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.

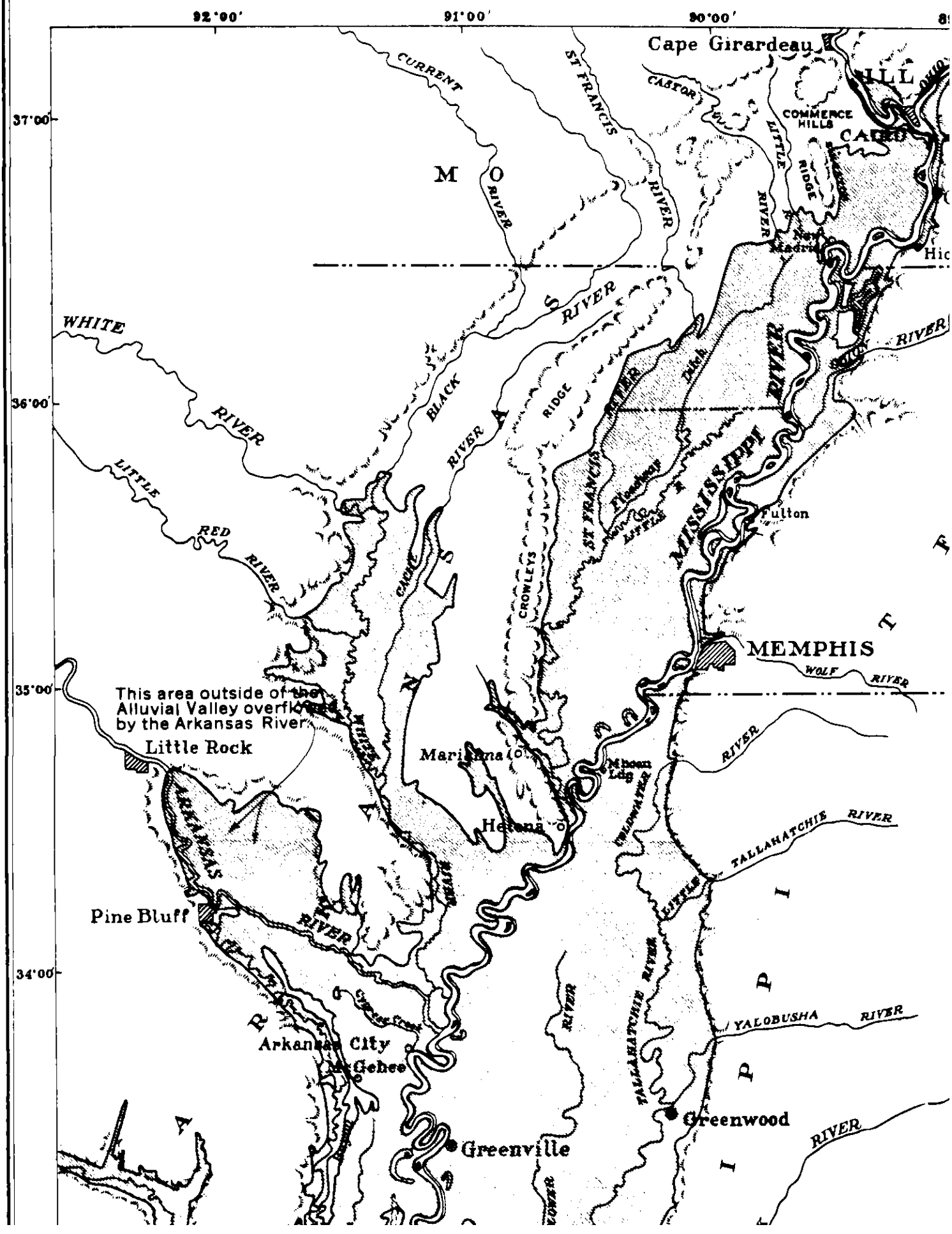
On 26 April, late in the evening, Governor Oramel H. Simpson ordered the levee to be cut at Poydras Plantation, below the city. One hundred thousand acres were expected to be flooded, the water eventually to find an outlet through natural drains into Lake Borgne and the Gulf of Mexico. The evacuation 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]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CROWLEYS RIDGE
MEMPHIS
This area outside of the Alluvial Valley overflowed by the Arkansas River
Little Rock
Marianna
Helena
Mhoon Ldg
TALLAHATCHIE RIVER
Pine Bluff
ARKANSAS RIVER
Arkansas City
McGehee
YALOBUSHA RIVER
Greenville
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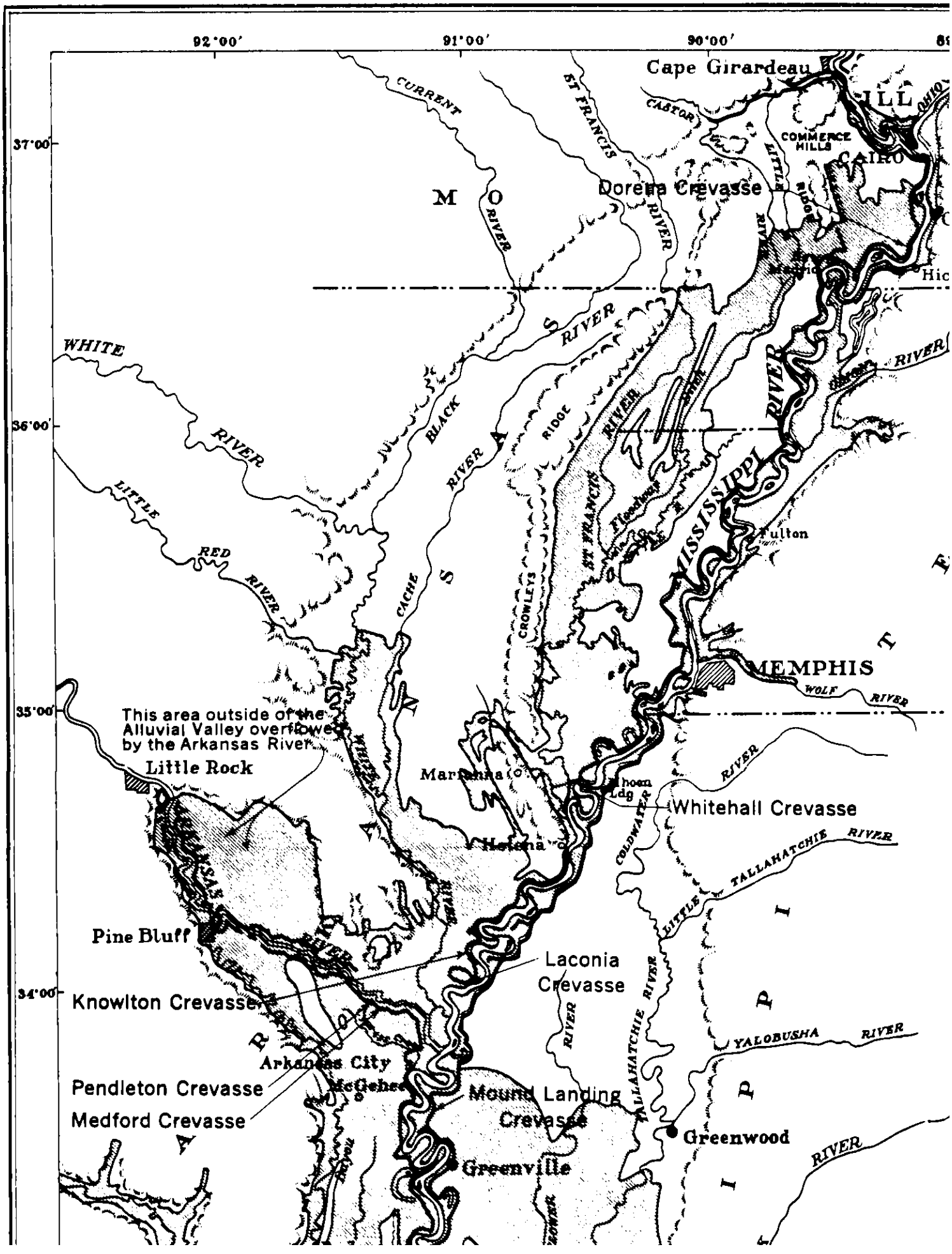
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CROWLEY'S
Floodway
Fulton
MEMPHIS
WOLF
RIVER
This area outside of the Alluvial Valley overflowed by the Arkansas River
Little Rock
Marianna
Helena
Whitehall Crevasse
COLDWATER
RIVER
TALLAHATCHIE
RIVER
LITTLE
TALLAHATCHIE
RIVER
Pine Bluff
Laconia Crevasse
Knowlton Crevasse
RIVER
YALOBUSHA
RIVER
Arkansas City
McGehee
Pendleton Crevasse
Medford Crevasse
Mound Landing Crevasse
Greenwood
Greenville
RIVER

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

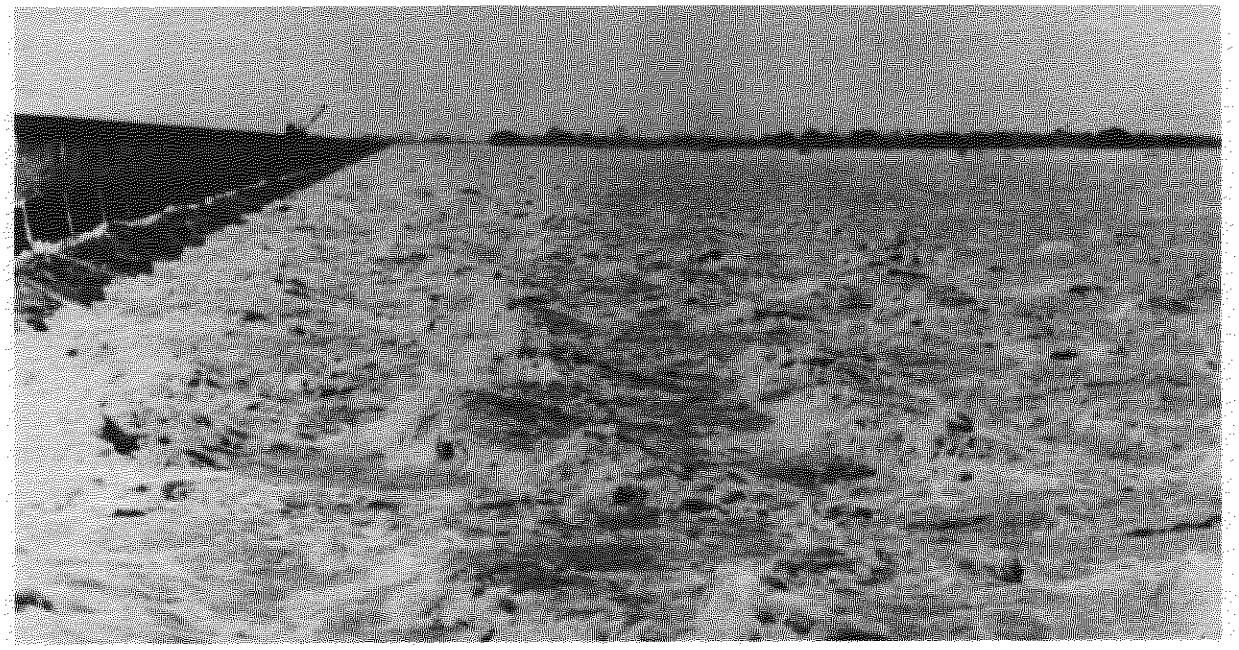
correction of the levee formed the last element in the work, and in December 1936 the Chief of Engineers was able to announce that the entire floodway project stood complete. The timing was theatrically close. In January 1937 one of the greatest of all recorded floods started on its way down the Mississippi.[37]

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]

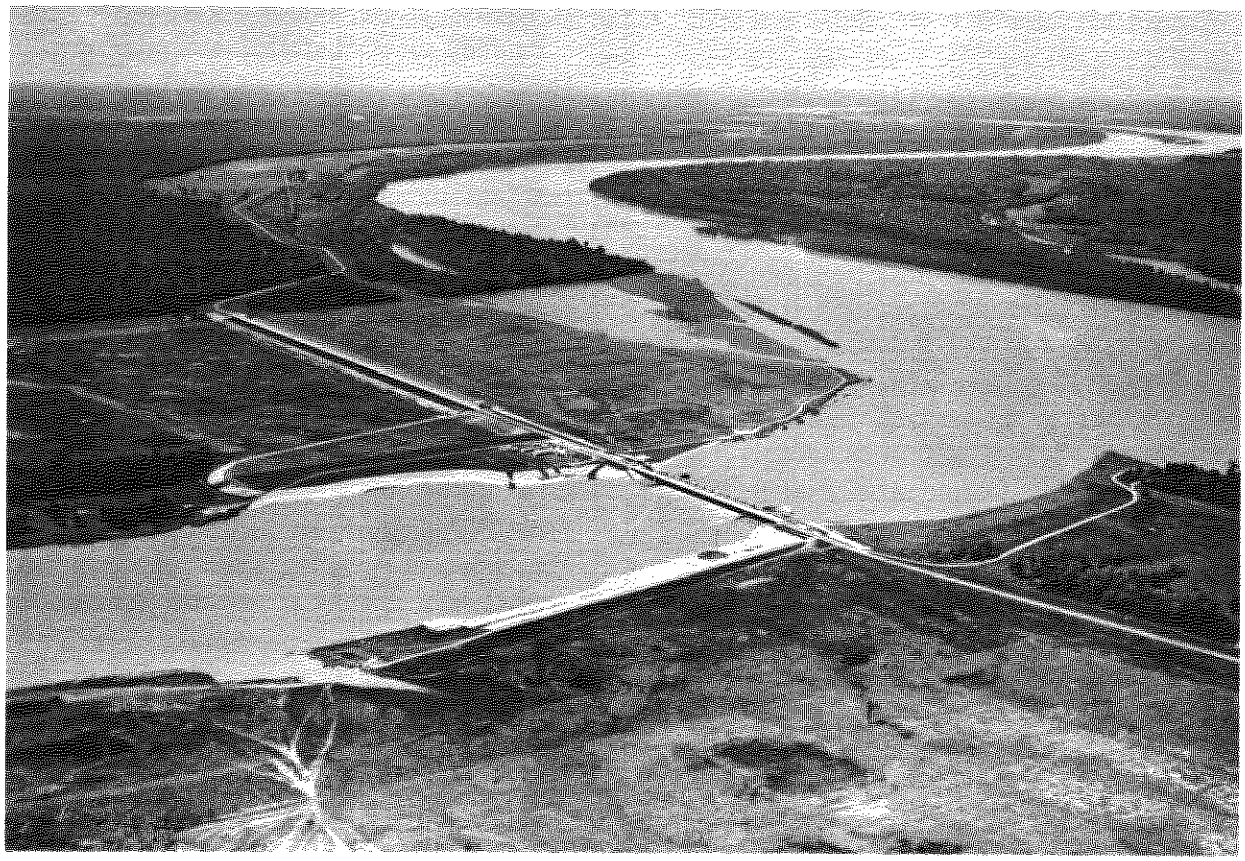
Meantime, in 1831, Henry M. Shreve cut off Turnbull's Bend.[48] The abandoned bend, whose arms were known as Upper and Lower Old River, showed the customary tendency to silt up, and in fact first the southern and then the northern arm did close. Both the channels would eventually have become permanently 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]

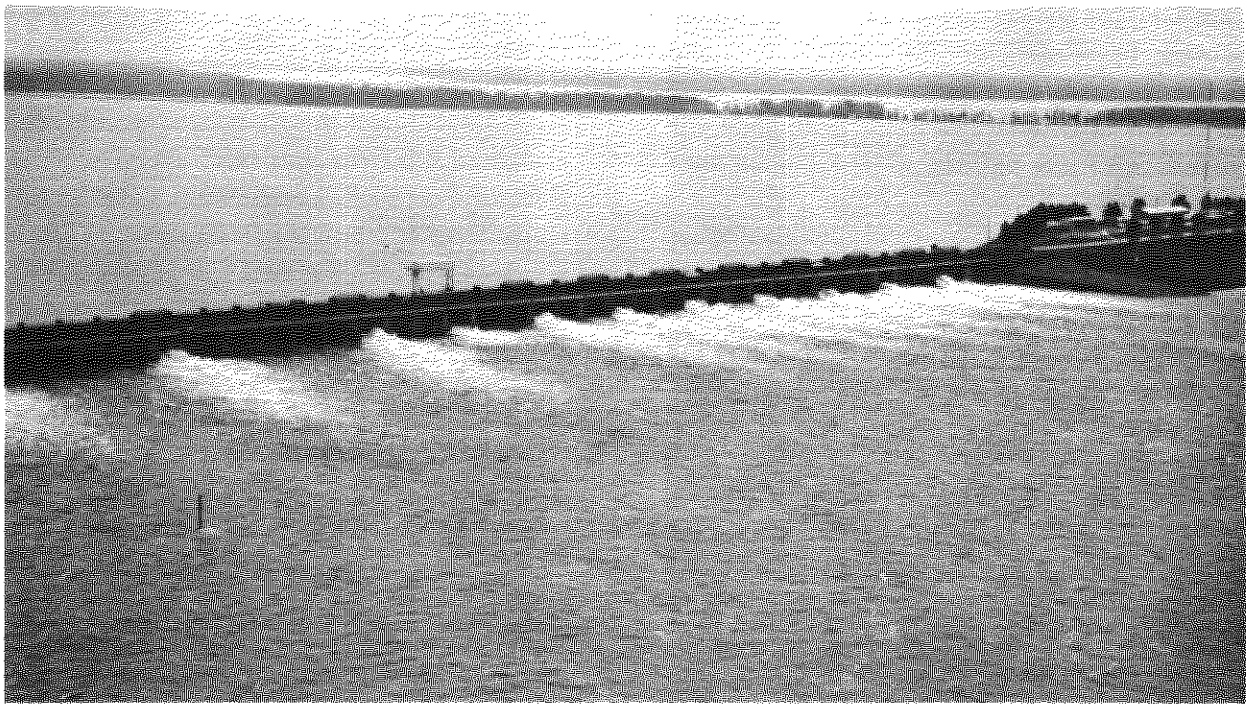
As might be expected, the existence of so vast a structure as the Atchafalaya Floodway caused problems. Like any other alluvial stream the Atchafalaya continued to build land and change its own course. The inefficiency of its lower channel caused constantly rising stages upstream, and soil instability 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.

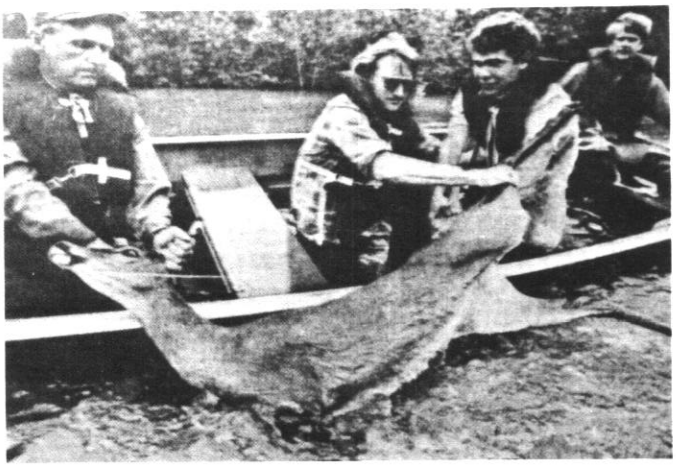
The test came in 1973. Serious flood emergencies in 1945 and 1950 brought new openings of Bonnet Carré, but not of the Atchafalaya system, though dynamite was ready in 1945 and the decision not to breach the fuse plugs was "a matter of tenths of a foot."[60] Almost a quarter of a century elapsed without 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.

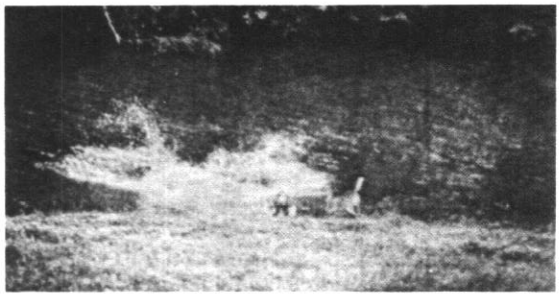


Morganza Spillway's first opening—1973.

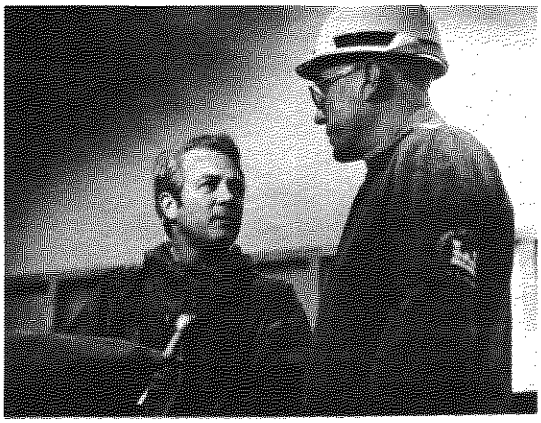


RESCUE OPERATION—State and Federal wildlife personnel estimate that more than 600 deer were rescued from the water which covered the East Atchafalaya Floodway when the gates of the Morganza Spillway were opened 17 Apr 73. The Louisiana Wildlife and Fisheries Commission is now surveying the area to try 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.