization, followed by flood control through reservoir storage and channel improvement. Aiming at an open channel for barge commerce, an end to bank caving, and a dependable flow of water, the plan sought to provide a basis for the growth of industry and recreation throughout the valley.[34] Following the existing channel of the Red as far as possible, the channel would provide a depth of nine feet from Old River Junction to Daingerfield, Texas. However, cutoffs would straighten the meanderings of the Red, creating oxbow lakes for fishing and recreation. Depth would be maintained by nine lock and dam combinations. Total cost of the project was estimated in 1974 at $1.09 billion, including $685.9 million Federal expenditure in Louisiana.[35]

Overall, the Red River Waterway project, when completed, would be the biggest single civil works project in the history of the New Orleans District. It gave promise of a new and more prosperous environment into which people and industry could flow, finding there not only cities, jobs, and transport, but wild and recreational areas as well. Of all forms of transport, only the waterway could improve life in so many different ways—and encourage other forms of transport as well, since road, rail, and air transport would follow the movement of people and industry to a newly developed area. Engineer work in developing the Arkansas River had already shown the practicality of such hopes. There was no less promise in the development of the Red, and Captain Shreve himself might have approved the boldness of the project for the final disciplining of his vagrant river.[36]

If planning was to be effective, however, improved resource management and more rigorous control of industrial pollution had to be applied wherever development took place. Through much of their history, the American people had accepted growth as an automatically desirable goal without pausing to examine its environmental cost or to make provision against its destructive side effects. In

the 1960's however, smog, congestion, and poisoned waters began to change the public outlook. For the New Orleans District the years of the "environmental crusade" meant new urgency in carrying out many traditional programs of pollution control, and new responsibilities under precedent-setting environmental legislation.

Many older District programs, though undertaken for other purposes, had positive environmental impact. For more than 70 years, the New Orleans Engineer Office and its successors struggled to improve navigation by controlling the water hyacinth, an aquatic herb native to tropical America. Growing prolifically, the plant blocked both lagoons and free-flowing streams, destroying aquatic life of all kinds and producing in some areas "a virtually sterile aquatic ecosystem."[37] District work in this field benefitted navigation, mitigated flooding, and preserved aquatic life as well.[38] Control of saltwater intrusion into freshwater streams was another long-standing District program with environmental implications. Because of the flatness of the Delta landscape, saltwater and fresh had always mingled to an unusual degree along the Louisiana coast. Cutting new channels increased a problem which was inherent in the landform. Hence, the Engineers undertook to build salinity control structures. On the Calcasieu River, for example, saltwater entering through new channels forced rice growers to irrigate by wells or diversion of upstream tributaries. Though local interests had earlier agreed to hold the United States free from claims for such damages,[39] sentiment veered around as difficulties mounted. In response to local demands, the New Orleans District began searching for a way of meeting the problem.[40] In 1962 the Engineers proposed a saltwater barrier, which would close the Calcasieu, and provide control and navigation facilities in an artificial channel. The program was approved by Congress, and construction began in 1965. Traffic was first routed through the artificial channel on 7 September 1967.[41] The control structure was basically a weir with movable floodgates over a fixed sill. When saltwater was high, the gates were closed; when low, they were opened to permit outflow of freshwater, while the undercurrent of heavier brine was stopped by the sill. The structure provided the key to continued development for the harbor of Lake Charles without destructive side effects to the region's agriculture. But a significant result was to restore, by artificial means, a boundary between two aquatic systems that earlier work had broken down.

Another salinity problem developed from the Mississippi-Gulf Outlet. Opening this channel permitted an influx of saltwater into Lake Pontchartrain which threatened the salinity gradient of the lake, an important nursery area for Louisiana's fisheries.[42] The Seabrook complex proposed by the Engineers for the Industrial Canal included structures to control this influx. The same sort of difficulty might have arisen where the Intracoastal Waterway crossed the rice-growing area of the Mermentau-Vermilion basins, except for the locks on the Waterway at Calcasieu, Vermilion, Schooner Bayou, and Catfish Point. The locks permitted navigation to continue without endangering the rice crop. When high water levels were required along the Mermentau to flood the ricefields, the locks helped to retain the water. When the freshwater of the basin was higher than the Gulf, and the flooding period was ended, the locks stood continuously open. When adverse winds piled up saltwater from the Gulf and threatened to invade the basin, the locks came into operation again, this time to keep out the salinity. Enormously busy (Calcasieu Lock passed above 42 million tons of cargo in an average year), these locks additionally helped to reduce saltwater intrusion, not only through the GIWW, but also through the natural

streams of the region. Here too devices intended to aid navigation and agriculture took on an environmental function.

Though Louisiana had never been a highly industrialized state, industrial pollution had long been a problem. Sugar refining and petroleum production both produced objectionable effluents, which were deliberately or accidentally dumped into the state's waterways. The responsibilities of the New Orleans District to regulate dumping originated in the so-called Refuse Act of 1899, which forbade depositing of refuse in navigable waters of the United States, except under a permit from the Chief of Engineers. To detect unlawful acts and bring charges against those responsible was a duty of the District for three generations, and, despite the fact that the law was clearly framed only to protect navigation, the environment benefitted.[43] Surviving records indicate that about 1,000 violations were cited by the District between 1955 and 1969 alone. When sugarmill effluent was polluting Bayou Teche, the Corps charged that the mill owners were obstructing navigation on a project stream by making it offensive to human use. Similarly, oil spills were frequently discovered and those responsible punished. In this way the District exercised a pollution-control function decades before the environment became a major public issue.

Deliberate and explicit environmental functions, on the other hand, came late to the Corps, for reasons that went deep into the nature of American society. Presented with a rich and unexploited continent, Americans were slow to be convinced that resources had a limit, that wild species were not inexhaustible, and that they themselves were tenants of their land and not owners in fee simple. Not until 1956 did Congress require effects on fish and wildlife to be taken into account in enforcing the Act of 1899. And not until passage of the National Environmental Policy Act in 1969 and the Federal Water Pollution Control Act Amendments in 1972 were basic laws rewritten to give the United States, for the first time in its history, an overall environmental policy. In 1970 the District set up the area's first environmental permit program under provisions of the Refuse Act. Though the program later passed to the Environmental Protection Agency, the District continued to act as advisor to the new agency on questions related to navigation and flood control. The contribution of the District itself, and of the Corps generally, to the new program had been a large one. In 1975 a court decision drastically expanded Engineer responsibilities for protecting wetlands. In line with these departures, change appeared in the District at many levels. Organizational restructuring gave greater weight to planning and recreation. A continuing search for nonstructural alternatives including a heavier emphasis on floodplain management underlined the importance which the new era brought to the District's intrinsic concern with the Louisiana environment.

Thus new duties took form. The district had to help inaugurate a new act in the relationship between man and nature in the Delta. No state possessed so great a proportion of water to land area as Louisiana, and in no other was the rational development of that water more significant. In no other did water provide such opportunities, if developed and protected, or present so many obstacles and dangers, if undeveloped or misused. And the management of the state's water resources had to take into account a strenuously growing economy, which saw Louisiana, by 1970, producing 20 percent of the nation's crude petroleum, 50 percent of its sulfur, and 24 percent of its salt. Sugar and rice were harvested from the fields, fur from the marshes. An immense fishing industry exploited the resources of the Gulf. Great wildlife preserves stretched along the

southwestern Louisiana coastline, and others were proposed for the wilderness of the Atchafalaya basin. None of these interests could be neglected, none could be sacrificed, and all came to a greater or lesser degree within the purview of the New Orleans District. To find a way through the tangle of political, economic, and environmental factors—to protect, develop, and conserve at the same time—was a unique and heavy reponsibility.

The District had come a long way from the brick forts of the 1820's. It began with military duties, took on civil functions, and gradually grew into the Federal agency primarily responsible for controlling and making useful the whole network of the Delta waterways. As it matured, it became a significant agent in transforming much of Louisiana from its primitive condition as a floodplain of the Mississippi to a settled region of cities, productive agriculture, and extractive industries. By changing the seemingly endless waterways of the state to facilitate navigation and by erecting works of flood control, the Corps of Engineers laid an indispensable groundwork for growth. Its work in mitigating the effects of hurricanes likewise provided the Delta a measure of protection against a major natural enemy. Development of many minor streams, of the Calcasieu, and planned river basin development of the Red promised major improvements in prosperity and the quality of life in north and south Louisiana. In the 1970's the New Orleans District also took on heavier responsibilities for controlling environmental pollution resulting from both natural and artificial causes. Faced with a new age in which conservation would mean as much as development, the Engineers carried on their complex duties under the Corps' traditional motto—*Essayons*, let us try.

NOTES

INTRODUCTION

[1] Harold N. Fisk, *Geological Investigation of the Alluvial Valley of the Lower Mississippi River* (Vicksburg: Mississippi River Commission, 1944), 67-69; Robert W. Harrison, *Alluvial Empire* (Little Rock: Pioneer Press, 1961), 12.

[2] A classic study of the meander phenomenon is J. F. Friedkin, *A Laboratory Study of the Meandering of Alluvial Rivers* (Vicksburg: Waterways Experiment Station, 1945). Friedkin found that meanders develop even in a perfectly straight channel with uniform banks and unvarying flow, the sole requirement being that the banks should be susceptible to erosion. Water can carry sand only a short distance downstream. For this reason erosion produces deposition in the channel; the bar deflects the current, producing increased erosion of the bank opposite, and this in turn produces more deposition. Meander begets meander, and is propagated downstream. Consequently, too, any factor which limits erosion will limit meander.

[3] "Six... delta complexes have been studied in lower Louisiana. From oldest to youngest, they are Bayou La Rose, Maringouin, Cocodrie, Teche, Lafourche, and Plaquemine-St. Bernard." Harold N. Fisk, *Geological Investigation of the Atchafalaya Basin and the Problem of Mississippi River Diversion* (Vicksburg: Waterways Experiment Station, 1952), 34.

[4] *Lafcadio Hearn, Chita* (New Young: Harper & Brothers, 1889), 15.

[5] The drainage basin is approximately 32 percent arid, 15 percent semiarid, and 53 percent humid. *House of Representatives Document 798*, 71 Congress, 3 Session (1931), 84. It ranges over 36 degrees of longitude and 21 degrees of latitude. *Ibid.*, 61. These great variations in climate and aridity not only make the flooding of the river extremely variable but, as a rule, prevent the synchronization of floods in the great tributaries. When even a partial exception to the rule occurs—as in 1927—the results are likely to be cataclysmic.

[6] "Above the mouth of Red River on the right bank, and above Baton Rouge on the left bank, the drainage of the alluvial valley finds its way through small streams and bayous into tributaries of the Mississippi River. Below these points the drainage is through numerous bayous, lakes, and streams, into the Gulf of Mexico." *Ibid.*, 67. This is not perfectly accurate (small tributaries do enter even below Baton Rouge) but it is true as regards the overall drainage pattern.

[7] Mark Twain, *Life on the Mississippi*, from *The Favorite Works of Mark Twain* (New York: Garden City, 1939), 127-128.

[8] For the purposes of this study, the following terminology will be adopted:

"Valley" means the Alluvial Valley—the Mississippi flood plain south of Cape Girardeau.

"Delta" means the deltaic plain—the part of the flood plain south of the Red River.

"Engineer" when capitalized means an officer of the U. S. Army Corps of Engineers, or a civilian engineer employed by the Corps.

"District" when capitalized means the New Orleans District of the Corps of Engineers.

CHAPTER ONE

[1] Major D. O. Elliott, *The Improvement of the Mississippi River for Flood Control and Navigation*, 2 vols. (Vicksburg: Waterways Experiment Station, 1932), II, 275. Hereafter cited as *Improvement of the Mississippi.*

[2] "... it was a beautiful thing," wrote Garciliasco de la Vega, "to look upon the sea where there had been fields, for on each side of the river the water extended over twenty leagues of land, and all this area was navigated by canoes,

and nothing was seen but the top of the tallest trees." Quoted in Robert W. Harrison, *Alluvial Empire* (Little Rock: Pioneer Press, 1961), 52.

[3] M. Penicaut, *Annals of Louisiana from 1698 to 1722*, 138-139. In B. F. French, *Historical Collections of Louisiana and Florida* (New York: J. Sabin and Sons, 1869).

[4] De la Tour is supposed to have disputed Bienville's choice of a site on just these grounds.

[5] Dumont de Montigny, *History of Louisiana*, 23-24. In B. F. French, *Historical Collections of Louisiana* (New York: Lamport, Blakeman & Law, 1853).

[6] *Flood Control in the Lower Mississippi River Valley* (Vicksburg: Mississippi River Commission, 1969), 2.

[7] To Wadsworth, 10 July 1803. Letters Sent, II, 26, Record Group 107, National Archives. The sender was almost certainly the Secretary of War. See also—to Wadsworth, 13 February 1804, Buell Collection, Item 51, Record Group 77, National Archives. References to this collection hereinafter cited in the form "Buell 51 NA."

[8] Wilkinson indicated considerable intelligence and foresight in warning against the vulnerability of Louisiana to maritime attack. His curious "Memoir" of 27 March 1812 protested against the distrust enveloping his own reputation while putting forward a comprehensive plan for the defense of Louisiana. He recommended the seizure of Pensacola, an alliance with the Mexican revolutionists, calling out the "yeomanry" of Louisiana and the Mississippi Territory, the massing of materiel at Baton Rouge and—only 5 years after Fulton—the employment for warlike purposes of "6 Boats, to be propelled by steam." Wilkinson to Eustis, 27 March 1812, Buell 297 NA.

[9] Despite certain indications of continuing activity, at least in the form of surveys and investigations, there does not appear to have been any positive action of consequence even in the military field until after the War of 1812. One such indication which also has a certain interest in itself is a report, Armistead to—, 25 December 1807, in which Engineer Captain W. K. Armistead reported from Fort St. Philip on, among other things, the existence of a ruinous "Ft. Bourbon" across the river—i. e., at or near the site of the future Fort Jackson. Armistead considered the site unsuitable for masonry fortification.

[10] W. Stull Holt, *The Office of the Chief of Engineers of the Army: Its Non-Military History, Activities and Organization* (Baltimore: The Johns Hopkins Press, 1923), 1. Hereafter cited as Stull Holt, *Office of the Chief of Engineers.*

[11] *Ibid.*, 2.

[12] However, even Rensselaer did not give a civil engineering degree until 1835, and its course was limited to 1 year until 1860. See Forrest G. Hill, *Roads, Rails & Waterways: The Army Engineers in Early Transportation* (Norman: University of Oklahoma Press, 1957), 208. Hereafter cited as Hill, *Roads, Rails and Waterways.* See also Raymond H. Merritt, *Engineering in American Society 1850-1875* (Lexington: University Press of Kentucky, 1969), 40-45. Hill emphasizes the school's limitations, Merritt its achievements.

[13] Quoted in Hill, *Roads, Rails and Waterways*, 4.

[14] Swift to Dallas, 21 March 1815, Buell 546 NA.

[15] —To Dumas, 4 May 1815, Buell 555 NA orders Dumas to New Orleans. —to Gadsden, 13 January 1816, Buell 631 NA contains Gadsden's orders; Swift to—, 16 October 1815, Buell 685 makes it plain that Dumas has been arrested, though not why; Buell 808 NA is Gadsden's report to Jackson. The title is given Gadsden in the Monthly Returns of the Corps of Engineers, Record Group 77 NA, hereafter cited as Monthly Returns. The Returns are available in two record groups, the work copies retained by the Corps (RG77) and the fair copies submitted to the Adjutant General (RG94).

[16] Hill, *Roads, Rails and Waterways*, 6-9.

[17] Orders to General Bernard and—, 10 February 1817, Buell 710 NA.

[18] Poussin was sent on a per diem arrangement; "whilst on Topographical Duty, you will be allowed one dollar and a half per day..." Swift to Poussin, 10 February 1817, Buell 712 NA. Strictly speaking, all ranks in the Topographical Engineers were brevet ranks until President Jackson organized the service as a separate bureau in 1831.

[19] Swift to Gadsden, 9 April 1818, Buell 758 NA.

[20] Swift to Cox, 28 July 1818, Buell 806 NA. The agent handled the money under the "total" supervision of the local Engineer. Materials and workmanship were supplied by a Washington firm.

[21] Emanuel Raymond Lewis, *Seacoast Fortifications of the United States: An Introductory History.* (Washington: Smithsonian Institution, 1970), 42; *Annual Report of the Chief of Engineers for 1898*, 745.

[22] *Laws of the United States Relating to the Improvement of Rivers and Harbors*, 3 vols. (Washington: Government Printing Office, 1940), I, 21. Hereinafter cited as *Laws Relating to Rivers and Harbors.*

[23] *Ibid.*, 22.

[24] *House of Representatives Document 35*, 17 Congress, 2 Session (1823); Andrew A. Humphreys and Henry L. Abbot, *Report upon the Physics and Hydraulics of the Mississippi River...* (Washington: Government Printing Office, 1876), 121.

[25] *Laws Relating to Rivers and Harbors*, I, 27; on *Gibbons v. Ogden*, see Felix Frankfurter, *The Commerce Clause*

Under Marshall, Taney & Waite (Chicago, 1964) and citations therein.

[26] *Proceedings of Congress*, 18 Congress, 1 Session (1824), 3217.

[27] *House of Representatives Document 2*, 20 Congress 1, Session (1827), 51-52. This report of Secretary of War James Barbour gives an excellent summary of the work undertaken in the years of Adams-Clay nationalism.

[28] *House of Representatives Document 125*, 20 Congress, 1 Session (1828), is the Bernard-Poussin report. The quoted phrase used in the preceding citation will be found in this report, 41.

[29] However, officers from other branches were regularly detailed to the Engineers and the Topographical Engineers. Andrew A. Humphreys, for example, was detailed from the artillery.

[30] *House of Representatives Document 2*, 21 Congress, 2 Session (1830), 12.

[31] *House of Representatives Document 1*, No. 17, 22 Congress, 2 Session (1832).

[32] Hill, *Roads, Rails and Waterways*, 214.

[33] *Ibid.*, 128.

[34] Shreve to Gratiot, *House of Representatives Document 1*, 23 Congress, 1 Session (1834), 126-130; Louis C. Hunter, *Steamboats on the Western Rivers: An Economic and Technological History* (New York: Octagon Press, 1969), 13-17, 75-76, 89-90, 193-203.

[35] Elliott, *Improvement of the Mississippi*, I, 69.

[36] Humphreys and Abbot, *Physics and Hydraulics*, 396-403. The authors take these cutoffs for study and reach general conclusions about all cutoffs. Modern views do not hold that all cutoffs are feasible, but that each one proposed must be studied independently. "The extent and character of the channel changes which follow a cutoff depend entirely upon local conditions. No general rule covering them can be deduced." Elliott, *Improvement of the Mississippi*, I, 61. See also Harley B. Ferguson, *History of the Improvement of the Lower Mississippi River for Flood Control and Navigation*, 1932-1939 (Vicksburg: Mississippi River Commission, 1940).

[37] Harrison, *Alluvial Empire*, 61-65; Humphreys and Abbot, *Physics and Hydraulics*, 154 *et seq.* On flooding, see *House of Representatives Document 11*, 24 Congress, 1 Session (1835), 34.

[38] *Ibid.*, 67-87; Martha Virginia Shipman, "The Mississippi River Commission," unpublished M. A. Thesis (University of Arkansas, 1937), 10-11. The flood of 1849 inundated a large part of New Orleans as well as agricultural land. See Harry (Henry) Kmen, "New Orleans' Forty Days in '49," *The Louisiana Historical Quarterly*, XL (January 1957), 24-25.

[39] *Laws Relating to Rivers and Harbors*, I, 116.

[40] *Returns of the Bureau of Topographical Engineers*, October 1850 and January 1852. In 1851 Humphreys was taken ill in the field. He traveled to Europe, partly for study and partly to regain his health and, following his return, was assigned to office work on the Pacific Railroad projects at Washington. Here he met Henry L. Abbot, who had done fieldwork on the railroad surveys. When the Delta Survey was resumed in 1857, Abbot took over the fieldwork, in which he received assistance from civil engineer Caleb G. Forshey. See the introduction to the *Physics and Hydraulics*.

[41] Charles Ellet, *The Mississippi and Ohio Rivers: Containing Plans for the Protection of the Delta* (Philadelphia: Lippincott, Grambo & Co., 1853). Previously printed as *Senate Executive Document 20*, 32 Congress, 1 Session (1852). Hereinafter cited as Ellet, *Mississippi and Ohio*.

[42] Elliott's volumes, an official publication of the Mississippi River Commission, praised Ellet's work: "In general, Ellet's studies are worthy of admiration. He not only phrophesied the alarming increases in flood elevations which have since occurred, but his flood plan is in many respects remarkably similar to the present adopted project.... Ellet's greatest mistake was probably his advocacy of headwater reservoirs. His conclusions here were unsound." Elliott, *Improvement of Mississippi River*, II, 302.

[43] Ellet, *Mississippi and Ohio*, 63.

[44] These were essentially the criticisms of Humphreys and Abbot. See *Physics and Hydraulics*, 407-408.

[45] Elliott says, "(Ellet) apparently regarded levees as a dangerous expedient to be used only when no other method of flood control was practicable." *Improvement of Mississippi River*, II, 308.

[46] *Senate Executive Document 20*, 32 Congress, 1 Session (1852), 49-50.

[47] See for example Humphreys and Abbot, *Physics and Hydraulics*, 114-115.

[48] *Ibid.*, 350.

[49] The work was translated into the principal European languages, and was widely read, though not always praised, by Continental engineers. See Humphreys and Abbot, "Reply to Criticisms Made by Dr. Hagen," *Van Nostrand's Eclectic Engineering Magazine*, XVIII (January 1878), 1-8.

[50] On "levees-only" see Humphreys and Abbot, *Physics and Hydraulics*, 428-445. The other points will be discussed in the following chapters. A good biography of Humphreys is needed. See Henry H. Humphreys, *Andrew*

Atkinson Humphreys, A Biography (Philadelphia: John C. Winston Company, 1924).

[51] *House of Representatives Document 185*, 22 Congress, 1 Session (1831-1832), 53-54.

[52] Monthly Returns, March 1840; September 1840; March 1841; May 1841; September 1842. See also T. Harry Williams, *P. G. T. Beauregard, Napoleon in Gray* (Baton Rouge: LSU Press, 1954), 9-12.

[53] Monthly Returns, November 1845; November 1846; January 1847; December 1847; August 1848; September 1852; October 1852. The general distribution of rank in August 1848 also saw Robert E. Lee made a Brevet Colonel, Henry Halleck a Brevet Captain, and George B. McClellan a Brevet Captain.

[54] Hill, *Roads, Rails and Waterways*, 138; Monthly Returns, September, October, November 1852; May, September, October 1853. Smith was made captain in July 1853 and died on 13 September of the same year.

[55] *House of Representatives Report 88*, 34 Congress, 1 Session (1856), contains a critical report by the Commerce Committee on Davis' action, and the text of the proposed contract with Eads & Nelson. Estill McHenry, ed., *Addresses and Papers of James B. Eads, Together with a Biographical Sketch* (St. Louis: Slawson & Co., Printers, 1884), vii, says that the proposal passed the House of Representatives "but failed for want of time in the Senate."

[56] *Annual Report of the Chief of Engineers for 1866*, in *House of Representatives Executive Document 59*, 39 Congress, 1 Session (1866), 9 *et seq.* References to these reports will henceforth be given in the form *Annual Report* (1866). Not all forms of civil works were abandoned; efforts to open the Passes of the Mississippi continued intermittently, and the Pacific Railroad surveys were carried out by the Topographical Bureau. These were works desired for various reasons by powerful elements of the Democratic Party, especially in the South, and were exceptions to the overall trend of events under the so-called "doughface Presidents," Pierce and Buchanan.

[57] Monthly Returns, February 1856; October 1856; April 1857; November 1860; January 1861; February 1861. Among others, the following former Engineer officers served with the contending armies: George B. McClellan, Robert E. Lee, Henry W. Halleck, William S. Rosecrans, P. G. T. Beauregard, Edmund Kirby Smith, George G. Meade, John Pope, and Godfrey Weitzel.

CHAPTER TWO

[1] In the 15 years between 1861 and 1876, the production of Delta staples dropped from 469,000 hogsheads of sugar and 2.3 million bales of cotton to 135,000 hogsheads and 1 million bales of cotton. The House committee which gave these figures blamed failure to recover from the war upon the fact that the "heart of the richest valley in the world... is annually inundated by the waters of the Mississippi." *House of Representatives Report 494*, 44 Congress, 1 Session (1876), 1.

[2] Between 1860 and 1870 the states drained by the Mississippi increased 64 percent in population. Manufactures in some cases increased five times over. During debate of the Eads bill, "Granges, boards of trade, chambers of commerce, political conventions... as well as... State legislatures" were cited in Congress as demanding the opening of the Passes. *Congressional Record*, 43 Congress, 2 Session (1875), 1442-1443. The boom in the regions that used the Mississippi as a road of commerce did not, of course, contradict the simultaneous picture of desolation in the inundated regions of the Delta. Boom and depression existed simultaneously and both contributed to the shaping of Federal policy for the river.

[3] The accompanying chart is based on C. H. Chorpening, "Waterway Growth in the United States," *Centennial Transactions of the American Society of Civil Engineers* (1953), 1001. A good summary of the postwar change in attitude was expressed by James B. Eads, the future builder of the jetties, to the Mississippi Improvement Convention, 12 February 1867: "Formerly constitutional objections were urged against the improvement of these rivers by those who had no scruples in voting for seaboard works. But such objectors are now rare, and their mischievous quibbles are generally rejected by a loyal people.... Does any statesman gainsay (Washington's) right to do it then? Does any patriot question its power to do it when the Union was in peril? When the necessity occurred there was a power in the government somewhere to provide for it." McHenry, *Addresses and Papers of James B. Eads*, 1.

[4] Monthly Returns, March 1861.

[5] Later under Major General Nathaniel P. Banks.

[6] Monthly Returns, March 1862.

[7] *Ibid.*, March 1864.

[8] Captain George L. Gillespie. The Military Division was renamed the Department of the Gulf in August 1866 and later, under the Second Reconstruction Act, became part of the Fifth Military District (Texas and Louisiana). Gillespie stayed until 22 August 1867.

[9] Monthly Returns, December 1865, March and August 1866; *Annual Report* (1866), 364.

[10] The evolution of the responsibilities of the New Orleans District will be treated in the topical chapters that follow.

[11] *Annual Report* (1866), 9 *et seq.*

[12] *Annual Report* (1867), 376 *et seq.* Captain Charles Howell, later to be District Engineer at New Orleans, was chief assistant to Major John N. Macomb, who had charge of the Office of Western River Improvements at Cincinnati.

[13] *Proceedings of the Convention for the Improvement of the Mississippi River* (Washington, D. C.: Mississippi River Improvement Convention, 1884), 31. The language of the speakers at the convention was only a colorful and unrestrained repetition of the viewpoint that Howell stated in his official report a decade earlier. See *Annual Report* (1874), Appendix R, 5-6. For that matter, McAlester had mentioned the same possibility in 1866: see *House of Representatives Document 56*, Part 2, 39 Congress, 2 Session (1866), 236-243.

[14] 15 *Stat.* 25.

[15] Elliott, *Improvement of the Mississippi River*, I, 6.

[16] Summaries in *Annual Report* (1874), Appendix R, 19 *et seq.* See also *Annual Report* (1866), 240.

[17] The Danube also discharges into a sheltered sea. The Sulina outlet of the Danube, where jetties had been successfully employed, was the subject of studies and polemics by American engineers trying to show that it was, or was not, similar to the Passes of the Mississippi and that the Black Sea was, or was not, a useful analogue to the Gulf of Mexico. See for example the discussion in Barnard's minority report of 29 January 1874, in *Annual Report* (1874), 73-76. On the four basic methods of improvement, see *House of Representatives Executive Document 16*, 33 Congress, 1 Session (1853), 8.

[18] Of the many names used for this pass, the most sensible, Northeast Pass, is no longer used. Antoine-Simon Le Page du Pratz, *The History of Louisiana* (New York: Lamport, Blakeman & Law, 1853), 117 calls it East Pass but notes the existence of another small pass nearby called Otter Pass, which is "fit only for pettyaugres (pirogues)." Since *loutre* is French for otter, it seems probable that the name was transferred to the larger pass and then fractured by folk etymology into Pass a l'Outre ("Pass to the Outside"). The most common form in the 1870's was Pass a Loutre which, if it was neither French nor English, was at least simple, and is adopted here.

[19] *Laws Relating to Rivers and Harbors*, I, 152.

[20] *Annual Report* (1866), Appendix XX, 236; *ibid.* (1867), Appendix F, 362.

[21] *Ibid.*, 370-372; Monthly Returns, October 1867.

[22] *Ibid.*, July 1868.

[23] *Annual Report* (1869), 260.

[24] From a memoir prepared by William M. Burwell and included in Howell's report for 1867. Burwell also estimated the ultimate cost of the *Essayons* at $350,000. *Annual Report* (1874), Appendix R, 19 *et seq.*

[25] *Annual Report* (1874), 260.

[26] Chase's report was dated 9 February 1837. I have not been able to obtain a copy. His conclusions however may be deduced from his letter to General Charles Gratiot, Chief of Engineers, in 1836. At the request of the New Orleans Chamber of Commerce, Chase informs Gratiot he has dispatched a surveying party to the river mouth. He then proceeds to anticipate their conclusions. "...no improvement by art either by dredging or by permanent jetties or piers can be accomplished so as to secure permanent benefit.... I would also recommend that the proposition to cut the canal recommended by Major Buisson be at once adopted... and that the sum of $500,000 be asked for the commencement of this work. The surveys, plans and details," he adds, "will not furnish data to alter materially this estimate." Letters of Captain W. H. Chase, No. 147, Record Group 77, National Archives. "M. Buisson" is spoken of by Ellet as "a distinguished engineer of New Orleans," in *Senate Executive Document 20*, 32 Congress, 1 Session (1852), 20.

[27] *Laws Relating to Rivers and Harbors*, 119.

[28] *House of Representatives Executive Document 16*, 33 Congress, 1 Session (1852).

[29] *Annual Report* (1875), Appendix R, 5-15 and 50-52.

[30] Monthly Returns, July 1866.

[31] *Annual Reports* (1874), Appendix B, 79.

[32] By this time the rise of the Granger movement was exerting pressure on Congress to find farm products an alternate route to market. See, for example, the statement of Congressman Charles G. Williams of Wisconsin speaking in favor of the first (House) version of the Eads bill: "However flippant the term may be on the tongue here (at Washington), whether you denominate it the 'grangers,' the 'hay-seed,' or the plain 'farmers movement,' or whatever glee all this cheap wit may create, still the sober question remains to the people of the West, 'How shall the cheap transportation of our surplus products from the interior to the seaboard be best secured?'" *Congressional Record*, 43 Congress, 2 Session (1875), 1442.

[33] He built the propeller-driven ironclads *Milwaukee* and *Winnebago* among others. *Congressional Record*, 43 Congress, 2 Session (1875), 1505. Eads' ironclads saw action more than a month before the fight of the *Monitor* and *Merrimac*. McHenry, *Addresses and Papers of James B. Eads*, vii-viii. Eads was a figure who naturally provoked partisanship, and his colorful biography by Florence Dorsey, *Road to the Sea* (New York and Toronto: Reinhart, 1947), is recommended with reservations. Eads

and Humphreys were great engineers, both egoists possessing adamantine certainties about their own abilities. But Eads was the maverick entrepreneur, Humphreys an organization man. Each considered himself the supreme authority on the Mississippi River. The clash between them was predestined, if anything ever was.

[34] Elmer Lawrence Corthell, *A History of the Jetties of the Mouth of the Mississippi River* (New York: John Wiley and Sons, 1881), 365. Herafter cited as Corthell, *History of the Jetties*.

[35] *House of Representatives Executive Document 114* (Part 2), 43 Congress, 2 Session (1875).

[36] *Congressional Record*, 43 Congress, 2 Session (1875), 1441. This was by no means the first suggestion for involving private enterprise in the work on the river. Previous proposals had usually been for a "Mississippi Levee and Telegraph Company," or some variant thereof. The idea was to have levees constructed by a private company under specifications set by a mixed board of civil and military engineers. See *Senate Miscellaneous Document 3*, 42 Congress, Special Session (1871), 1-4; *House of Representatives Report 44*, 42 Congress, 2 Session (1872), 16; *House of Representatives Executive Document 187*, 42 Congress, 3 Session (1873), 1-7.

[37] In 1851 Ellet had reported that "at the head of South Pass... it is now scarcely possible for any useful craft to enter. A spit of sand has formed directly in the mouth of the pass, which has almost entirely closed up the entrance, and destroyed it for all commercial purposes." *Senate Executive Document 17*, 31 Congress, 2 Session (1851), 3-4. The Engineer Board of Chase, Latimer, Barnard, and Beauregard called the pass "now quite insignificant." *House of Representatives Executive Document 16*, 33 Congress, 1 Session (1854), 4-5.

[38] The chief provisions of the Act of 3 March 1875 were as follows:

Depth ft	Width ft	Payment
20	200	$ 500,000
22	200	500,000
24	250	500,000
24*	250	250,000
26	300	500,000
26*	300	250,000
28	350	500,000
28*	350	250,000
30	350	500,000
30*	350	500,000
		$4,250,000

* Indicates money payable when the channel had been maintained for 12 consecutive months. Five percent interest was added to date from the first attainment of the specified depth and width.

The remaining $1 million was retained, 5 percent interest being paid to Eads and associates, with the principal becoming payable in two equal installments, at the end of 10 and 20 years, provided the 30- by 350-foot channel was maintained. In addition, $100,000 per year for maintenance was to be paid from the first attainment of the 30- by 350-foot channel, which Eads was to maintain for 20 years. Thus, payment would total $8 million.

From *Laws Relating to Rivers and Harbors*, I, 246-247.

[39] Monthly Returns, June 1875.

[40] *Ibid.*, February 1877. Captain M. R. Brown, "Annual Report upon the Improvement of South Pass of the Mississippi River Showing the Condition of the Works on June 30, 1878," 24. In *Annual Reports, New Orleans, La., Engineer District*, II.

[41] Corthell, *History of the Jetties*, 344-345; *Annual Report* (1875), Appendix S; *House of Representatives Executive Document 12*, 44 Congress, 2 Session (1876); diagrams and charts accompanying *Annual Report* (1800), Appendix L.

[42] Cf. discussion of the *Grand Republic* incident in Corthell, *History of the Jetties*, Appendix VIII, 278-295. Eads charged that a boatload of visiting capitalists was intercepted by one of Howell's assistants who gave them information purporting to show that the Gulf was shoaling beyond the jetties.

[43] By the terms of the final bill the 30-foot channel was still required, but no width was specified. If a continuous line of 30-foot depths wide enough to receive the sounding lead could be found, Congress would be satisfied. *Laws Relating to Rivers and Harbors*, I, 281-283; 301-302.

[44] Note especially the Boards of 1874 and 1878, which reported favorably on the jetty system both before and after Eads had done his work, and the reports of Micah Brown. See *Annual Report* (1875), Appendix S, 6 *et seq.*

[45] Corthell, *History of the Jetties*, 26-27; reports a critical speech by Carl Schurz, for example.

[46] "*The conclusion is inevitable: the jetties must be extended annually at the same rate that the bar is advancing, if we intend to maintain permanently the same depth upon the bar.* If the depth to be maintained is 27 feet at low water, or 28 feet at high water, it will be found... that the annual advance will not be less than 1,200 feet." Humphreys and Abbot, *Physics and Hydraulics*, 672. Italics in original. This analysis, published as an appendix to the *Physics and Hydraulics*, was originally prepared by Humphreys as part of his campaign against the jetties. It appears also in the *Annual Report* (1874), Part I, 854-867, and in *House of Representatives Executive Document 220*, 43 Congress, 1 Session, 1-15.

[47] Howell's results were probably attributable to negligence. The contours of the Gulf bottom beyond the jetties were continually changing during the course of the

work, and a few scattered soundings might give almost any results.

[48] See Eads' complaints in Corthell, *History of the Jetties*, 279-295.

[49] *Ibid.*, 305-308.

[50] New Orleans *Democrat*, 6 May 1876.

[51] Corthell, *History of the Jetties*, 305; Williams, *P. G. T. Beauregard*, 288-290.

[52] M. R. Brown, "Annual Report," 24-27, in *Annual Reports, New Orleans, La., Engineer District*, II. Also *Senate Executive Document 95*, 45 Congress, 2 Session (1878), 46-47.

[53] The first seagoing vessel to enter the river by the jettied pass was the *Hudson* on 12 May 1876. During 1877, 587 ocean vessels went through the pass, and by 1879 Southwest Pass was almost abandoned except by fishing boats and schooners. Dorsey, *Road to the Sea*, 206, 213. The same year a New York paper reported, "To realize how much the jetties have already done for New Orleans, one has only to sail along the riverfront of the city, where I counted last week no fewer than one hundred and twenty large square-rigged sailing vessels and eighteen ocean steamers. Fully four-fifth of these ships came from foreign ports." New York *Daily Tribune*, 29 March 1879.

[54] Corthell, *History of the Jetties*, 320-330.

[55] *Senate Executive Document 8*, 40 Congress, 1 Session (1866), 13.

[56] *Annual Report* (1869), 327 *et seq.* A bill was considered by the Senate Committee on Commerce to underwrite state bonds of Louisiana, Mississippi, and Arkansas for levee repairs but the scheme came to nothing. *Senate Miscellaneous Document 8*, 41 Congress, 1 Session (1869), Louisiana was reported to have issued $8 million in bonds for levees by 1872 without any appreciable success in defending her best cotton land. *House of Representatives Report 44*, 42 Congress, 2 Session (1872), 6. See also Joe Gray Taylor, *Louisiana Reconstructed* (Baton Rouge: LSU Press, 1974), 195-196.

[57] Elliott, *Improvement of the Mississippi*, II, 162; *Annual Report* (1875), 539. The three-and-two makeup, with the president chosen from the Corps personnel, had the same form as the later House plan for the Mississippi River Commission.

[58] *Ibid.*, 552, 539; Elliott, *Improvement of the Mississippi*, II, 162.

[59] *Annual Report* (1875), 564-565.

[60] The flood of 1874 opened a period of transformation, and the flood of 1882 brought it to a climax. In 1874 Congress authorized the President to issue food and rations to the sufferers and followed up by creating the Levee Commission. There is some background on the state of Congressional feeling at this time in Martha Virginia Shipman, "The Mississippi River Commission," Unpublished Master's Thesis (University of Arkansas, 1937), 14-15.

[61] Conventions were held throughout the period. See, e.g., *Give Us an Unobstructed Mississippi* (St. Louis: J. J. Daly and Co., printers, 1877); *Official Report of the Proceedings of the Mississippi River Improvement Convention* (St. Louis: Great Western Printing Co., 1881); and *Proceedings of the Mississippi River Improvement Convention* (St. Louis: Great Western Printing Co., 1881); and *Proceedings of the Mississippi River Improvement Convention* (Washington: n.p., 1884).

[62] *Tom Sawyer* appeared in 1875, *Life on the Mississippi* in 1883, and *Huckleberry Finn* in 1884.

[63] *Congressional Record*, 46 Congress, 2 Session (1879), 1730. See also Arthur DeWitt Frank, *The Development of the Federal Program of Flood Control on the Mississippi River* (New York: Columbia University Press, 1930), 41-44.

[64] *Congressional Record*, 46 Congress, 2 Session (1879), 2101.

[65] See Senator Ferry's speech in favor of the defeated amendment. *Congressional Record*, 46 Congress, 1 Session (1879), 2102.

[66] *Laws Relating to Rivers and Harbors*, I, 304. The critical paragraph was Section 4: "It shall be the duty of the said commission to take into consideration and mature such plan or plans and estimates as will correct, permanently locate, and deepen the channel and protect the banks of the Mississippi River; improve and give safety and ease to the navigation thereof; prevent destructive floods; promote and facilitate commerce, trade, and the postal service.... *Provided*, that the Commission shall report in full upon the practicability, feasibility, and probable cost of the various plans known as the jetty system, the levee system, and the outlet system, as well as upon such others as they deem necessary."

The effect of this Delphic utterance was to establish channel stabilization as the primary goal, but to open the way to the advocates of levee building, who began by urging levees as a means of channel improvement and ended by frankly building for flood control.

[67] Shipman, "Mississippi River Commission," 26-33; Robert Harrison, *Alluvial Empire*, 150-152.

CHAPTER THREE

[1] *House of Representatives Executive Document 58*, 46 Congress, 2 Session, 22-23.

[2] Special Order 83, Headquarters of the Chief of Engineers, 25 July 1879, in Monthly Returns, July 1879.

[3] *Annual Report* (1881), 2732-2734.

[4] See Shipman, "Mississippi River Commission," 35; Elliott, *Improvement of the Mississippi*, III, Plates LIX and LX; John R. Ferrell, *From Single- to Multi-Purpose Planning: the Role of the Army Engineers in River Development Policy, 1824-1930* (Baltimore: Historical Division, OCE, 1976), 73.

[5] *Proceedings of the Mississippi River Commission*, I (1879-1884), 21 January 1880, 14; 7 May 1881, 2. Herinafter cited as *Commission Proceedings*.

[6] The Commission resolved in 1880 that a levee system "gives aid to navigation, promotes and facilitates commerce... trade and postal service," a repetition of the language of the organic law. *Commission Proceedings*, I, 22 January 1880, 20. However, it held also that levees were works subsidiary to the main purpose of channel stabilization. *Ibid.*, 25 March 1881, 7-9. The remark about experimental work is in *ibid.*, 24 March 1881, 6.

[7] *Annual Report* (1883), Pt. 1, 2118; 22 *Stat.* 191.

[8] *Laws Relating to Rivers and Harbors*, I. 382.

[9] *Annual Report* (1882), Pt. 2, 1354.

[10] On the extent of the flood, see illustration. "During this flood an area of 34,600 square miles in the lower valley was overflowed to an estimated average depth of six and one-half feet. The river was above bank-full stage for sixty days at Cairo and eighty days at Red River Landing, La." Elliott, *Improvement of the Mississippi*, I, 97. Plea of Greenville, *Commission Proceedings*, I, 16 August 1882, 6. Plea of 11 Louisiana Parishes, *ibid.*, 19 November 1882, 4. Statement of Senator Lamar, *ibid.*, 15 August 1882, 3.

[11] *Ibid.*, 16 August 1882, 6.

[12] *Ibid.*, 17 August 1882, 10. Brigadier General Quincy A. Gillmore, the president, did not vote. Eads and Judge R. S. Taylor were absent, Eads being in poor health at the time. In a letter to the Commission (*ibid.*, 15) he asked that his vote be recorded in the affirmative on any proposition to close the levee gaps.

[13] On levee priorities, see *Commission Proceedings*, III, 4 August 1892, 38. On the standard gage, see e.g. *ibid.*, 11 November 1899, 614. An example of maintenance rulings (forbidding cuts, pipes, and flumes) is given in *ibid.*, 24 March 1891, 10. Commission standards were of course extended as its authority grew to cover virtually the whole river above the Head of Passes, and the major tributaries as well. See summary in *Annual Report* (1928), 1876-1877.

[14] *Commission Proceedings*, 27 November 1886, 13-15; 10 May 1884, 8; 12 November 1900, 686.

[15] Above paragraphs based on material in George D. Waddill Papers, NOD Library; ledgers and account books, NOD Library; John Klorer "An Engineer Reminisces," Ms memoir, NOD Library.

[16] Waddill papers.

[17] *Commission Proceedings*, 9 July 1897, 455, 22 July 1897, 438-440.

[18] "When the Mississippi River Commission was created, the report of Humphreys and Abbot became a virtual 'Bible,' and successive generations of engineers saw fit to repeat the conclusions of the report. The idea that levees afforded the only sensible means of control became fixed in the minds of official engineers." Harrison, *Alluvial Empire*, 122-123. This viewpoint seriously underestimates Eads' influence, exaggerates Humphreys', and underrates the physical difficulties and political pressures which the Commission faced in developing a workable policy.

[19] "It would seem, therefore, that a closure of the crevasses might be expected to accelerate the removal of those shoals which have been produced by them...." reported the Commisssion on 17 February 1880. Compare Humphreys and Abbot, *Physics and Hydraulics*, 412: "Direct measurements do not show that deposits occur in the river channel below the crevasses."

[20] The theory that an almost impervious Tertiary "blue clay" formed the bed of the river was introduced in the *Physics and Hydraulics*, 91-95, and was repeated by Humphreys throughout his life. This represented a serious underestimate of the depth of Quaternary sediments in the Delta.

[21] *Commission Proceedings*, II, 1 July 1887, 9; 30 June 1887, 2.

[22] Commission Proceedings, 2 October 1890, 10. "The work to be done, which is necessary to protect the (Atchafalaya) district from another inundation, should the water of '91 reach the line of the last flood, will cost in money far more, than we have or can expect to raise this year.... In spite of popular clamor, we have levied the extreme limit of taxation... which is claimed to be so onerous that mass meetings of the people are being called to protest against collection. It is true that the power to issue bonds has also been conferred upon (us), but owing to stringency here and in New York of the money market, we have failed to negotiate them." See *ibid.*, 12-23 and *passim*. The plea of navigation was sometimes still made, but was more often omitted, as in the plea quoted.

[23] *Laws Relating to Rivers and Harbors*, I, 577-578. A resolution appropriating $4 million to meet the spring flood of 1891 restored the clause forbidding levee construction for flood control, apparently in a purely formal and pietistic spirit, since the Commission had long grown adept in justifying any levee by the navigation criterion. Reasons for revival of the clause come down to this: levee opponents wanted the restriction, and proponents felt it did not matter.

[24] *Laws Relating to Rivers and Harbors*, I, 609: *Commission Proceedings*, 19 March 1891, 2-3. The revival brought forth some blunt talk from riparian politicians and local interests: the levee boards were burdened with debt; the restriction was not meant, and should not be taken, seriously. See *Commission Proceedings*, 15 July 1891, 11-19. The votes which followed indicated that the Commission agreed. *Ibid.*, 19-20. The proviso disappeared again in subsequent acts and was not revived.

[25] *Ibid.*, 1 October 1890, 1-9, 16.

[26] *Ibid.*, 29 November 1890, 19.

[27] *Ibid.*, 2 August 1892, 62-63.

[28] *Ibid.*, 11 January 1896, 296-297; *Laws Relating to Rivers and Harbors*, I, 785.

[29] *Index to Annual Reports* (1866-1912), I, 1085.

[30] C. H. Chorpening, "Waterway Growth in the United States," *Centennial Transactions of the American Society of Civil Engineers* (1953), 1024.

[31] Threat to sue, *Commission Proceedings*, 27 June 1894, 166; Weather Bureau bulletin quoted, Harrison, *Alluvial Empire*, 120.

[32] *Ibid.*, 123.

[33] *Ibid.*, 124.

[34] *Ibid.*, 159.

[35] John C. H. Lee, "A Flood Year on the Mid-Mississippi," *The Military Engineer* (July-August 1928), 306. This and other gage readings, by the way, indicated height above a standard low point. The zero, though supposed to represent extreme low water, was, in fact, a standardized benchmark and minus readings were occasionally reported. See Elliott, *Improvement of the Mississippi*, I, 76.

[36] *Ibid.*, 307. See also *House of Representatives Document 798*, 71 Congress, 3 Session (1931), 99.

[37] New York *Times*, 17 April 1927, 9.

[38] See Elliott, *Improvement of the Mississippi*, III, Plate XXVII, for a vivid picture of the rainfall distribution. Many areas contiguous to the river received from one third to one half their normal annual precipitation during these 2 months alone. Compare *ibid.*, Plate II. The heavy rains of the preceding fall and winter saturated the terrain and filled the natural reservoirs. Rainfall was worst in Arkansas, Missouri, Tennessee, and Louisiana, and the rains of December, January, and March were responsible for the three great "waves" of the flood, each following a month after the precipitation. See *House of Representatives Document 798*, 71 Congress, 3 Session (1931), 96 *et seq.* for a comprehensive statistical and descriptive summary of the flood.

[39] This was the "Good Friday rain" which some residents of the city still remember.

[40] New York *Times*, 19 April 1927, 1.

[41] *Ibid.*, 2.

[42] *Ibid.*, 20 April 1927, 7.

[43] The crevasses of 1927 had a combined length of 5.2 miles, and water escaping through them overflowed about 23,000 square miles of land. Elliott, *Improvement of the Mississippi*, I, 114.

[44] New York *Times*, 24 April 1927, 1.

[45] Lee, "A Flood Year on the Mississippi," 309.

[46] New York *Times*, 22 April 1927, 1.

[47] *Ibid*, 23 April 1927, 1.

[48] *Ibid.*, 24 April 1927, 1.

[49] *Ibid.*, 27 April 1927, 1.

[50] *Ibid.*, 30 April 1927, 1, 29.

[51] Estimates by the Secretary of War. *House of Representatives Document 90*, 70 Congress, 1 Session (1927), 2. The Mississippi Flood Control Association estimate of direct damages was $236,334,414.06. *Ibid.*, 10.

CHAPTER FOUR

[1] See for example Gifford Pinchot's testimony in *Hearings Before the Committee on Flood Control of the House of Representatives* (Washington: Government Printing Office, 1927), V, 3469-3472. These hearings were marked by extreme hostility to the Corps on the part of the chairman, Frank R. Reid of Illinois. Reference cited hereafter as *House of Representatives Flood Control Hearings* (1927-1928).

[2] The Jadwin Plan is given in *House Document 90*, 70 Congress, 1 Session (1927). The Commission plan was withheld from Congress by Jadwin, but was secured by the committee and printed as *House of Representatives Committee Document 1*, Committee on Flood Control, 70 Congress, 1 Session (1927). See also Elliott, *Improvement of the Mississippi*, II, 323. Jadwin's own version of the differences between the plans is given in *House of Representatives Flood Control Hearings* (1927-1928), V, 3581. The four Boards reporting to the Chief of Engineers were the Spillway, Diversion, Reservoir, and Navigation Boards. Jadwin considered the Mississippi River Commission a fifth "Board," on a level with the others.

[3] *Laws Relating to Rivers and Harbors*, III, 204 *et seq.* The act repeats the language of the Jadwin Plan to a remarkable extent. The definitive account of the Mississippi River and Tributaries Project is Norman P. Moore, *Improvement of the Lower Mississippi River and Tributaries, 1931-1972* (Vicksburg, Mississippi River Commission, 1972).

[4] *House of Representatives Document 90*, 70 Congress, 1 Session (1927), 4-5 and 24.

[5] *House of Representatives Document 798*, 71 Congress, 3 Session (1931), I, 5.

[6] *House of Representatives Document 90*, 70 Congress, 1 Session (1927), 6-7. Jadwin quoted in letter, Jadwin to Black, 23 December 1927, Box 892, NA, RG 77.

... The Jadwin Plan envisioned a total cost of $296.4 million, later raised by Congress to $325 million.

[8] Elliott, *Improvement of the Mississippi*, II, 291-292. Local interests were not always happy about the fuse-plug concept, or for that matter, about the Jadwin Plan. See *House of Representatives Flood Control Hearings* (1927-1928), V, 4768-4769, and *infra*.

[9] "The chief contentions against the Army Plan are that there is no necessity for floodways and backwater areas of such width and length as the Army Plan provides, and that it lacks provision for indemnification for property to be used, damaged, or destroyed in the areas to be taken over for floodways, backwater areas, and outlets." *Flood Control in the Lower Mississippi Valley, Report Submitted by the Board of State Engineers to his Excellency, Huey P. Long, Governor of the State of Louisiana, November 30, 1929* (n.p., n.d.), 5. The claim for indemnification was based on the fact that the people of the floodway had previously taken equal chances with the rest of the flood plain—i.e., the levees might crevasse anywhere. By raising the mainline levees and leaving the levees guarding the floodway entrances as they were (thereby converting them into "fuseplugs") the flood control plan insured that great floods would enter the floodway areas and no place else. See *ibid.*, 8-9 and *passim*. The Lousiana Board of State Engineers demanded indemnification for flowage rights, restriction of floodway use to only one of the proposed basins, continuous and adequate guide levees, and relocation of traffic arteries which traversed the floodway. *Ibid.*, 22-23. These, plus the demand for control structures in place of the fuseplugs, and the "widening of Berwick Bay sufficiently to discharge the additional floodwaters," were all substantially met by the future evolution of the flood program.

[10] *House of Representatives Document 90*, 70 Congress, 1 Session (1927), 3. This was vigorously opposed by local interests which secured total assumption of the burden by the Federal Government. See *Laws Relating to Rivers and Harbors*, III, 2005. However, the same paragraph of the Flood Control Act that provided for total Federal assumption of cost also declared for the principle of local contribution.

[11] Colonel Charles Potter, President of the Commission, was promoted and then ousted and replaced by Brigadier General T. H. Jackson, a move widely believed to have been engineered by Jadwin with the support of the White House to insure acceptance of the Jadwin Plan and to bring the Commission to heel. See *House of Representatives Document 90*, 70 Congress, 1 Session (1927), 33; references in note 2 of this chapter; biography of Potter in Scheufele, *North Pacific Division*, Appendix I.

[12] See Harrison, *Alluvial Empire*, 115-135, for a good brief account of floods from 1897 to 1927.

[13] *Ibid.*, 113 (chart).

[14] *Ibid.*, 122.

[15] See Elliott, *Improvement of the Mississippi*, II, 315 and 319 on extension of Commission authority.

[16] Shipman, "Mississippi River Commission," 90-101, gives a much less favorable view of the Commission's role comparing it only with what came after and not with what came before.

[17] Samuel P. Hays, *Conservation and the Gospel of Efficiency: The Progressive Conservation Movement*, 1890-1920 (New York: Atheneum, 1969); *House Document 308*, 69 Congress, 1 Session (1925); Ferrell, *From Single- to Multi-Purpose Planning, passim.*

[18] *Laws Relating to Rivers and Harbors*, III, 1703.

[19] The establishment of the Federal Barge Line played a large part in this revival. See *Mississippi River Navigation* (Vicksburg: Mississippi River Commission, 1970), 5. For present traffic see chart, *ibid.*, Appendix I. Chorpening, "Waterway Growth in the United States," 1025-1026, rightly sees the underlying causes of the revival in the needs of industry and a growing population. The war speeded a redevelopment of water commerce that would have occurred anyway.

[20] *Laws Relating to Rivers and Harbors*, III, 1903, Sec. 3.

[21] *Ibid.*, III, 2404, Sec. 1. This important act also redefined into its present form the responsibilities of local authority in works undertaken by the Federal

Government. See *ibid.*, 2405, Sec. 3.

[22] For a discussion of these points see Chapter Six.

[23] War Department General Order 15, Office of the Chief of Engineers, 7 October 1929, paragraphs 2 and 3.

[24] On the cutoff program see Brigadier General Harley B. Ferguson, *History of the Improvement of the Lower Mississippi River for Flood Control and Navigation, 1932-1939*. Pages 4-5 give a concise account of the Boeuf and Eudora Floodways.

[25] Bonnet Carré is shown as a church on the west bank, within the convex curve of the river, on the Bernard and Poussin map. The area identified with the name in recent years is the east bank, i.e., the concave arc of the bend where bank caving normally takes place. Here the river approaches to within 8 miles of Lake Pontchartrain. Pontchartrain, in turn, connects with the Gulf through Lake Borgne and the Mississippi Sound.

[26] Other crevasses occurred in 1948 and 1959. Elliott, *Improvement of the Mississippi*, II, 198.

[27] Humphreys and Abbot, *Physics and Hydraulics*, 422 *et seq.*; Ellet, *Mississippi and Ohio Rivers*, 170-180.

[28] *Laws Relating to Rivers and Harbors*, III, 1932. On the Comstock and Taylor proposals, see J. A. Ockerson and R. S. Taylor, *Outlets for Reducing Flood Heights* (St. Louis: MRC, 1914), 7, 43-45.

[29] The report of the Spillway Board is printed as *House of Representatives Document 95*, 70 Congress, 1 Session (1927).

[30] *House of Representatives Document 798*, 71 Congress, 3 Session (1931), is the prime source for the first years of the flood control program.

[31] *Ibid.*, 206.

[32] *Ibid.*, 207. Many photographs and plans of the work will be found following *ibid.*, 238.

[33] *Ibid.*, 206.

[34] *Ibid.*, 214 *et seq.*

[35] *Ibid.*, 207-214; 235.

[36] *Ibid.*, Plate III; *Annual Report* (1937), I, 1675.

[37] *Annual Report* (1937), I, 1678.

[38] By comparison, the project flood was visualized as consisting of 2.2 million second-feet from the Ohio and 250,000 from the upper river; or by a different rainfall distribution, 1.45 million from the Ohio and 1 million from the upper river. The 1937 flood was, therefore, about 82 percent of the project flood at Cairo.

[39] *Annual Report* (1937), I, 1679; *Commission Proceedings* (1932-1939), II, 5228-5235.

[40] *Annual Report* (1937), I, 1743; 1679.

[41] *Ibid.*, 1744.

[42] *Ibid*, 1678.

[43] Harold N. Fisk, *Geological Investigation of the Atchafalaya Basin and the Problem of Mississippi River Diversion*, I, 8-9.

[44] *Ibid.*, 17-18; 65-68.

[45] William Sommer, "Atchafalaya Basin Levee Construction," Unpublished Master's Thesis (Tulane University, 1966), 8-9.

[46] *Commission Report* (1881), 131.

[47] Quoted in *Commission Report* (1881), 130.

[48] See Chapter One.

[49] Fisk, *Geological Investigation of the Atchafalaya*, 122.

[50] *Annual Report* (1880), Pt. II, 1295; (1881), Part II, 1391-1392; *Annual Report* (1888), Pt. IV, 2294 *et seq.* On Eads' resignation, see Dorsey, *Road to the Sea*, 264.

[51] The Atchafalaya is leveed for 52 miles south of Old River junction. Fisk, *Geological Investigation of the Atchafalaya*, 9. The western rim of the basin (the Teche ridge) and the eastern rim (the Lafourche-Mississippi ridge) were to be leveed and closed by fuseplugs at the northern ends. Thus, three channels were to be created: the Atchafalaya itself, and the West and East Atchafalaya Floodways, the last two to be used during great floods only. Despite the significant changes introduced by the building of the Morganza Floodway and Control Structure in place of the East Floodway, this pattern remains the basic form of the Atchafalaya diversion system.

The floodways converge below the leveed portion of the river, where the whole basin becomes a single flood channel.

[52] Fisk, *Geological Investigation of the Atchafalaya*, 141.

[53] Rodney A. Latimer and Charles W. Schweizer, *The Atchafalaya River Study* (Vicksburg: Mississippi River Commission, 1951), 35. In 1970 some eastward flow was again observed, for the first time in 28 years. Interview with Jefferson L. Smith, Chief of Construction Division, New Orleans District.

[54] *Ibid.*, 43, 47. Ironically, the Chief of Engineers and the Mississippi River Commission reported favorably on a scheme to enlarge Old River for navigation the same year. See *Senate Document 53*, 82 Congress, 1 Session (1951).

[55] Fisk, *Geological Investigation of the Atchafalaya*, 141. A critical period occurs in the deterioration of a channel,

when the water velocity drops too low to carry sand. The rapid precipitation which follows blocks the channel with a "sand plug" after which filling is rapid and well-nigh irreversible.

[56] See the series of articles by B. L. Krebs in New Orleans *Times-Picayune*, 20-23 September 1953.

[57] Sommer, "Atchafalaya Basin Construction," *passim*. Sommer was Assistant Chief of the Design Branch in the New Orleans District.

[58] Interview with Herbert Juneau, Lafayette, La., 1971.

[59] Interview with Warren B. Dodd, New Orleans, La., 1971, and Herbert Juneau, Lafayette, La., 1971.

[60] Interview with George H. Hudson, New Orleans, La. 1971.

[61] Washington *Post*, 4 April 1973.

[62] New York *Times*, 5 April 1973.

[63] Washington *Post*, 6 April 1973.

[64] *Ibid.*, 9 April 1973.

[65] *AP Bulletin* PD 1045 AES 4/9; New Orleans *Times-Picayune*, 9 April 1973.

[66] New Orleans *States-Item*, 11 April 1973.

[67] *AP Bulletin* SR 1043 AES 4/17.

[68] Quoted in *Ibid.*

[69] *UPI Bulletin* 09: 32 AES 4/18.

[70] *UPI Bulletin 08: 49 AES 4/20.*

[71] *UPI Bulletin* 09: 37 AES 4/23.

[72] Washington *Post*, 28 April 1973.

[73] *UPI Bulletin* 09: 37 AED 5/7.

[74] See *Christian Science Monitor*, 22 May 1973.

[75] *U. S. News and World Report*, 23 April 1973.

[76] Jacksonville (Ill.) *Journal*, 24 May 1973.

[77] Jackson *Clarion-Ledger*, 6 May 1973.

[78] *Christian Science Monitor*, 31 May 1973.

CHAPTER FIVE

[1] The district apparently did not have firm boundaries, but was assigned projects in a region that generally included the Sabine basin but excluded the Mississippi and Red. See for example *Annual Report* (1902), 329 *et seq.* On coast defenses, citations in *Index to Annual Reports*, II, 1979-1982.

[2] Scheufele, *North Pacific Division*, 1.

[3] Creation of Divisions, *Annual Report* (1889), 16; assignment of New Orleans to Southeast Division, *ibid.*, 194.

[4] Creation of Gulf Division, *Annual Report* (1902), 62; assignment of Adams, above and *ibid.*, 310.

[5] *Ibid.*, 315-316.

[6] *Senate Document 1*, 19 Congress, 2 Session (1826), 217; *House of Representatives Document 185*, 22 Congress, 1 Session (1831-1832), 53-54. See also *Annual Report* (1876) 514. On the Florida Canal, see Henry E. Barber, "The History of the Florida Cross-State Canal," Ph. D. Dissertation, University of Georgia, 1969.

[7] *Treasury Document 373* (1882) cited in *Index to the Annual Reports* (1866-1912), I, 623-624.

[8] *Annual Report* (1876), 511-514, 523.

[9] *Ibid.*, 508-511.

[10] *Index to the Annual Reports* (1866-1912), 623-624.

[11] *Laws Relating to Rivers and Harbors*, I, 219.

[12] *Annual Report* (1873), 66.

[13] This officer is an intriguing figure in many ways. His life was short (he died in 1882, when he was only 40) and his projects by and large were unsuccessful. Yet he planned the canal to the Gulf, directed the first surveys of the Gulf Intracoastal Waterway, and experimented with the mattress revetment for the harbor of New Orleans.

[14] *Annual Report* (1875), 875.

[15] *Ibid.*, 876.

[16] *Ibid.*, 877-80. Pages 876-900 contain the first thorough study for the route of the western Intracoastal Waterway.

[17] *Laws Relating to Rivers and Harbors*, II, 1127.

[18] *House of Representatives Document 640*, 59 Congress, 2 Session (1902), 7. On the origins of the Louisiana oil and sulfur industries, see C. Vann Woodward, *Origins of the New South, 1877-1913* (Baton Rouge: Louisiana State University Press, 1951, 1971), 303-304.

[19] *Ibid.*, 2, 9; "United States Inland Waterways: Existing and Proposed Routes. Compiled from maps accompanying report of Board of Eng'rs. dated Feb. 1, 1910 and other sources," New Orleans District Library. The Engineer Board which reported on the Florida-Rio Grande section of the national Intracoastal Waterway recommended following one of these canals on grounds of cost. *House of Representatives Document 610*, 63 Congress, 2 Session (1914), 40.

[20] George D. Waddill, then a junior engineer with the New Orleans District, left a description of his part in these surveys. "Memorandum from Mr. Chas. Senour. Subject: Survey of Gulf Intracoastal Waterway—1907," George D. Waddill Papers, New Orleans District Library.

[21] *House of Representatives Document 610*, 63 Congress, 2 Session (1914), 32; *Laws Relating to Rivers and Harbors*, II, 1242.

[22] *Annual Report* (1912), Pt. 1, 659; *ibid.* (1909), 1468.

[23] *Annual Report* (1917), Pt. II, 2551.

[24] *Laws Relating to Rivers and Harbors*, II, 1352 *et seq.*

[25] In 1907 Edgar Jadwin, future Chief of Engineers, wrote: "The Mississippi river seems to be started on its proper function, as far as transportation is concerned, of carrying heavy articles to relieve the railroads, and doing it more economically." He viewed the western Intracoastal Waterway as a logical way to develop this function, and he felt that the region west of the Mississippi, with its longer distances and higher freight rates, would especially benefit from the development of waterways for bulk transport. See *House of Representatives Document 640*, 59 Congress, 2 Session (1907), 26-27 and *passim*.

[26] *Laws Relating to Rivers and Harbors*, III, 1869.

[27] *Ibid.*, III, 1879.

[28] *House of Representatives Document 238*, 68 Congress, 1 Session (1924), 6-7. On the IWC, see Edwin A. Leland, Jr., "An Administrative History of the Inland Waterways Corporation," Ph. D. Dissertation, Tulane University, 1960.

[29] Article "Houston," *Encyclopedia Brittanica* (Chicago: The Encyclopedia Brittanica, Inc., 1939), XI, 844-845; *House of Representatives Document 582*, 87 Congress, 2 Session (1962), 3.

[30] *House of Representatives Document 238*, 68 Congress, 1 Session (1924), 7-8 and accompanying maps and charts.

[31] *Ibid.*, 11.

[32] *Mississippi River Navigation*, 19.

[33] *Laws Relating to Rivers and Harbors*, III, 1899.

[34] *Annual Report of the New Orleans District* (1926), 871.

[35] *Annual Report of the Chief of Engineers* (1930), 5.

[36] *Ibid.* (1931), 5.

[37] *Ibid.* (1968), 409-412.

[38] *Mississippi River Navigation*, Appendix A.

[39] See Chapter Two.

[40] Biographical information obtained for Historical Division, Office of the Chief of Engineers, P. O. Box 1715, Baltimore, Md. 21203.

[41] *Annual Report* (1878), Pt. I, 614-617

[42] *Laws Relating to Rivers and Harbors*, I, 271.

[43] *Annual Report* (1879), 875-878.

[44] *Commission Proceedings*, 18 September 1882, 19.

[45] *Commission Proceedings*, 8 November 1893, 150; 22 July 1897, 442. The Orleans Levee Board applied for Commission funds but was evidently refused.

[46] *Commission Proceedings*, 30 November 1897, 498; 11 December 1898, 515. See also *Maps of the Mississippi River* (Vicksburg: Mississippi River Commission, 1936), Map 46.

[47] Cf. *Commission Proceedings*, 2 September 1886, 18; 21 September 1888, 13; 24 September 1888, 24; December 1888, 13; 28 December 1888, 5; 1 July 1896, 360.

[48] See Chapter III, *Commission Proceedings*, 16 March 1897, 419-420.

[49] See *Senate Document 36*, 87 Congress, 1 Session (1961), *passim*.

[50] On early efforts by New Orleans to secure a river-lake connection see *Laws Relating to Rivers and Harbors*, I, 20; *Annual Report* (1868), 486-496. Such a connection, resembling the Industrial Canal, was seen as a part of an intracoastal waterway system by Brigadier General Simon Bernard in 1826. See Note 6, this chapter.

[51] *Commission Proceedings*, 1 November 1908, 1449-1450; 25 November 1970; *Annual Report* (1925), 810-911.

[52] *Laws Relating to Rivers and Harbors*, III, 1811.

[53] *House of Representatives Committee Document 46*, Committee on Rivers and Harbors, 71 Congress, 2 Session (1930), 1.

[54] *Ibid.*, 1-2.

[55] *Ibid.*, 3. But see *House of Representatives Committee Report 46*, Committee on Rivers and Harbors, 71 Congress, 2 Session (1930).

[56] *Annual Report* (1948), 1040; *House of Representatives Document 96*, 79 Congress, 1 Session (1942).

[57] *House of Representatives Document 245*, 82 Congress, 1 Session (1951) 1, 6.

[58] The Bureau of the Budget represented local contributions as amounting to only about nine-tenths of one percent, which may have been accurate with regard to direct costs but did not reflect the whole burden of the locality. The Chief of Engineers required that local interests supply all rights-of-way, maintain a projected highway bridge over the Outlet (a bridge whose construction had already been authorized for the eastern Intracoastal Waterway), hold the United States free from all claims for damages, and "construct, maintain and operate terminal facilities commensurate with requirements for the expanded port." *Ibid.*, 5.

[59] *Ibid.*, 2-3.

[60] See speeches by Senators Russell Long and Allen Ellender, *Congressional Record*, 84 Congress, 2 Session (1956), CII, Pt. 4, 5027.

[61] Public Law 84-455; New York *Times*, 14 May, 20 January, 19 January 1954.

[62] *House of Representatives Document 740*, 63 Congress, 2 Session (1914), I, 681-688.

[63] During 1898-1909 the Corps improved Bayou Plaquemine as a connection to the Mississippi, providing it with a lock at the town of Plaquemine a few miles south of Baton Rouge. See *Annual Report* (1898), 1471; *Annual Report* (1909), 1460. This link has now been discontinued.

[64] Article "Lake Charles," *Encyclopedia Brittanica* (Chicago: The Encyclopedia Brittanica, Inc., 1939), XIII, 601.

[65] *House of Representatives Document 46*, 46 Congress, 3 Session (1871); *Annual Report* (1881), 1301.

[66] *House of Representatives Document 299*, 75 Congress, 1 Session (1937).

[67] *Annual Report* (1941), 863.

[68] The lock was built to protect the basin of the Mermentau from saltwater intrusion.

CHAPTER SIX

[1] War Department, Office of the Chief of Engineers, General Order 15, 7 October 1929, Pars. 2 and 3. Mississippi River Commission Library, Vicksburg, Miss.

[2] *Annual Report* (1941), 798. The change occurred on 1 November 1940, Lieutenant Colonel Clark Kittrell of the Second New Orleans District becoming Engineer of the combined District.

[3] Interview with George H. Hudson, 1970.

[4] Ms. District History, in "Historical Summaries of Public Works," Mississippi River Commission Library. See also *Annual Report* (1941), 5; Blanche D. Coll *et al.*, *The Corps of Engineers: Troops and Equipment* (Washington: Government Printing Office, 1958), 9 *et seq.*

[5] Interview with George H. Hudson, 1970.

[6] See Public Law 71, 84 Congress, 1 Session, 15 June 1955.

[7] *Hurricane Study: History of Hurricane Occurrence Along Coastal Louisiana* (New Orleans: U. S. Army Engineer District, 1961), 1-34. See also Dumont de Montigny, *History of Louisiana*, 24 *et seq.*; Issac Monroe Cline, *Tropical Cyclones* (New York, 1955), 24-25; and Harrison, *Alluvial Empire*, 43.

[8] The Federal Disaster Act of 1950 (64 *Stat.* 1109) authorized the President to proclaim disaster areas and made a variety of assistance available to the victims.

[9] *House of Representatives Document 231*, 89 Congress, 1 Session (1965), 46-47.

[10] *Ibid.*, 47.

[11] *Hurricane Betsy, September 8-11, 1965* (New Orleans: U. S. Army Engineer District, 1965), *passim*; Public Law 89-298, 27 October 1965 (79 *Stat.* 1073).

[12] See *Annual Report* (1968), 427. Compare map of Hurricane Camille's flooding pattern, in *Report on Hurricane Camille* (New Orleans: U. S. Army Engineer District, 1970), Exhibit 49, with *Hurricane Betsy*, Plates 5-11. On south Louisiana, see *Hurricane Camille*, Exhibits 46-47.

[13] Public Law 99-84 as amended by Section 206 of 33 U. S. Code 701n (the Flood Control Act of 1962) deals with Corps duties during emergencies. Public Law 875-81 deals

with disaster planning and relief before and after such emergencies.

[14] See *Engineer Regulation 500-1-1*, 1 September 1967, as amended.

[15] *Ibid.*, Pars. 22.10-22.13.

[16] *Ibid.*, Par. 22.33.

[17] *Ibid.*, Par. 22.412.

[18] *Hurricane Betsy*, 8.

[19] The brief sketch given here refers only to the immediate period of the disaster. The Coast Guard, the Department of Health, Education and Welfare, the General Services Administration, the Federal Housing Administration, the Small Business Administration, the Department of Labor, the Federal Bureau of Investigation, and a variety of other agencies may become involved in the complicated problems resulting from the destruction of property and the dangers of public health and safety that follow a storm. See e.g. *Hurricane Betsy*, 12-13.

[20] Interview with Milton Rider, 1971.

[21] *Annual Report* (1909), 511.

[22] See Chapter One.

[23] *Annual Report* (1909), 511. See also *Annual Report* (1893), 1908 and the remarkable map in *Annual Report* (1882), 1542.

[24] *Annual Report* (1882), 1540.

[25] *Annual Report* (1893), 1902-1904. References to specific acts of Congress will be found in *Annual Report* (1909), 511-512.

[26] *Ibid.*, 512; *Laws Relating to Rivers and Harbors*, I, 632. For the "plan of Captain Willard" mentioned in the law, see *Annual Report* (1892), 1905, which gives the general principles on which the Vicksburg Engineer Office proposed to treat the Red.

[27] *Ibid.*, 513.

[28] See the following citations in the *Annual Reports*: (1911), 624; (1913), 2314; (1914), 2361; (1915), 2692; (1916), 2539; (1917), 2626.

[29] *Annual Report* (1921), 888; (1924), 941.

[30] *Comprehensive Basin Study: Red River Below Denison Dam* (New Orleans: U. S. Army Engineer District, 1968), II, Appendix I, 4-5; I, 81.

[31] Cited in Irving K. Fox and Isabel Picken, *The Upstream-Downstream Controversy in the Arkansas-White-Red Basins Survey*, Inter-University Case Program No. 55 (Indianapolis and New York: Bobbs-Merrill, 1960), 5. On reservoirs, see 49 *Stat.* 1570; 60 *Stat.* 647; *Annual Report* (1956), I, 627.

[32] *Ibid.*, 5-6 and *passim.*

[33] The Federal agencies were the Corps, the Federal Power Commission, and the Departments of Agriculture, Commerce, Health, Education and Welfare, and Interior. The chairman was Colonel Thomas J. Bowen, New Orleans District Engineer. Much of the practical work must be credited to Frederic M. Chatry, currently Chief of Engineering Division of the New Orleans District. The interim plan owed much to the work of Jerome C. Baehr and John Gentilich.

[34] 82 *Stat.* 731; *H. Doc. 304*, 90th Congress.

[35] *Red River Study*, I, 90-91; 115.

[36] "In 1969 the Arkansas River Waterway carried two and a quarter million tons of commerce, even though it was in operation only about 8 months of the year. This past year of 1970, the tonnage was almost 3-1/2 million. During the year, the amount of new jobs created so far... is well over 13,000." Remarks by Lieutenant General F. J. Clarke, Chief of Engineers, at Water Resources Associated, Chicago, Illinois., 31 January 1971.

[37] Raymond F. Dasmann *et al.*, *Environmental Impact of the Cross-Florida Barge Canal with Special Emphasis on the Oklawaha Regional Ecosystem* (Gainesville: Florida Defenders of the Environment, 1971), III.

[38] *House of Representatives Document 251*, 89 Congress, 1 Session (1965), 4.

[39] See *House of Representatives Document 582*, 87 Congress, 2 Session (1962), vii-viii. On cost-sharing, see *House of Representatives Document 169*, 88 Congress, 1 Session (1963), *passim.*

[40] Interviews with Herbert Juneau, Lafayette Area Engineer, 1971; A. H. Davis, Calcasieu Lockmaster, 1971; and Warren B. Dodd, 1971. See also *A Detailed Report on Hurricane Study Area No. 1: Lake Pontchartrain and Vicinity, Louisiana* (Atlanta, 1962).

[41] *Laws Relating to Rivers and Harbors*, II, 888.

[42] Fish and Wildlife Coordination Act, 72 *Stat.* 563; NEPA, 83 *Stat.* 852; WPCA Amendments, 86 *Stat.* 816.

[43] See Albert E. Cowdrey, "Pioneering Environmental Law: The U. S. Army Engineers and the Refuse Act," *Pacific Historical Review, XLIV* (1975), 331-349.

BIBLIOGRAPHY

1. MANUSCRIPT MATERIALS

Engineers, Corps of. Buell Collection, Record Group 77, National Archives.

—. Letters of Captain W. H. Chase, Record Group 77, National Archives.

—. Monthly Returns, 1818-1879, Record Groups 77 and 94, National Archives.

—. Selected Documents Pertaining to the Investigation of Flood Control on the Mississippi River (1928). Record Group 77, National Archives.

Engineers, Topographical, Bureau of. Returns. 1831-1863. Record Group 77, National Archives.

New Orleans Engineer District. Unpublished History. In file "Historical Summaries of Civil Works," Mississippi River Commission Library, Vicksburg, Mississippi.

—. George D. Waddill Papers, New Orleans District Library.

War Department. Letters Sent, Volume 2. Record Group 107, National Archives.

Unpublished Theses

Leland, Edwin A., Jr. "An Administrative History of the Inland Waterways Corporation," Ph. D. Dissertation, Tulane University, 1960.

Shipman, Martha Virginia. "The Mississippi River Commission." M.A. Thesis, University of Arkansas, 1937.

Sommer, William Everett. "Atchafalaya Basin Levee Construction." M.A. Thesis, Tulane University, 1966.

2. GOVERNMENT DOCUMENTS

Fish and Wildlife Service, U. S. Department of the Interior. *A Detailed Report of Hurricane Study Area No. 1: Lake Pontchartrain and Vicinity, Louisiana.* Atlanta: Fish and Wildlife Service, 1962.

Louisiana, Board of State Engineers of. *Flood Control in the Lower Mississippi Valley. Report Submitted by the Board of State Engineers to His Excellency, Huey P. Long, Governor of the State of Louisiana, November 30, 1929.* n.p., n.d.

Mississippi River Commission. *Maps of the Mississippi River.* Vicksburg: Mississippi River Commission, 1936.

—. *Proceedings*, 1879-1939.

New Orleans Engineer District. *Annual Reports, 1877-1936.* n.p., n.d.

—. *Comprehensive Basin Study: Red River Below Denison Dam.* Summary Report. 8 Vols. New Orleans: U. S. Army Engineer District, 1968.

—. *Hurricane Betsy.* New Orleans: U. S. Army Engineer District, 1965.

—. *Hurricane Hilda*, 3-5 October 1964. New Orleans: U. S. Army Engineer District, May 1966.

—. *Hurricane Study: History of Hurricane Occurrences Along Coastal Louisiana.* New Orleans: U. S. Army Engineer District, 29 December 1961.

—. *Report on Hurricane Camille, 14-22 August 1969.* New Orleans: U. S. Army Engineer District, May 1970.

—. *Report on Hurricane Carla, 9-14 September 1951.* New Orleans: U. S. Army Engineer District, May 1962.

United States Army Corps of Engineers. *Annual Reports of the Chief of Engineers, 1866-1968.*

—. *Index to the Reports of the Chief of Engineers, U. S. Army (Including Reports of the Isthmian Canal Commission, 1899-1914), 1866-1912.* 2 Vols. Washington: Government Printing Office, 1915.

United States Congress. *Proceedings of Congress.* 18 Congress, 1 Session (1824).

—. *Congressional Record.* 43 Congress, 2 Session (1875); 46 Congress, 1 Session (1879); 84 Congress, 2 Session (1956), CII.

United States Government. *Laws of the United States Relating to the Improvement of Rivers and Harbors*. 3 Vols. Washington: Government Printing Office, 1940.
United States House of Representatives. *Committee Document 1*. Committee on Flood Control, 70 Congress, 1 Session (1927).
—. *Committee Document 46*. Committee on Rivers and Harbors, 71 Congress, 2 Session (1930).
—. *Committee Print No. 14*. 87 Congress, 1 Session (1961).
—. *Document 2*. 16 Congress, 2 Session (1820).
—. *Document 2*. 20 Congress, 1 Session (1827).
—. *Document 125*. 20 Congress, 1 Session (1827).
—. *Document 185*. 22 Congress, 2 Session (1831-1832).
—. *Document 1*. 22 Congress, 2 Session (1832).
—. *Executive Document 16*. 33 Congress, 1 Session (1852).
—. *Executive Document 16*. 33 Congress, 1 Session (1854).
—. *Executive Document 59*. 31 Congress, 1 Session (1848).
—. *Document 56*. 39 Congress, 3 Session (1866).
—. *Document 46*. 46 Congress, 3 Session (1871).
—. *Executive Document 187*. 42 Congress, 3 Session (1873).
—. *Executive Document 220*. 43 Congress, 1 Session (1874).
—. *Executive Document 114*. 43 Congress, 2 Session (1875).
—. *Executive Document 12*. 44 Congress, 2 Session (1876).
—. *Executive Document 58*. 46 Congress, 2 Session (1880).
—. *Document 91*. 55 Congress, 3 Session (1898).
—. *Document 640*. 59 Congress, 2 Session (1907).
—. *Document 610*. 63 Congress, 2 Session (1914).
—. *Document 238*. 68 Congress, 1 Session (1924).
—. *Executive Document 90*. 70 Congress, 1 Session (1927).
—. *Document 95*. 70 Congress, 1 Session (1927).
—. *Document 798*. 75 Congress, 3 Session (1931).
—. *Document 299*. 75 Congress, 1 Session (1937).
— *Document 96*. 79 Congress, 1 Session (1942).
—. *Document 37*. 85 Congress, 1 Session (1956).
—. *Document 582*. 87 Congress, 2 Session (1962).
—.*Document 169*. 88 Congress, 1 Session (1963).
—. *Document 251*. 89 Congress, 1 Session (1965).
—. *Document 304*. 90 Congress, 2 Session (1968).
—. *Flood Control: Hearings Before the Committee on Flood Control*. House of Representatives, Seventieth Congress, First Session, on the Control of the Destructive Flood Waters of the United States. In 7 parts. Washington: Government Printing Office, 1928.
—. *Document 740*. 63 Congress, 2 Session (1914).
—. *Report 44*. 42 Congress, 2 Session (1872).
—. *Report 88*. 34 Congress, 1 Session (1956).
—. *Report 494*. 44 Congress, 1 Session (1876).
United States Senate. *Document 1*. 19 Congress, 2 Session (1826).
—. *Executive Document 17*. 31 Congress, 2 Session (1851).
—. *Executive Document 20* 32 Congress, 1 Session (1852).
—. *Executive Document 8*. 40 Congress, 1 Session (1866).
—. *Miscellaneous Document 8*. 41 Congress, 1 Session (1869).
—. *Miscellaneous Document 3*. 42 Congress, Special Session (1871).
—. *Executive Document 95*. 45 Congress, 2 Session (1878).

3. BOOKS AND ARTICLES

Chase, John. *Frenchmen, Desire, Goodchildren, and Other Streets of New Orleans*. New Orleans: Crager, 1949, 1960.
Chevalier, Michel. *Society, Manners and Politics in the United States*. Boston: Weeks, Jordan, 1839.
Chorpening, C. H. "Waterway Growth in the United States," *Centennial Transactions of the American Society of Civil Engineers* (1953).
Cline, Issac Monroe. *Tropical Cyclones, Comprising an Exhaustive Study Along Entirely New Lines of...Sixteen Tropical Cyclones Which Have Moved in on the Gulf and South Atlantic Coasts... 1900 to 1924 Inclusive....* New York: The Macmillan Company, 1926.
Corthell, E. L. A History of the *J River*. New York: John Wiley & Sons, 1881.
Darby, William. *A Geographical Description of the State of Louisiana*. Philadelphia: John Melish, 1816.

Dasmann, Raymond F. et al. *Environmental Impact of the Cross-Florida Barge Canal, with Special Emphasis on the Oklawaha Regional Ecosystem*. Gainesville: Florida Defenders of the Environment, 1971.
Dorsey, Florence. *Road to the Sea: The Story of James B. Eads and the Mississippi River*. New York and Toronto: Rinehart, 1947.
Dumont de Montigny. *History of Louisiana*. In French, B. F., *Historical Collections of Louisiana*. New York: Lamport, Blakeman & Law, 1853.
Ellet, Charles. *The Mississippi and Ohio Rivers: Containing Plans for the Protection of the Delta*.... Philadelphia: Lippincott, Grambo & Co., 1853.
Elliott, D. O. *The Improvement of the Lower Mississippi River for Flood Control and Navigation*. 3 Vols. Vicksburg: Mississippi River Commission, 1932.
Ferguson, Harley B. *History of the Improvement of the Lower Mississippi River for Flood Control and Navigation, 1932-1939*. Vicksburg: Mississippi River Commission, 1940.
Fisk, Harold N. *Geological Investigation of the Mississippi Alluvial Valley*. Vicksburg: Mississippi River Commission, 1944.
Fox, Irving K. and Picken, Isabel. *The Upstream-Downstream Controversy in the Arkansas-White-Red Basins Survey*. Inter-University Case Program No. 55. Indianapolis and New York: Bobbs-Merrill, 1960.
Friedkin, J. F. *A Laboratory Study of the Meandering of Alluvial Rivers*. Vicksburg: Waterways Experiment Station, 1945.
Harrison, Robert W. *Alluvial Empire*. Little Rock: Pioneer Press, 1961.
Hearn, Lafacadio, *Chita*. New York: Harper & Brothers, 1889.
Hill, Forrest, G. *Roads, Rails & Waterways: The Army Engineers in Early Transportation*. Norman: The University of Oklahoma Press, 1957.
Holt, W. Stull. *The Office of the Chief of Engineers of the Army: Its Non-Military History, Activities and Organization*. Andrew A. and Abbott, Henry L. "Reply to Criticisms made by Dr. Hagen," Van Nostrand's Eclectic Engineering Magazine, XVIII (January 1878).
—. *Report upon the Physics and Hydraulics of the Mississippi River*. Washington: Government Printing Office, 1876.
Hunter, Louis C. *Steamboats on the Western Rivers: An Economic and Technological History*. New York: Octagon Press, 1969.
Hennepin, Louis. *Description de la Louisiane, nouvelle decouverte*. Paris: Chez la veuve Sebastein Huré, 1683.
Kmen, Harry (Henry M.). "New Orleans' Forty Days in '49," *The Louisiana Historical Quarterly*, XL (January 1957).
Koll, Blanche D. and Keirh, Jean. *The Corps of Engineers: Troops and Equipment*. Washington: Government Printing Office, 1958.
Latimer, Rodney A. and Schweizer, Charles W. *The Atchafalaya River Study*. 3 Vols. Vicksburg: Mississippi River Commission, 1951.
Lee, John C. H. "A Flood Year on the Mid-Mississippi," *The Military Engineer* (July-August 1928).
Le Page du Pratz. *The History of Louisiana*. New Orleans: J.S.W. Harmanson, 1947. Reprint of English translation London: T. Becket and T.A. de Font, 1774.
McHenry, Estill, ed. *Addresses and Papers of James B. Eads, Together with a Biographical Sketch*. St. Louis: Slawson & Co., Printers, 1884.
Merritt, Raymond H. *Engineering in American Society, 1850-1875*. Lexington: The University Press of Kentucky, 1969.
Mississippi River Commission. *Flood Control in the Lower Mississippi Valley*. Vicksburg: The Mississippi River Commission, 1969.
—. *Mississippi River Navigation*. Vicksburg: The Mississippi River Commission, 1970.
Mississippi River Improvement Convention, St. Paul, Minn., 1877. *Give Us an Unobstructed Mississippi. A Memorial to Congress to Secure an Adequate Appropriation*. St. Louis: J.J. Daly & Co., Printers, 1877.
Mississippi River Flood Control Association. *Losses and Damages Resulting from the Flood of 1927*. Memphis: Mississippi River Flood Control Association, n.d.
Mississippi River Improvement Convention, St. Louis, 1881. *Official Report of the Proceedings of the Convention*. St. Louis: Great Western Printing Co., 1881.
Mississippi River Improvement Convention, Washington, D. C., 1884. *Proceedings of the Convention*, Washington: n. pub., 1884.
Moore, Norman R. *Improvement of the Lower Mississippi River and Tributaries, 1931-1972*. Vicksburg: Mississippi River Commission, 1972.
Penicaut, M. *Annals of Louisiana from 1698 to 1722*. In French, B.F., *Historical Collections of Louisiana and Florida*. New York: J. Sabin & Sons, 84 Nassau Street, 1869.
Red Cross, American National. *The Mississippi Valley Flood Disaster of 1927*. Washington: n. pub., 1929.
Scheufele, Roy W. *The History of the North Pacific Division, U. S. Army Corps of Engineers, 1888 to 1965*. Portland: The North Pacific Division, 1969.
Taylor, Joe Gray. *Louisiana Reconstructed, 1863-1877*. Baton Rouge: Louisiana State University Press, 1974.
Tiffany, Joseph B. ed. *History of the Waterways Experiment Station (to) 1 June 1968*. Vicksburg: The Waterways Experiment Station; 1968.
Twain, Mark. *Life on the Mississippi*. In *The Favorite Works of Mark Twain*. New York: Garden City, 1939.
Weathersbee, Christopher. "The New Corps," *Science News*, XCV (1 February 1969).
White, Gilbert F., et al. *Changes in the Urban Occupance of Flood Plains in the United States*. Chicago: The University of Chicago Press, 1958.
Williams, T. Harry. *P.G.T. Beauregard, Napoleon in Gray*. Baton Rouge: Louisiana State University Press, 1954.
Woodward, C. Vann. *Origins of the New South, 1877-1913*. Baton Rouge: Louisiana State University Press, 1951-1971.

4. NEWSPAPERS

New Orleans *Democrat*. 1876.

New Orleans *States-Item*. 1971.

New Orleans *Times-Picayune*. 1953.

New York *Times*. 1927, 1954.

Wall Street *Journal*. 1971.

APPENDIX I

DISTINGUISHED CIVILIAN EMPLOYEES OF NEW ORLEANS DISTRICT[1]

Nicholas Balovich ..... Construction Superintendent, Operations Division
Robert N. Bruce ..... Chief, Construction Division
Anna R. Carey ..... Administrative Assistant, Operations Division
Horace L. Dear ..... Chief, Navigation Branch
Fernando Estopinal, Jr. ..... Area Engineer, New Orleans Area Office
George H. Hudson ..... Chief, Engineering Division
Herman Huesmann ..... Chief, Foundations & Materials Branch, Engineering Division
Lizzamond A. Jeanfreau ..... Navigation Specialist, Operations Division
John E. Kennedy ..... Assistant Chief, Operations Division
Robert A. Schaneville ..... Personnel Officer
W. B. Smith ..... Chief, Operations Division
Horace A. Thompson ..... Chief, Operations Division
Herbert L. Williams ..... Supervisory Structural Engineer

[1] These are distinguished civilian employees who have been singled out by the New Orleans District for recognition. All are now retired, and were associated with the District's work during the past generation.

INDEX


GEN. JOHN NEWTON
CORPS OF ENGINEERS