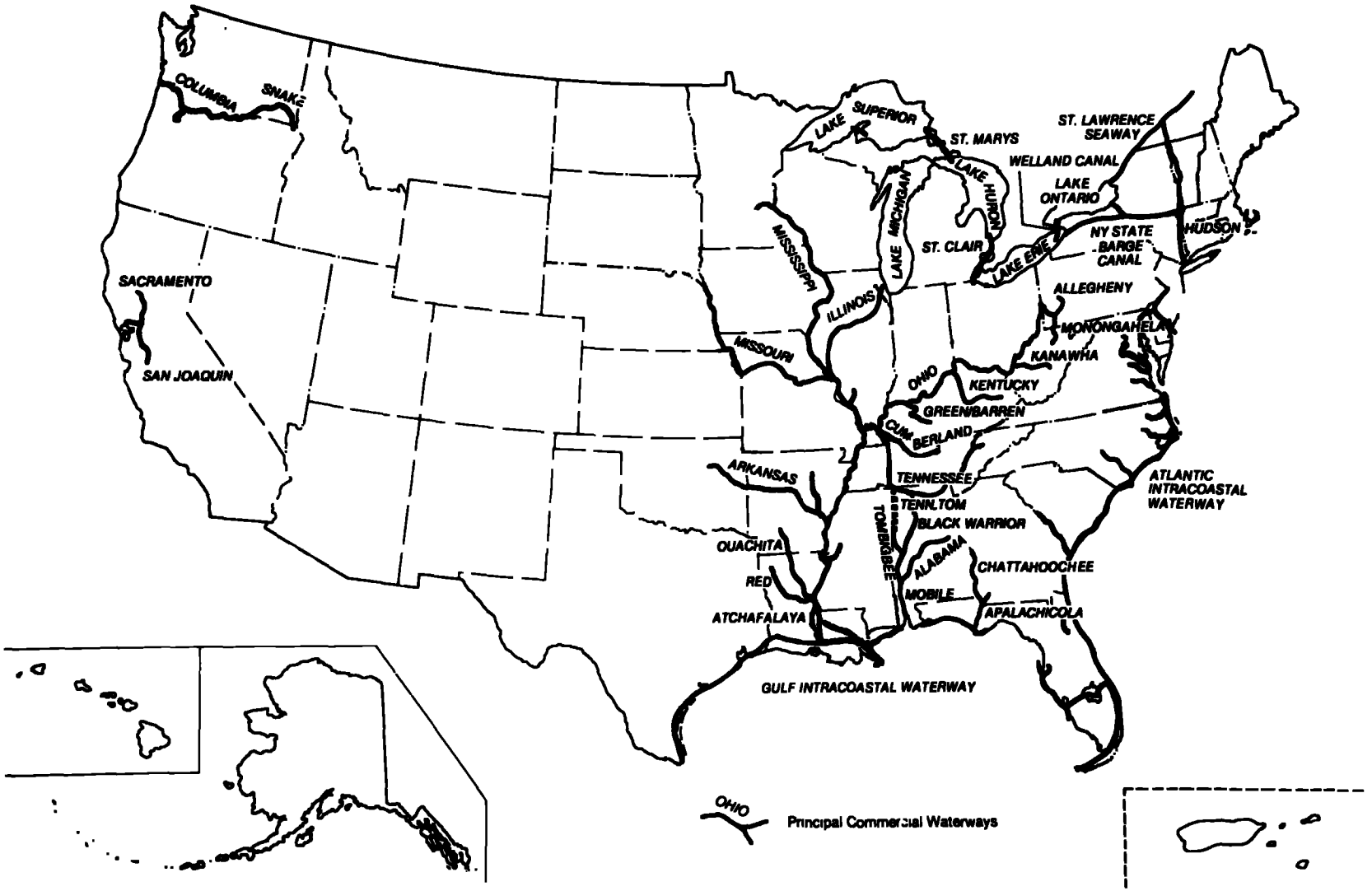
REFERENCE

History of Transportation on the Upper Mississippi & Illinois Rivers

National Waterways Study □ U. S. Army Engineer Water Resources Support Center □ Institute for Water Resources

THE NATIONAL WATERWAYS
UPPER MISSISSIPPI AND ILLINOIS RIVERS



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Roald D. Tweet

January 1983
Navigation History NWS-83-6

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AUTHORITY FOR THE NATIONAL WATERWAYS STUDY

The Congress authorized the National Waterways Study (NWS) and provided the instructions for its conduct in Section 158 of the Water Resources Development Act of 1976 (Public Law 94-587):

> The Secretary of the Army, acting through the Chief of Engineers, is authorized and directed to make a comprehensive study and report on the system of waterway improvements under his jurisdiction. The study shall include a review of the existing system and its capability for meeting the national needs including emergency and defense requirements and an appraisal of additional improvements necessary to optimize the system and its intermodal characteristics. The Secretary of the Army, acting through the Chief of Engineers, shall submit a report to Congress on this study within three years after funds are first appropriated and made available for the study, together with his recommendations. The Secretary of the Army, acting through the Chief of Engineers, shall upon request, from time to time, make available to the National Transportation Policy Study Commission established by Section 154 of Public Law 94-280, the information and data developed as a result of the study.

PREFACE

This pamphlet is one of a series on the history of navigation done as part of the National Waterways Study, authorized by Congress in Public Law 94-587. The National Waterways Study is an intensive review by the Corps of Engineers' Institute for Water Resources of past, present, and future needs and capabilities of the United States water transportation network. The Historical Division of the Office of the Chief of Engineers supervised the development of this pamphlet, which is designed to present a succinct overview of the subject area.

John T. Greenwood

JOHN T. GREENWOOD
Chief, Historical Division

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Chapter 1

THE UPPER MISSISSIPPI

PHYSICAL CHARACTERISTICS

Beginning as little more than a trickle running out of Lake Itasca in north-central Minnesota, 1,670 feet above sea level, the Upper Mississippi River slowly falls 700 feet through lakes, pines, and hardwood forests, a resort and tourist river until it reaches Minneapolis 513 miles away. Here it crosses the Falls of St. Anthony and becomes a working, navigable river. It has begun to earn its Ojibway name, Missi Sipi, the "Great Water."

From Minneapolis the river flows south toward St. Louis, 660 miles away. It travels a narrow valley hemmed in by limestone bluffs and palisades up to 500 feet high, and forms parts of the borders of Minnesota, Wisconsin, Iowa, Illinois, and Missouri. Along the way it is fed by the Minnesota, St. Croix, Wisconsin, Rock, Des Moines, and Illinois Rivers, and many lesser streams. Then, just above St. Louis, the Mississippi meets the Missouri River, muddy with brown silt from 3,000 miles of western plains. For some miles the two waters--the Mississippi with only 7% of the silt content of the Missouri--remain visibly separate. Finally, 200 miles south of St. Louis near Cairo, Illinois, 857 miles from Minneapolis, the waters of the Ohio River pour into the channel, more than doubling its volume. Here it changes character and name. It has become the Lower Mississippi, that "mile-wide tide, shining in the sun" made famous by Mark Twain, with its own problems and its own story.

Measured by volume and length, the Upper Mississippi is the least impressive of the three major stems of the Mississippi system. Both the Ohio and the Missouri are larger and longer, and it is the Missouri stem that is used to compute the length of the system. Measured by its work, however, this middle stem commands attention. It was the Upper Mississippi and its tributaries which formed the inland water highway by which the Midwest was settled and its resources were carried out. Down this river, between 1835 and 1915, came virtually every usable white pine log in the states of Minnesota and Wisconsin, the logs used to build most of the homes and farms of the American heartland from St. Louis north.

Geologically, the Upper Mississippi is not an old river. Its channel was formed and reformed during the four glacial ages of the Pleistocene epoch beginning less than one million years ago. Prior to the

first of the ice sheets, the Mississippi flowed through central Iowa. The Nebraskan glacier pushed the channel into its present location as far south as Clinton, Iowa. The edge of this ice sheet forced the river to run over hard rock rather than seek natural valleys. Eventually, the water scoured a deep channel through the rock, creating the distinctive Upper Mississippi bluffs visible today. The Kansan glacial age several hundred thousand years ago pushed the channel east from Clinton until it met the Illinois River at Hennepin. From here it flowed south with the Illinois to St. Louis. During a third glacial age, the Illinoisan glacier forced the Mississippi back west, blocking its channel and those of the Cedar and Iowa Rivers, and forming Lake Calvin, which covered most of central Iowa. Lake Calvin drained south over the Des Moines Rapids near Keokuk, Iowa. Two later ice sheets, the Iowan and Wisconsinan, further changed the land and when the last named glacier retreated, the river was in its present channel.

The last advance of the Wisconsinan, the Mankato, some 12,000 years ago, deposited huge amounts of sand and gravel near St. Paul. This material, scoured from the Canadian Shield, eventually filled in the riverbed as far south as St. Louis. Erosion of this gravel bed left the Upper Mississippi Valley with terraces at 25 and 75-foot levels. The sand provided one of the major obstructions to navigation on the Upper Mississippi: the constantly reforming sandbars as well as the stationary islands which dotted the river, twisting the channel from one side to the other and creating long shallow stretches. This legacy from the glaciers, together with the two stretches of rapids at Rock Island and Keokuk, hindered navigation between St. Louis and St. Paul until well into the 20th century.

EXPLORATION AND SETTLEMENT

On June 17, 1673, Louis Jolliet, a French government agent, and Father Jacques Marquette, a Jesuit priest, led two canoes of French voyageurs past the mouth of the Wisconsin River into the channel of the Upper Mississippi. Historians have credited these two explorers with the discovery of the river, although Pierre Esprit Radisson and Médard Chouart, Sieur des Groseilliers may have come upon the river during their explorations in northern Minnesota in 1659. Hernando de Soto, of course, had already discovered the Lower Mississippi in 1541.

All of these explorers had been preceded by a long series of Indian cultures who had settled along the Mississippi and its tributaries, and who, at least as early as 900 A.D., used the waterways to establish lengthy and active trade routes. Perhaps the best examples of such trade are found in the prehistoric village of Cahokia across the river

from St. Louis. Here, from before 800 A.D. until about 1200 A.D., a group of Indians, moundbuilders, lived in a metropolitan community of from 10,000 to 38,000, supported by a well-organized group of farming communities up and down the river.[1] The village of Cahokia covered an area 2.25 miles by 3 miles. Excavation of the mounds, the largest prehistoric man-made mounds north of central Mexico,[2] has uncovered much evidence of the control and exchange of copper, mica, and other exotic resources from nearly every part of North America. By 1300 Cahokia had also established a colony in southern Wisconsin on the Crawfish River. This site, Aztalan, also revealed a wide trade area through artifacts such as beads made from Gulf Coast shells.

The Indians encountered by Marquette and Jolliet showed just as much familiarity with the Mississippi and its tributaries. They traveled the rivers in canoes of bark or skins or in pirogues hollowed out of cottonwood logs pointed at both ends. Both vessels, paddled or poled depending on the water depth, were well adapted to the shallow and shifting channels. They could handle heavy loads with a small draft and remain maneuverable. The French had already begun to adapt these boats for their own explorations and fur trading.

Nevertheless, it was Marquette and Jolliet whose voyage in 1673 discovered the Upper Mississippi for the Europeans still to the north and east. They made their way slowly down the river, visiting friendly Indian communities, until they were within 700 miles of the Gulf of Mexico. By this time, they had become convinced that the river did flow into the Gulf, and not, as they had hoped, westward to provide that Northwest Passage to the Pacific so many explorers had hoped to find.

On the return trip up the river, they met Indians near the mouth of the Illinois who convinced them that they could reach their destination, the fort at Green Bay on Lake Michigan, faster by using the Illinois, Des Moines, and Chicago Rivers to reach the lake. They did this, portaging the short distance between the Des Plaines and Chicago. Jolliet became the first explorer to note the advantages of a connection between Lake Michigan and the Mississippi, and also the first to underestimate the difficulty of such a connection. "There will be but one canal to make," he wrote, "and that by cutting only one half-league of prairie from the lake of the Illinois [Michigan] into the St. Louis [Illinois] River which empties into the Mississippi."[3] Returning by this route, the two explorers also foreshadowed the competition between a north-south and an east-west route that was to determine the character and problems of Upper Mississippi River transportation throughout most of the 19th century.

The French presence on the Mississippi was made more firm in 1678 when René Robert Cavelier, Sieur de La Salle, received permission from the French government to explore the Mississippi and establish forts where necessary. In 1679, La Salle left Green Bay and sailed down Lake Michigan and across to the Illinois River. After stopping to establish Fort Crèvecoeur, his party split into two groups. A party of three, including Father Louis Hennepin, went down the Illinois and then up the Mississippi as far as the Falls of St. Anthony, which Hennepin named. La Salle, meanwhile, traveled down the Mississippi, and reached the Gulf of Mexico on April 9, 1682. On this basis, La Salle claimed the Arkansas River and the entire Mississippi Valley for France, naming it Louisiana.

TERRITORIAL CLAIMS

Although French explorers continued to travel this vast new region, La Salle's voyage marked the end of French exploration and the beginning of a period of establishing forts and missions.[4] The French had established Green Bay as a mission and fur trading post in 1634; now they moved out to their new holdings. By the 1730's the French had established military and trading posts on the Mississippi from the Ohio River north, as well as on major tributaries. Posts were built at Kaskaskia, Fort Chartre below the mouth of the Missouri, Cahokia, Ste. Genevieve, St. Phillipé, Prairie du Rocher, and at Point du Sable on Lake Pepin. In Wisconsin, major posts were constructed along the Wisconsin-to-Green Bay trade route, including posts at Green Bay and Prairie du Chien. Northern Minnesota was controlled by a post at Grand Portage.

This heavy French military presence in Upper Louisiana was not meant to prepare the way for future settlement or subdue the Indians. The French were interested primarily in furs; the forts were there to keep the routes open--and to prevent British encroachment. Consequently, during the period of French ownership, there was little French settlement and almost no permanent villages. By 1713, the vast French empire stretching from Quebec to the Gulf of Mexico contained less than 20,000 French, nearly all of them traders, trappers, missionaries and military personnel.[5]

The Seven Years War (French and Indian War) cost France its North American empire, but she was still able to block a British takeover of the continent. In late 1762, at the end of the war, France, having lost Quebec and the lands east of the Mississippi to Britain, ceded Louisiana, the land west of the Mississippi, to its ally, Spain. The action satisfied Spanish interests, and, by the Treaty of Paris, in early 1763, Spain acknowledged the British seizure of Florida. The same treaty formalized the British takeover of French territory won during the war;

the British ruled from the Gulf of Mexico to Hudson Bay, but not west of the Mississippi.

American independence ended British rule south of the St. Lawrence, but the British retained many of their trading posts within the old Northwest Territory. The friction created by this commercial rivalry led eventually to the War of 1812. Initially victorious, the British soon occupied Green Bay, Chicago, and Prairie du Chien, and controlled much of the region. In the 1814 Treaty of Ghent, however, Britain conceded American sovereignty over what is now Minnesota and most of Wisconsin. The Americans were more interested in settlement than in trade, and soon made the territory theirs in more than name.

Meanwhile, west of the Mississippi, Louisiana had again changed hands. In 1800, the Spanish returned the territory to France in the Treaty of San Ildefonso. In 1802, President Thomas Jefferson, worried about free navigation on the Mississippi, instructed Robert Livingston, American minister in Paris, to negotiate a guarantee of American trade and navigation rights on the river. Early in 1803, James Monroe, with authorization to purchase New Orleans, joined Livingston in Paris. Renewed war between France and Britain assisted the negotiators, and, in April, 1803, Charles Talleyrand, who had resisted American efforts, was ordered by Napoleon to offer the whole of the Louisiana Territory. The Americans accepted, proffering $15 million and conceding 12 years toll-free commerce for French and Spanish shipping. The treaty was signed at the end of the month and ratified by the U.S. Senate in December.

The Louisiana Purchase not only dramatically increased the size of the young United States, it fueled for many Americans the feeling that America was destined to eventually own all the land to the Pacific Ocean. Jefferson's purchase produced an almost immediate increase in both exploration and settlement from Illinois west. On the Upper Mississippi, from St. Louis north, there were hardly any permanent settlements. That now began to change, and with that change, the real history of transportation on the Upper Mississippi begins.

U.S. ARMY EXPLORATIONS

As did the French following the expedition of Marquette and Jolliet in 1673, so did the United States, following the Louisiana Purchase, fan out to explore its new territory, make a census of its resources, and insure the safety of its waterways by establishing posts and forts The Lewis and Clark expedition was the most famous of these explorations, overshadowing similar explorations of the Upper Mississippi.

In 1805, Lieutenant Zebulon Montgomery Pike was ordered by General James Wilkinson, who was commander-in-chief of the western army and the governor of Louisiana Territory, to explore the Upper Mississippi to its headwaters. Pike's responsibilities were both civil and military. He was to discover and map the source of the Mississippi, to note the size and location of the Indian nations along the river, and the amount and kind of furs they traded. Pike was also to note such physical features as rapids, shoals, mines, quarries, and timber. Most important, he was to select sites for three military posts between St. Louis and the Minnesota River, and to purchase these sites from the Indians.

In other words, Pike was to begin the process of making the Upper Mississippi Valley safe for settlement as well as noting the commercial possibilities upon which such settlement depended. Pike and his company left St. Louis in 1805 in a 70-foot keelboat. The journey would take him 5,000 miles. He did not find the source of the Mississippi, but he did select sites for forts, including two sites below the Falls of St. Anthony, one at the mouth of the Minnesota River, and a second at the mouth of the St. Croix--over 100,000 acres for which Pike negotiated a purchase agreement with the Sioux. The U.S. Senate ratified that purchase treaty in 1808 and gave the Sioux $2,000 for the land.

The first Engineer officer to explore the Upper Mississippi was Brevet Major Stephen H. Long. In 1817, Long was sent to explore and map the Upper Mississippi to Prairie du Chien, as well as the Wisconsin-Fox waterway to Lake Michigan. Passing through the small village of Chicago, Long noted, as had Jolliet, the advantage of a canal from the Chicago River to the Illinois River.[6] Long extended his exploration upriver from Prairie du Chien to the Falls of St. Anthony to examine the two sites purchased by Pike in 1805. He recommended the site at the mouth of the Minnesota River, where, two years later, Fort St. Anthony was founded.

Major Long returned in 1823 on a scientific and military mission to explore the Minnesota River, the Red River of the North, and the boundary between the United States and British America. By 1823, Fort St. Anthony was a thriving fort, already visited by a steamboat, and the Upper Mississippi Valley, though still frontier, showed signs of new settlement and growth.

THE FUR TRADE

During the period from French discovery to American ownership, virtually the entire traffic on the Upper Mississippi, both Indian and white, was connected to the fur trade. Formerly carried on in

Canada and the Great Lakes region, the fur trade followed Marquette and Jolliet to the Upper Mississippi Valley almost immediately. In the spring of 1683, Nicolas Perrot established a trading post on the west bank of the Mississippi near present-day Wabasha, Minnesota, and built Fort St. Nicholas on the east bank near the mouth of the Wisconsin River. Two years later he built a third post near present-day La Crosse, Wisconsin, and another, Fort St. Antoine, near the mouth of the Chippewa River. For several years, Perrot carried on an extensive fur trade with Indians in Minnesota, Wisconsin, and Iowa.[7]

Although all of these posts were abandoned by 1700 when French soldiers were withdrawn to Lower Canada, the French fur trade continued to flourish. By 1740, French trading posts extended from the Great Lakes to the Yellowstone River and north to Winnipeg. Although the British had chartered Hudson's Bay Company in 1670 to compete directly with the French in the fur trade, French fur traders remained isolated, individual operators, each trader going out when the ice broke in the spring to the individual tribes he had made an agreement with. Individual English traders also competed with the French; it was primarily the rivalry between traders and conflicting claims that led to the French and Indian War in 1755.[8]

When France relinquished claims to the land east of the Mississippi to England in 1763, Hudson's Bay Company traders flooded into the new territory and changed the character of the fur business. It became better organized, better financed, and more competitive. About 1783 several English and Scottish merchants of Quebec and Montreal formed an association to engage in the fur trade with Indians west of the Great Lakes. They established trading posts throughout the area, the principal ones located at Green Bay, Prairie du Chien, and Grand Portage. In 1787 the group took the name the Northwest Company, and expanded into northern and western Minnesota and also into territory which had been ceded to the United States in 1783.

American competition first came in 1808 when the New York Legislature chartered John Jacob Astor's American Fur Company. In 1809 the Missouri Valley Fur Company opened a headquarters at St. Louis. What had begun as an individual enterprise by the voyageurs now became big business. Although other fur trading companies such as Cheyenne American and the Columbia Company were active especially in the region above the Falls of St. Anthony,[9] the American Fur Company dominated trade. Coming when it did, after the fur trade in the eastern United States had nearly disappeared, the American Fur Company located its operations along the Upper Mississippi. It was the first to realize the advantage of steamboat transportation and it pioneered the use of

such boats on the river, profitably combining fur cargo with military supplies for the forts which the United States had established between St. Louis and St. Paul. By establishing company headquarters at St. Louis, it helped turn that small village into a major port city.

By the 1820s approximately 500 people were engaged in the fur trade along the Upper Mississippi.[10] Trading posts had been established to collect furs nearly everywhere a tributary met the main channel. There were posts at the mouth of the Skunk, Rock, Iowa, Fever, and Chippewa rivers as well as at all the major rivers. In addition to St. Louis, there were major collecting points at Prairie du Chien and across from Fort St. Anthony, renamed Fort Snelling in 1825, at the mouth of the Minnesota River. Located here were two of the prominent names in the Upper Mississippi history. Henry J. Sibley at Fort Snelling and Hercules L. Dousman, the main representative of the American Fur Company on the river, at Prairie du Chien.

By 1834, however, Astor had sold his interest in the American Fur Company due to the declining fur trade. Trappers had already depleted the prized beaver; beaver trapping by 1800 had moved west toward the Missouri River. The pelt most trapped and shipped on the Upper Mississippi River was muskrat.[11] In addition, the rapid movement of settlers into the Midwest following the Louisiana Purchase, together with the demoralizing effect of the War of 1812 made the fur trade increasingly difficult.

In an attempt to protect American interests, the War Department had established military forts on the Upper Mississippi and Missouri Rivers to "exclude foreigners from trade and intercourse with the Indians residing within our limits."[12] This attempt was not always successful. Many traders ignored American authority; others simply became American citizens. Even if military presence had worked, it could not have saved the fur trade. Aside from St. Louis, only Prairie du Chien and St. Paul remained as important fur trading centers into the 1850s. By the Civil War, the fur trade had disappeared from these, too.

TYPES OF BOATS IN THE FUR TRADE

Just as the fur trade business evolved from one or two-man operations to company businesses, the boats used on the Upper Mississippi to haul these furs changed from craft operated by one or two men to boats requiring a crew of ten or more. Large or small, however, all boats had to meet the rigid requirements of the Upper Mississippi. The channel was shallow, especially during the low water season (which often lasted for five months), and crooked. In places such as the Rock Island Rapids,

the current was dangerously swift; in most other stretches the current prohibited the use of sails to move upstream. Just above the mouth of the Des Moines River every boat had to contend with the Des Moines Rapids, the greatest obstacle to navigation between St. Louis and St. Paul. Here, an eleven-mile shelf of limestone lay from shore to shore, with no channel through it, and with only inches of water in low season.

The French were quick to see the advantages of the two boats developed by the Indians for this river. The birch bark canoe became a favorite of the voyageurs and fur traders on the small streams; its lightness made it easy to portage and its shape made it maneuverable through rapids. The pirogue, however, quickly became the dominant means of transportation on the Upper Mississippi. Made of sycamore, cypress, or cottonwood logs, hollowed out by fire or adze, the pirogue could be made in any size. The largest ones, 50 feet or more long with a 5-foot beam, could hold 30 men and a cargo of 40 to 50 tons. Pirogues were steered by stern oars and propelled by oars or poles, occasionally aided by sails. Variations developed, such as the use of two logs, catamaran style, connected by a cargo platform which could be covered to protect the contents.[13]

By the French and Indian War, the pirogue had evolved, in French hands, to the bateau, or Mackinac boat, used extensively on the Upper Mississippi until the 1790s.[14] Larger than the typical pirogue, the bateau was a keeless, flatbottom vessel with ends tapering to a point. It was built of plank and was more maneuverable than the pirogue. Steered by rudder or oar, it was propelled by oar and sail. The bateau carried a crew of 18 to 20 men and a cargo of up to 40 tons. Often the cargo was protected by an awning or wooden cabin.

Sometime before 1800--as early as the 1750s on the Ohio River--someone added a 4-inch square beam to the bottom of the bateau to minimize damage from rocks and snags and to help keep the boat on course.[15] In this way was born the most sophisticated of the inland river craft prior to the steamboat: the keelboat, as these modified bateaus and their descendants were called. On the Lower Mississippi the barge, a large relatively deep-draft boat became popular, but the light, shallow-draft keelboat soon came to dominate both passenger and freight traffic on the Ohio, Upper Mississippi, and Missouri.

The typical keelboat had ribs, planking, and a keel, and it drew about two feet of water. Keelboats ranged from 40 to 80 feet long and 7 to 10 feet wide. Like the bateau, the keelboats were pointed at both ends, and usually had a covered cargo or passenger cabin. A keelboat looked much like the later canal boats of the eastern United States. With a crew of about 10, the keelboat carried between 15 and 50 tons

of cargo, though usually less than 30.[16] The distinctive feature of the keelboat, however, and its main advantage on the Upper Mississippi, was its ability to return upstream against the current, even with a load. Although the keelboats had sails, they were at best an aid when the wind was right. Generally, the boat was pushed up the river by poles. A cleated footway ran all around the edge of the deck. On this footway, crew on both sides of the boat pushed their poles against the bottom of the channel while they walked toward the stern. Repeated again and again, the crew in this way literally walked the boat upstream at about 15 miles per day.

Where the channel was too deep for poling, the crew resorted to cordelling or warping. Cordelling consisted of attaching a towline up to 1000 feet long to the mast, with the crew pulling the boat along while walking on shore. In warping, the towline was tied to a tree upstream and pulled up by a crew on the boat, while a second crew had already moved further upstream with a second towline. Pulling or poling, it is easy to see why it was the keelboatmen--Mike Fink the most famous--who became the folk heroes of early river transportation.

The last of the craft to evolve to meet the needs of the inland rivers was the flatboat, a boat that solved the problem of returning against the current simply by not returning. The flatboat was little more than a rectangular raft made of planks, anywhere from 20 to 100 feet long and 12 to 30 feet wide, but it could carry 40 to 50 tons of cargo--downstream. Reaching its destination, the flatboat was broken up and the lumber sold.

Flatboating began on the Ohio River in the 1780s, but did not reach their peak on the Upper Mississippi until the 1840s, long after the steamboat had arrived. The reason is that the flatboat was suited much more to the farmer and smalltime merchant than to the fur trade. Though the flatboat was used in the fur trade, its primary use came from the farmers who settled along the river after the Louisiana Purchase. At the end of a season a farmer could built a flatboat, load it with a few hogs, a barrel or two of honey, sacks of grain, and whatever else his farm had produced and float off down the river. On the way, he could stop at small settlements, selling what he could; and when it was all gone he could sell the lumber in his boat. Such loads of diversified farm produce were floated down to New Orleans from the Illinois and Upper Mississippi even before 1800.[17] Flatboats also enabled tinsmiths, blacksmiths, and other traders to travel to isolated settlements.

These few boat types, the carriers for the fur trade, were adequate for the sparsely populated Upper Mississippi Valley. Before 1804 there

were no settled towns north of St. Louis, and a few keelboats were able to handle the fur traffic. Prior to 1817, commerce between New Orleans and the Upper Mississippi River was handled by about 20 flatboats of 100 tons each making one trip per year.[18] They were soon to be replaced by a new age and a new form of river transportation.

Chapter 2

THE STEAMBOAT AGE ON THE UPPER MISSISSIPPI

The history of transportation on the Upper Mississippi during the 19th century is primarily the story of the rapid rise, short success, gradual decline, and virtual cessation of steamboat traffic--indeed, of all traffic--between St. Louis and St. Paul. At its peak, the steamboat determined the economy and the politics of the Midwest. Steamboat traffic determined the location and growth of towns along the river. By 1915, however, steam transportation had ceased to be a competitive--or even very important--part of inland transportation in the United States.

A second distinctive feature of transportation north of the Ohio River in the 19th century is the dramatic shifts in cargo carried by the steamboats. The fur trade decreased quickly after the steamboat trade began, to be replaced by lead and military supplies. As these in turn diminished in the 1840s, immigrants arrived to settle the farms of Iowa and Minnesota, creating a brisk passenger traffic that turned St. Paul from a small port into a commercial center. Then came the grain and other produce from these new farms, followed, when the grain shifted to the railroads, by logs and lumber. Lumber was by far the single most important commodity shipped down the Mississippi from the 1870s until 1915. When the logs disappeared, so did the steamboat.

The steamboat made its debut on the western rivers in 1812, when the New Orleans, built in Pittsburgh and designed by Robert Fulton and Robert Livingston for Nicholas Roosevelt, arrived at New Orleans after a 3½ month journey. Although Fulton and Livingston had obtained a monopoly for their route between New Orleans and Natchez from the governor of New Orleans, they were soon challenged by competitors. One of these was Henry Shreve, who began his long series of contributions to Mississippi River transportation by developing a high pressure, horizontal steam engine and installing it in a vessel more along the lines of a keelboat. This boat, the Washington, revealed the true potential of the steamboat by steaming up the Ohio to Louisville and back.

Steamboat traffic on the Lower Mississippi advanced quickly, but the draft of these early boats was still too deep, and the engines too underpowered, for the river above the mouth of the Ohio. The New Orleans, for example, though it was small, 148 feet long with a 32-foot beam, needed a 12-foot draft to handle the upright steam engine.

Not until 1817 did a steamboat venture north of Cairo. In that year the Zebulon M. Pike cautiously pulled up to the waterfront at St. Louis,

met by citizens who had eagerly awaited her arrival.[1] The Pike was a small boat, little more than a barge with an engine. At 31.76 tons, she was the second smallest steamboat documented on the Mississippi. With an underpowered engine, she had to be helped against the current by her crew, who poled her, keelboat-style. The Pike took six weeks to come up from Louisville.[2]

It was a beginning. That same fall another boat, the Constitution, reached St. Louis, and by 1818, the steamboat had ceased to be a novelty for residents.[3] During the 1919 season, five boats had arrived by May, including the Maid of Orleans which had sailed from Philadelphia and come up from New Orleans.[4] By 1822, six small steamboats were operating above the Des Moines Rapids in the Galena lead trade, though their cargo had to be transferred to keelboats from the rapids down to St. Louis.[5]

The first steamboat to go above St. Louis was a government boat, the Western Engineer, designed and commanded by Major Stephen Long. Long had taken the boat up the Missouri in 1819. In 1820, the boat steamed up the Mississippi to Keokuk at the foot of the Des Moines Rapids before turning back.

Until 1823, most rivermen assumed that no steamboat would ever get past the Des Moines Rapids. That year they were proven wrong by the Virginia, under government contract, on a trial basis, to carry military supplies to Fort St. Anthony. The Virginia left St. Louis on May 2, got across both rapids, and reached Fort St. Anthony safely. She returned in time to make a second trip in June. In size and design, the Virginia was little more than a glorified keelboat. She was 112 feet long with a 22-foot beam and displaced 110 tons. Her boxy cabin had no pilot house, the pilot steering the boat from a tiller in the stern. Her first cargo of military supplies included salt, pork, beans, soap, candles, vinegar, and whisky, as well as powder and shot. She also carried an assortment of passengers, including a missionary lady, an Indian chief, Lawrence Taliaferro, the Indian agent at Fort St. Anthony, and Count Giacomo Beltrami, the Italian traveler and explorer whose account make this voyage famous.[6]

Steamboat traffic on the Upper Mississippi grew steadily but slowly for the 20 years following the voyage of the Virginia. Most of the 230 steamboats on the Mississippi by 1834 operated below St. Louis where the channel was deeper and the settlements more populous. By the mid-1820s, St. Louis sent only 9% of its traffic to the Upper Mississippi, the rest going to Ohio or Lower Mississippi.[7] North of St. Louis a few boats were engaged in the Galena lead trade. In 1827, for example, 7 million pounds of lead reached St. Louis from Galena, some of it by steamboat,

much of it by keelboat. Some of the steamboats on the upper river were hired by the American Fur Company to handle what was left of the fur trade. Most of the rest were chartered by the government to deliver supplies to the string of forts north of St. Louis. The country above St. Louis was still too sparsely settled to support regular steamboat traffic. As Indian treaties proliferated, due to the influx of settlers into the Midwest, the transportation of Indian annuities also became an important livelihood for steamboats. Boats delivered axes and farm tools, lard, tobacco, flour, blankets, and other goods to tribal sites all along the river. Steamboats even did a small business transporting Indian tribes to treaty sites.[8] As late as 1853, steamboats carried an estimated $390,000 worth of trade in general merchandise to St. Paul, while bringing in $400,000 worth of government trade.[9]

As steamboat traffic developed on the Upper Mississippi, the boats themselves adapted to the conditions of the channel. On the Lower Mississippi the steamboat evolved rather quickly into the grand sidewheelers which became the stereotype of the Mississippi steamboat. Those two and three-story gingerbread palaces, however, could seldom go above the mouth of the Ohio and certainly not above St. Louis. Although smaller versions of the sidewheelers did traffic on the Upper Mississippi, the standard boat for the upper river soon came to be a relatively modest sternwheeler of between 200 and 300 tons.[10] While the sidewheeler had more power and was easier to steer, location astern protected the wheel from sandbars, shallow water, and rocks, a necessity above St. Louis.

Boats also grew lighter and less bulky as builders learned to build them by experience. Improvements came quickly because the average life of a western-rivers boat was about five years; replacements were constantly needed. The ratio of tonnage measurement to cargo capacity on the early boats such as Shreve's Washington was 2:1; by 1825 the ratio had reached 1:1; it had risen to 1:1½ and to 1:2 by the late 1840s.[11] The draft decreased, too, to more nearly match the shallow channel--under four feet in many places--of the Upper Mississippi. The first boats on the river carried 300 tons in eight feet of water; the same eight feet could carry 2,000 tons by the 1860s,[12] although boats that large could not operate above St. Louis. The sternwheelers on the upper river eventually operated with drafts as little as two feet--a few even less.

Beginning about 1840, both steamboat traffic and the population of the region began to boom. Illinois had been admitted as a state in 1818 and Missouri in 1821, the result of an influx of settlers between 1810 and 1820. Now the same thing began to happen further north. Between 1840 and 1860, Iowa's population went from 43,112 to 674,913, while that of Illinois grew from 476,183 to 1,711,951 as settlers moved into the northern

section of that state. These increases in population resulted in an immediate increase in steamboat traffic. Arrivals of steamers at St. Louis from the Upper Mississippi jumped from 143 in 1841 to 663 by 1846 (see Table 2-1). By comparison, in 1846, 395 boats arrived at St. Louis from New Orleans, 420 from the Ohio River, 446 from the Illinois River, and 256 from the Missouri River (see Table 2-2).[13] Keelboat traffic from

TABLE 2-1. ANNUAL ARRIVALS AT ST. LOUIS FROM THE UPPER MISSISSIPPI

Year	Steamboats	Keelboats
1841	143	108
1842	195	88
1843	244	55
1844	not reported	not reported
1845	547	not reported
1846	663	not reported

Source: Hartsough, From Canoe to Steel Barge on the Upper Mississippi, p. 67.

the north declined in numbers as steamboat traffic took over. The keelboat never did die out completely, however. Steamboats began to use keelboats--towing them behind or lashed alongside--to increase their cargo capacity. In this way, the keelboat helped river traffic evolve into the towboat and barge so common on the river today.[14]

The Growth of River Ports

Nothing shows the economic power of steamboat transportation on the Upper Mississippi more than the settlements which sprang up to serve that traffic after 1817. There were virtually no settlements along the river north of St. Louis in 1817; by 1850 there were 100 towns and a few young cities between St. Louis and St. Paul. The size and success of the towns depended on the needs of river traffic more often than on other advantages of their locations. This economic power can be seen by contrasting a river port which lasted with one which failed: St. Louis and Galena.

St. Louis

St. Louis was founded in 1764 by Pierre Laclede, a partner in Maxent, Laclede and Company, which had earlier enjoyed exclusive fur trading privileges with the Indians along the Missouri River by the French

government in North America. Laclede chose the location because it was the first elevated spot south of the junctions of the Illinois and Missouri rivers with the Mississippi. It was protected from floods, but it had access to all the northern tributaries from which furs came. St. Louis' location proved to be important in both respects. Older and larger towns such as Ste. Genevieve and Kaskaskia nearby soon ran into serious flooding problems--in the case of Kaskaskia, sinking it permanently beneath the Mississippi.

For fifty years St. Louis remained a small fur trading post. The settlement around the post contained many houses elevated on scaffolds to protect the inhabitants from wild animals and Indian attacks.[15] By 1780 the population had reached 800, mostly French and Spanish. By 1810 St. Louis had 1,400 residents and was still essentially a trading post. Seven years later the first steamboat arrived, and in 1822 the first wagon train set out from St. Louis for the Santa Fe Trail, followed by at least one a year from then on.

The effect was immediate. St. Louis, which had just opened its first bank and its first public school, and built a courthouse in 1817,[16] jumped in population to 9,732 by 1821, the year Missouri was admitted to statehood. By 1835 several regular packet boats were operating between St. Louis and New Orleans, and St. Louis and Louisville. Commercial success spilled over into manufacturing as St. Louis built sawmills, flour mills, meat packing plants, facilities for iron working and for processing fur and hides. By the mid-1830s, the population had risen to 15,000, and George Catlin, the American painter and traveler wrote that the city was "destined to be the greatest inland town in America."[17] The next decade seemed to confirm that. Between 1845 and 1849, the population of St. Louis doubled, almost all from new immigrants to America.

St. Louis' great asset was its location. Not only was it located just below the mouths of the Illinois and Missouri rivers, it stood at a point where the channel of the Upper Mississippi deepened, permitting larger boats below than above. Because the larger boats were more economical, it was less expensive to transfer cargo to smaller boats at St. Louis for the trip north than to use boats small enough to travel the entire waterway. The same economics operated for boats coming down from upriver. The small boats necessary to cross the Des Moines Rapids transferred cargo to large boats as soon as possible, in other words, at St. Louis. Because of this, St. Louis became the terminus of nearly all boats and all cargo coming up and down the river. Table 2-2 shows how active the port of St. Louis was from 1845 through 1852 compared with traffic to the north.

TABLE 2-2. STEAMBOAT ARRIVALS AT ST. LOUIS, 1845-1852

Year	Upper Miss.	Illinois River	Missouri River	Cairo	Ohio River	New Orleans	Other Points	Total
1845	547	298	249	---	406	205	167	1,872
1846	663	446	256	---	420	395	232	2,412
1847	717	658	314	146	430	502	204	2,971
1848	697	690	327	194	429	446	396	3,179
1849	806	686	355	122	406	313	217	2,905
1850	635	788	390	75	493	301	215	2,897
1851	639	634	301	119	457	300	175	2,625
1852	705	858	317	223	520	330	231	3,184

Source: Hunter, Steamboats on the Western Rivers, An Economic and Technological History, p. 49.

From the mid-1830s to the mid-1840s, St. Louis held her own in the number of arrivals with the ports of New Orleans, Pittsburgh, and Louisville, exceeding one or more of those ports on several occasions.[18]

The two commodities which contributed most to the success of St. Louis as a river port until the 1850s were furs and lead, both of which arrived in larger amounts at St. Louis than anywhere on the Mississippi. St. Louis had early established itself as a leading fur center, and when lead from Dubuque and Galena began replacing fur as the main river cargo in the 1830s, St. Louis' position 29 miles above Herculaneum, Missouri, where most of the lead shot in the United States was made, gave St. Louis an advantage in that trade too. The location of Jefferson Barracks 12 miles below St. Louis brought the city much of the military supply business on the upper river, including the lucrative Indian annuities trade.[19] In addition, St. Louis shipped her own active manufactures and farm produce from the surrounding territory to every major port on the inland waterways. St. Louis was a city confident of her future.

Galena and the Lead Trade

Although furs continued to be an important factor in the economy of St. Louis, Prairie du Chien, and other posts along the upper river through the 1840s, it was soon overtaken the the traffic in lead. By 1850 only St. Paul and Prairie du Chien remained as important fur posts, and the lead traffic occupied more than half of the steamboats operating north of St. Louis. The headquarters of this trade was Galena in northwest Illinois, located on the Fever River seven miles from the Mississippi.

From a small settlement of miners in 1823, Galena grew in 20 years to rival St. Louis as a commercial center.

Small amounts of lead had been mined by Indian and white miners at several points along the Upper Mississippi as early as 1717.[20] In 1788 Julien Dubuque opened a mine near the Iowa town that bears his name. When Pike visited Dubuque during the 1805 explorations, he found the Frenchman smelting between 20,000 and 40,000 pounds of lead annually. By 1810 Fox Indians were melting 400,000 pounds of lead in the Fever River region. That year, a young Henry Shreve, just beginning his career as a Mississippi riverman, made a handsome profit by becoming the first American to take a load of this lead down to New Orleans in a keelboat.[21]

Galena (a name change in 1827 avoided the unpleasant connotations of its original name, Fevre) grew rapidly after the United States granted the first leases in 1822, and mines began producing more and more lead. In 1825 there were 100 mines in the region; a year later there were 453. Since the government retained control of the land, anyone was free to claim and mine it. "Every farmer was also a miner," a visitor reported, and thousands of acres were randomly torn up.[22] The lead ore contained 80% lead and 5% silver, by far the largest and richest deposit so far discovered in the United States.

From 1823 to 1826, steamboats took only a small percentage of Galena lead downriver, the majority going by keelboat. Then in 1827 a stampede of prospectors brought the steamboat into the lead trade for good. More steamboats made trips on the river north of St. Louis in 1827 than the total number for the previous four years.[23] By the close of the season in 1828, 100 boats had departed from Galena with 13 million pounds of lead. Galena--five years before Chicago became a town--already had a newspaper, The Miner's Journal, as well as 42 stores and warehouses, 22 porter cellars and groceries, lawyers, doctors, mechanics, and 700 residents.

Both lead production and steamboat traffic continued rapid growth. In 1835, 176 steamboats arrived, replacing nearly all keelboats, and Galena became dependent on this new transportation. Between 1835 and 1848, lead production rose from 11 million to 55 million pounds annually. By 1848, Galena lead had outstripped furs as a factor in St. Louis economy. That year, St. Louis did $300,000 worth of business in fur receipts and $500,000 in business associated with the Santa Fe Trail, compared with an 1847 traffic in lead worth $1,654,077.[24]

Between 1840 and 1860, Galena produced 80% of the nation's lead. Such prosperity made Galena a commercial center whose influence extended far beyond the lead trade. By the 1850s she had become the most important wholesale center north of St. Louis.[25] Her use of gold and silver as currency brought her into contact with Chicago, where such currency was available.[26] Just as St. Louis had earlier become the dividing point between upper and lower river, so Galena now became a dividing point for traffic between St. Louis and St. Paul. So much traffic developed between Galena and St. Paul that in 1853 a highway was built to connect the two, with regular stage service. Of the steamboat arrivals at St. Paul in 1857, 213 were from Galena, compared with 156 from St. Louis.[27]

Lead traffic continued to dominate upper river commerce. Of the 365 boats which had made their way above the Des Moines Rapids between 1823 and 1848, 200 were primarily in the lead trade. In 1848, 30 boats were exclusively in that trade.[28] But many of the 300 arrivals and departures at Galena by the late 1840s carried other goods as well, in and out of Galena's wholesale warehouses. Increasing numbers of boats began to make Galena their home port, until by the mid-1850s, Galena commercial interests owned and controlled a large share of the steamboat business on the Upper Mississippi. Residents such as Captain Smith Harris were the first to organize boat traffic into regular packet lines, and Galena boats made daily trips to warehouses at St. Paul, Dubuque, Rock Island, and even St. Louis.[29]

The port of Galena enjoyed prosperity until the 1850s. Then, as rapidly as it had grown, the steamboat traffic disappeared. Some lead had always gone east from Galena to markets there. The Wisconsin River-Fox River route to Green Bay had proved too costly because of the portages necessary, but by 1840 lead was regularly going overland to Milwaukee, reaching eastern markets more cheaply than via the Mississippi.[30] Such diversion eastward made little dent in river traffic, however, until 1854, when the Galena and Chicago Railroad tracks reached Galena. Shipments of lead by river immediately fell to their lowest point in 15 years and within 5 years had almost disappeared.[31]

Galena herself might have survived the shifting transportation patterns had not the railroad the following year gone on to Dunlieth on the east bank of the Mississippi across from Dubuque, leaving Galena with only lead to depend on, lead that was giving out. When it did, so did Galena. By 1860, Dubuque had passed Galena in size and population, and the Fevre River had begun to silt in. By 1870, Galena was inaccessible by steamboat. Her population dwindled from a peak of more than 9,000 to less than 4,000 as the commercial "emporium of the Northwest"[32] lost contact with the Mississippi River.

THE GOLDEN AGE OF STEAMBOAT TRANSPORTATION: 1850-1865

St. Louis, meanwhile, continued to improve her standing as an inland port. Steamboats were crowding her waterfront by the late 1840s. Visitors to St. Louis reported as many as 100 steamboats lined up along the levee, many firing up for departure. On May 17, 1849, the inevitable happened. A spark from a smokestack ignited a boat, and when it was over, the Great Fire, as it came to be known in St. Louis folklore, had destroyed 22 boats and 15 city blocks.[33] Although this was more spectacular than the average steamboat accident, it did not affect traffic. From 1852 until 1860, St. Louis never had less than 3,000 steamboat arrivals annually. In 1853, 529 more boats stopped at St. Louis than at New Orleans.[34] The 3,449 arrivals in 1855 surpassed arrivals at Pittsburgh (1,987), Cincinnati (2,845), Louisville (2,427), and New Orleans (2,763).[35] In 1856, a watchman reported being able to walk from deck to deck for 20 city blocks along the St. Louis levee without touching land.[36] By 1860, although many of the steamboats arriving at St. Louis were smaller than those touching at other ports, the St. Louis river trade averaged 200 million dollars annually.[37]

Even smaller ports along the Upper Mississippi were busy in the 1850. Burlington, Iowa, recorded 500 steamboat arrivals per year.[38] Similar statistics were being compiled for Davenport, Rock Island, and Dubuque. Even this early, traffic on the Upper Mississippi showed a preference for short haul rather than long haul or through traffic, an aspect that remains true today. In 1857, for example, steamboat arrivals at St. Paul originated all along the river, almost as many from Prairie du Chien (138) and Dubuque (123) as from St. Louis (156).[39] The entire upper river was so busy that the demand far outstripped the supply of boats, and the increased rates made it possible for a boat to pay for itself in two years.[40]

PASSENGER TRAFFIC

Just as fur and then lead had earlier provided the bulk of shipments for steamboats on the Upper Mississippi, passenger traffic dominated river economy from 1850 until the Civil War. By 1850, receipts from passenger traffic exceeded freight receipts, and did so until the mid-1860s.[41] Passenger traffic came from two sources. A small but steady number of passengers were excursionists who came from the east to take the popular "fashionable tour" of the Mississippi. Arriving at St. Louis (generally from the Ohio), passengers would travel by steamboat to Rock Island, Galena, Dubuque, Prairie du Chien, Lake Pepin, to the head of navigation at Fort Snelling and the Falls of St. Anthony. The tour included a return trip to Prairie du Chien, then up the Wisconsin River to

Fort Winnebago, Green Bay, Mackinaw City, Sault Ste. Marie, Detroit, Buffalo, Niagara, and home.[42] In 1854 the small settlement of St. Paul, then six years old, hosted 1,200 of these visitors.[43] That same year the excursion became even more popular as the railroad reached the Mississippi at Rock Island, making access to the river easier for easterners. Despite the rise of tourism, however, the overwhelming number of passengers who crowded the Mississippi steamboats during this period were the immigrants who arrived in the Midwest during the first great wave of immigration, 1848-1860. Nearly every immigrant had to make all or part of his trip by steamboat.

St. Louis, its population already doubled from immigration between 1845 and 1849, increased even more rapidly after 1850. By 1860, St. Louis had 61,390 American-born residents and 98,086 foreign-born.[44] Far more immigrants, however, arriving at St. Louis from Pittsburgh or New Orleans, went north by steamboat into newly opened territory in Iowa and Minnesota. Iowa's population rose from 43,000 in 1840 to 192,000 in 1850, and to 674,000 in 1860. By that year, 1860, the 2,028,948 residents of Minnesota, Iowa and Missouri exceeded by 400,000 the combined populations of Arkansas, Texas, New Mexico, California, Oregon, Washington, Nevada, Utah, and Colorado.[45] Communities all along the Upper Mississippi Valley repeated the pattern of Lansing, Iowa, which went from one cabin on the river bank in 1850 to 400 residents by 1854. From steamboat landings at Guttenberg, Lansing, La Crosse, in fact all along the river, settlers fanned out toward rich Midwest farmlands, and in the process, brought the steamboat on the upper river its moment of glory.

The Port of St. Paul

Fur had created St. Louis, and lead, Galena. Passenger traffic now took a small settlement known as Pig's Eye by squatters who settled there in 1838 after being kicked off of Fort Snelling reservation land, and turned it into a thriving commercial center with the more respectable name of St. Paul. The settlement had only 642 residents in 1849 when it was chosen the capitol of the new Territory of Minnesota. When it was incorporated as a city five years later, it had grown to 10,000.

The creation of the Territory of Minnesota brought about the golden age of steamboating on the Upper Mississippi. The number of immigrants boarding boats at St. Louis and traveling upriver to St. Paul dwarfed the 1849 gold rush to California and Oregon.[46] Minnesota's 6,077 population in 1850 swelled to 172,023 in the next ten years. In 1856-1857 alone, 90,000 new residents arrived. St. Paul, which had had some steamboat arrivals each year since 1823, began regular packet service in 1847. From 1850-1858, as Table 2-3 shows, steamboat arrivals at St. Paul

increased more than tenfold. Arrivals dropped slightly during the Civil War, and, in spite of immigration into Minnesota through the 1870s, declined even more after the first railroad arrived in 1867.

TABLE 2-3. STEAMBOAT ARRIVALS AT ST. PAUL: 1844-1862

Year	Arrivals	Year	Arrivals
1844	41	1854	256
1845	48	1855	560
1846	24	1856	837
1847	47	1857	1,026
1848	63	1858	1,090
1849	95	1859	802
1850	104	1860	776
1851	119	1861	772
1852	171	1862	846
1853	200		

Source: Hartsough, From Canoe to Steel Barge on the Upper Mississippi, p. 100.

St. Paul's location at the head of navigation on the Mississippi was a distinct advantage. Small boats could continue up the St. Croix River for a short distance or up the Minnesota River as far as Mankato, but seven miles beyond St. Paul the Falls of St. Anthony stopped all navigation. Even those seven miles were so shallow that navigation was restricted to the highest water stage. This, and the fact that St. Paul was a respectable distance from St. Louis, helped the city survive the decline of passenger traffic and go on to become a major Midwest commercial center. By 1870, St. Paul merchants were doing 10 million dollars worth of jobbing business annually, trading with St. Louis, Chicago, and most eastern cities. This business grew to 46 million by 1881 and to 81 million by 1885,[47] by which time St. Paul's population had reached 100,000.

Packet Service

The shift from freight to passenger traffic in the late 1840s led to a major improvement of steam transportation on the Upper Mississippi: the organization of individual boats and their owners into packet lines with regular schedules. Prior to 1840, steamboats, built and owned by single individuals or small groups of men, were operated as individual enterprises. Every boat competed against every other boat for the available freight. Further, boats kept to no schedule as to either time or place.

Size might limit a boat to a particular stretch of river, but aside from that, an owner went where he felt the business was.

Such a system operated quite well for freight, but passengers soon grew annoyed by delays of up to several days as a captain waited at a waterfront until he had enough passengers and freight to make the trip profitable. Both passengers and freight shippers were annoyed further by the lack of uniform rates and through service. Because short haul was more frequent than long haul, a passenger might have to take a boat from St. Louis to Keokuk, another from Keokuk to Rock Island, a third from there to Galena, and a fourth boat to get to his destination at St. Paul. At each stop, he would have to wait for a boat going his way and buy another ticket, at a different rate.

Operating agreements were initiated in 1830 when Joseph Throckmorton arranged with another owner to transport goods above the Des Moines Rapids. Throckmorton's boat ran above the rapids, the other boat below, with keelboats transferring the freight across the rapids. This experiment in guaranteeing through passage on one ticket proved successful,[48] but it led to no other similar arrangements until 1842, when the St. Louis and Keokuk Packet Line began operations. The company began with one boat operating on a regular schedule between St. Louis and the rapids. By 1852, it had expanded to three boats and ran a separate line to Quincy, Illinois.

Packet service above the rapids began in 1847 when the Minnesota Packet Company, organized by Captain M. W. Lodwick with a single boat, began a St. Paul-to-Galena route. Such packet boats, differing from the transient boats, kept to a single route and schedule and rapidly developed into "lines" with multiple owners and several boats. The Minnesota Packet Company, for instance, merged with a rival packet company in 1853 to become the Galena and Minnesota Packet Company, owned by Galena interests. The Galena company began with four boats, including the War Eagle, one of the famous Upper Mississippi boats. As was the case with nearly every packet line until the last packet boat disappeared, the history of this line was one of constant alteration and merger. In 1855 the company added a boat to make connections with the newly completed Illinois Central Railroad at Dunlieth, and became the Galena, Minnesota and Dunlieth Packet Company. This, in turn, absorbed a rival, the Dubuque and Minnesota Packet Company in 1857 and became the Galena, Dubuque, Dunlieth and Minnesota Packet Company. In 1863, William F. Davidson, who had formed the La Crosse and St. Paul Packet Company in 1860, gained control of the Galena Company and merged both companies into the White Collar Line. This soon competed with a line formed by minority stockholders from the old Galena Line, until Davidson gained control and

merged the two into the Northwestern Union Packet Lines in 1886, controlling 30 boats and barges and a shipyard, and dominating shipping on the upper section of the river.[49] Davidson extended operations down to St. Louis, where he ran into competition from the Northern Line of St. Louis. These two lines and a third, under Davidson, merged in 1873 as the Keokuk and Northern Line Packet Company, the "tightest monopoly in the history of western steamboating."[50]

A year later, Davidson's line was bankrupt. It was reorganized and consolidated, eventually ending up being absorbed into the Diamond Jo Line of Dubuque, run by Captain Joseph Reynolds, Davidson's equal in fame and power on the Upper Mississippi. The Diamond Jo Line was the last company to operate packet service between St. Louis and St. Paul. In 1909 it ran only 4 boats in this trade, compared to the 30 boats on the Davidson combine in 1875. These last Diamond Jo boats were sold to the Streckfus Line in 1911, which ran them until 1917, when they were converted into excursion boats for day trips, effectively ending packet service on the river.

THE CIVIL WAR

The golden age of steamboating--especially for St. Louis--came to an abrupt end in 1860 with the beginning of the Civil War. The war closed southern ports and sent Upper Mississippi steamboat traffic even further into the short haul trade. While traffic was aided to some degree by troop transport and other federal business, the St. Louis-to-New Orleans trade never fully recovered. In 1860, before the war, St. Louis sent 472 boats to New Orleans; in 1880 she sent only 157.[51] St. Louis was further hurt on December 10, 1861, when the Union placed her entire river commerce under military surveillance and control. The trade restrictions imposed by the federal government hurried the eastward movement of freight which had begun in the mid-1850s. Recovery was also hindered by close identification with the South. Commercial interests on the upper river had always perceived St. Louis as Southern and Chicago, tremendously helped by the war, as Northern.

THE DECLINE OF STEAMBOATING: 1860-1915

On September 8, 1866, 36 steamboats--one for each state--and a 37th representing Washington, D.C., left the St. Louis levee in a grand parade up the river. At Alton, Illinois, the steamboat Andy Johnson picked up her namesake, President Johnson, as well as Admiral David Farragut, General Ulysses S. Grant, and a party of other distinguished visitors. The armada steamed back to St. Louis, made a trip to Jefferson Barracks, and returned to St. Louis. The Mississippi River represented an opportunity to reunite North and South by restoring river commerce, and this trip was to inaugurate a new and more glorious era in that commerce.[52]

The mood among rivermen themselves was more gloomy. They watched the railroad tracks, which had arrived at the Mississippi in 1854 and begun to cross it in 1856, begin to parallel the river. They knew that the railroads had captured much of the passenger service and high class freight, and many were already predicting the end. Then Mark Twain returned to the Mississippi in 1882 for a nostalgic trip from New Orleans to St. Paul, he noticed how few boats were on the river. Passing the St. Louis waterfront, he was saddened by the "half a dozen sound-asleep steamboats where I used to see a solid mile of wide-awake ones." He pronounced Mississippi steamboating dead.[53]

The assessment of the rivermen eventually proved correct, but it was a gradual process, masked by a boom in lumber and logging that made the period from 1870 to 1910 the busiest the Upper Mississippi had ever experienced. It was also complicated by changing transportation habits. A towboat and its barges in 1890, for example, equaled the freight capacity of several packetboats of the 1850s. Yet a decline there was, as became painfully evident in 1915 following the end of the logging traffic. By that time, the fleet assembled by the Rock Island District, Corps of Engineers, to work on a channel project was by far the largest operation on the upper river.[54]

Measured by steamboat arrivals at St. Louis, river traffic remained relatively constant throughout the last half of the 19th century. Average annual steamboat arrivals at St. Louis (Table 2-4) and estimates of commercial tonnage carried on the Mississippi between the Missouri and Ohio rivers (Appendix A) show variations more due to yearly differences in river conditions than to declining traffic. In fact, total tonnage on the western rivers doubled between 1860, when Twain was pilot on the river, and 1882 when he returned and discovered a "dead" river.[55] The number of boats passing measurement points on the Upper Mississippi continued to increase slightly until 1892, when a peak of 5,468 boats passed the Winona, Minnesota, bridge, in addition to about 1,000 barges and 2,000 log and lumber rafts.[56] Much of this traffic was short haul, so that the Quincy and Hannibal bridges recorded only half as many boats as Winona; but river traffic was far from dead.

TABLE 2-4. AVERAGE ANNUAL STEAMBOAT ARRIVALS AT ST. LOUIS: 1866-1895

Years	From Lower Miss.	From Upper Miss.	From Mo. River	From Ill. River	From Ohio River	Total
1866-1870	712	947	335	370	252	2,675
1871-1875	805	922	139	268	177	2,354
1876-1880	863	909	141	262	191	2,365
1881-1885	786	894	104	188	143	2,226
1886-1890	767	909	145	160	152	2,114
1891-1894	864	796	97	147	105	2,009

Source: Dobney, River Engineers on the Middle Mississippi, p. 44.

River traffic, however, was in trouble. By 1880, the steamboats were left with little but low class freight, which they primarily moved from port to port along the river.[57] Much of it, in fact, was sand, gravel, and other supplies being transported by the Corps of Engineers to various improvement projects. Each trip from a gravel quarry along the river to an improvement site--perhaps only a few miles--counted as one boat trip if it passed under a bridge, through a lock, or past another data collection site. Logs and lumber rafts were also counted in tonnage figures. In 1889, for example, the cargo transported on the Upper Mississippi system was slightly less than 7,000,000 tons, a figure somewhat less impressive when one removes the 4,500,000 tons of lumber and forest products (lath and shingles) included in the total.[58] Finally, it is important to note that while steamboat traffic remained fairly constant until the 20th century, both the railroads and the economy of the Upper Mississippi Valley increased rapidly, so that to remain level was actually to decline. Table 2-5, traffic passing through the Des Moines Rapids Canal from 1891 to 1903, shows how lumber inflated the figures. The total freight tonnage for 1903 also includes, for the first time, government rock and gravel and other maintenance items.

TABLE 2-5. DES MOINES RAPIDS CANAL TRAFFIC: 1891-1903

	1891	1895	1899	1903
Steamboats	577	760	882	713
Barges	191	272	381	158
Passengers	10,260	21,778	27,489	47,893
General Merchandise, tons	12,228	40,365	25,105	15,838

	1891	1895	1899	1903
Grain	63,210 tons	54,345 tons	6,902 bu.	1,278 bu.
Lumber, feet	140,654,084	101,649,575	78,857,657	9,500,000
Logs, feet	24,514,000	13,616,000	32,142,560	3,400,000
Shingles	61,141,137	28,866,520	24,564,721	3,200,000
Lath	39,476,926	28,834,228	18,502,200	900,000
Total freight	4,200,000	2,250,000	2,900,000	4,545,129

(Source: Merritt, Creativity, Conflict and Controversy, p. 162.)

Grain Trade: The Shift to Towboat and Barge

The thousands of immigrants who had come up the river by steamboat in the 1850s should soon have been sending their grain and surplus produce back down the river from the rich Midwest farmlands and giving the steamboat its next important commodity. It did not happen, an early sign of serious trouble for Upper Mississippi transportation. The farms were producing--grain harvests in the north central states rose from 95 million bushels in 1859 to 321 million bushels in 1889--but only a small percentage made it down river to St. Louis. An even smaller percentage--a peak of 16 million bushels--made it all the way to New Orleans for shipment east or overseas.[59] In 1866, 15 million bushels of grain were shipped on the river above Rock Island; only 1 million bushels reached St. Louis.[60] None of the 318,000 hogs shipped from above Rock Island that year made it to St. Louis.[61]

It was unfortunate for steamboat interests that grain became an important commodity at the time the railroads reached and crossed the Mississippi and the Civil War sealed off the water route south. Shippers got into the habit of moving their grain by rail to Chicago and retained that habit following the war, in spite of cheaper water rates. There was never much contest. In 1875, 10 years after St. Louis began shipping grain east by rail, 77,996 tons of grain reached St. Louis by river. Grain shipped that year over the 13 railroad bridges that crossed the Mississippi between St. Louis and St. Paul, destined for Chicago, totaled 1,659,673 tons.[62] Table 2-6 shows how flour and grain shipments to Chicago jumped in 1854, when the railroad reached Rock Island, and again in 1860 as a result of the Civil War.

TABLE 2-6. SHIPMENTS OF FLOUR AND GRAIN EAST FROM CHICAGO, 1838-1863

Year	Bushels	Year	Bushels
1838	78	1849	2,895,959
1839	3,678	1850	1,858,928
1840	10,000	1851	4,646,591
1841	40,000	1852	5,873,141
1842	586,907	1853	6,422,181
1843	688,907	1854	12,902,320
1844	923,494	1855	16,633,645
1845	1,024,620	1856	21,583,221
1846	1,599,819	1857	18,032,678
1847	2,243,201	1860	31,109,059
1848	3,001,740	1863	54,741,839

Source: Dixon, A Traffic History of the Mississippi, p. 35.

River traffic's response to this loss of the grain trade to the railroads was the development of the barge and the towboat. Barges were already in common use on the Ohio, where coal was an important commodity, and on the Lower Mississippi, where the deeper channel permitted greater tonnage and larger, more powerful boats. The use of barges on the Upper Mississippi did not develop until the 1840s, and, until the Civil War, such use consisted primarily of attaching loaded keelboats alongside a standard steamboat. Such traffic was never extensive. Insurance was unavailable for such arrangements until 1852, and then only at twice the rate for regular steamboat traffic.[63] By the end of the Civil War, however, flat-bottomed, shallow-draft barges had emerged in large numbers. In 1866, 180 barges were employed in the St. Paul trade, with a combined tonnage triple that of all steamboats entering the port.[64]

In addition to tremendously increased cargo capacity, barges offered the same ease of loading and flexibility as railroad cars. Grain did not have to be sacked as it did when carried on boats, and, like rail cars, barges could be picked up and dropped off as needed on the way up or down the river. These improvements brought water rates down well below rail rates for the shipment of grain and other bulk goods. Barge rates were typically one-fifth the steamboat rates, falling as low as four cents a bushel from St. Louis to New Orleans.[65] From 1887 to 1903, the average rate per bushel by water from St. Louis via New Orleans to Liverpool was five to nine cents cheaper than via rail to New York to Liverpool.[66]

An especially busy barge traffic developed between St. Louis and New Orleans in the 1870s as these ports attempted to recapture the grain trade. In 1875 the Mississippi Valley Barge Line, with 4 towboats and 30 barges, was organized specifically to compete with railroads for the grain trade. By 1887, four barge lines were running 16 towboats and 120 barges, all in the grain trade, with a capacity of more than 3 million bushels of grain a month. By 1889 these lines had consolidated into the St. Louis and Mississippi Valley Transportation Company and with specially designed towboats provided long haul service from St. Paul (and even the Minnesota River) to New Orleans. That year it did its largest business: 549,464 tons of freight.[67]

In order to handle barges on the Upper Mississippi, the steamboat had to evolve into the towboat. The early keelboat-barges were often towed behind the steamboat, permitting only one per boat and making for difficult control in the river currents of the upper river. The practice of pushing barges ahead of the boat began in the 1840s and 1850s, and became standard after the Civil War. In order to control the five or six large barges pushed ahead in this way--enough to fill more than 100 rail cars--steamboats soon lost their gingerbread and unnecessary decks and developed exceptionally strong engines and multiple rudders. These "balance rudders" extended both fore and aft of the paddlewheel and permitted the wheel to draw water through the rudders for the added control needed to control the tow. The boats themselves grew smaller and more compact. They soon began to carry only fuel and crew, all the cargo going to the barges.

As can be seen by Table 2-5, however, the towboat and barge never did come to dominate traffic in the 19th century on the Upper Mississippi. By lowering rates as dramatically as they did, they competed with the steamboat lines even more seriously than with the railroads, and perhaps hastened the decline of river traffic. Even with significantly lower rates than railroads, the barge lines were unable to attract grain and other freight back to the river. Shippers believed that the heat and humidity via the New Orleans route somehow harmed the grain, and that it was safer, if more expensive, to ship by rail to Chicago. Shipments of grain between St. Louis and New Orleans declined after 1896, and stopped temporarily after 1903.[68]

THE RAFTING INDUSTRY

Although steamboats continued to be an active presence on the Upper Mississippi during the last half of the 19th century, the most characteristic sight on that stretch of river from 1866 to 1910 was the raft. Composed of logs or finished lumber, typically an island 600 feet long

and 270 feet wide, it was steered by a crew who lived on its surface. It carried more tonnage down the river for fifty years than did all other vessels put together. The largest of these rafts reached 1,500 feet long, as much as ten million board feet of lumber.[69] Bridges built during this period needed raft spans in addition to steamboat spans. By 1915 these rafts had brought nearly all the white pine in Minnesota and Wisconsin downriver to sawmills between St. Paul and St. Louis. The economy of nearly every town along the river north of St. Louis was dominated by the lumber industry. Those communities which did not have sawmills for the log rafts had retail yards supplied by lumber rafts sent down from Minneapolis and other locations on the upper part of the river.

Logs had been floated down the river to sawmills as early as 1839; the modest amounts of local lumber available along the Mississippi had already given out. White pine from the St. Croix and other Wisconsin tributaries was an ideal replacement, strong, straight trees 120 to 160 feet long and 3 feet in diameter. Immigration during the 1850s increased the demand for lumber, a demand which continued to increase long after the Minnesota and Wisconsin forests were gone. By 1873, 680 log and lumber rafts were passing under the Government Bridge at Rock Island each year, and by 1884 that number was 1,056,[70] in spite of the fact that most of the major sawmills were above that location and had already taken their share. In 1886, 1,315,120,020 board feet of lumber was floated on the Upper Mississippi.[71] The peak year for the logging industry came in 1892, when 632,350,670 board feet of logs came out of the Chippewa River alone.[72] Because the river transported the logs, Table 2-7 gives some indication of the size of the rafting business during its busiest years.

TABLE 2-7. LUMBER MANUFACTURE ON THE MISSISSIPPI FROM ST. PAUL TO ST. LOUIS: 1886-1894

Year	Lumber	Shingles	Laths
	Feet	Number	Number
1886	934,735,854	274,581,750	267,888,340
1887	988,361,094	363,239,750	---
1888	1,048,951,386	423,655,050	---
1889	1,044,555,298	463,132,700	---
1890	1,231,678,960	508,986,705	---
1891	814,228,707	332,666,750	207,722,350
1892	931,806,305	356,014,775	228,042,910
1893	811,576,588	285,897,000	190,394,000
1894	673,572,000	204,198,000	158,586,000

Source: Merritt, "The Development of the Lock and Dam System on the Upper Mississippi," p. 132.

As rafting became an increasingly important part of river traffic, it grew into an art. Early rafts were loose booms of logs floating down the river and often breaking apart, much to the annoyance of steamboats using the channel. These rafts soon became more sophisticated structures composed of individual units, or brails, tied together into larger rafts, tight enough to hang together but loose enough to bend around curves and twists in the channel. After the Civil War, assembling these rafts became big business at the mouths of all the Wisconsin tributaries. The largest such operation, the Beef Slough Boom and Improvement Company, began operations at the mouth of the Chippewa River in 1867. Logs coming down the Chippewa River from the several logging companies had to be separated by their brands (put there by each company to identify its own logs), and made into rafts. The Beef Slough operation provided work for up to 1,500 men during the busy season.

Even though such rafts were superior to free floating logs, they were hard to navigate, especially at broadened river stretches such as Lake Pepin, where wind and storm-generated waves frequently tore rafts apart, and where the lack of current made navigation difficult even in calm weather. As early as the 1850s, steamboats were used to assist rafts through Lake Pepin. Several experiments at using boats on other stretches of the river took place in the 1860s, but the boats used lacked the power to control the huge rafts. The first boat built specifically for rafting was the Le Claire, built in 1866 at Le Claire, Iowa, but it also proved too underpowered. Three years later, the first successful raftboat, the J. W. Van Sant, was launched at Le Claire. The Van Sant was a small, 100-foot by 20-foot, sternwheel boat. In 1870, she took a raft of lumber to Rock Island for the Weyerhauser and Denkman Lumber Company, lowering her hinged chimneys so that she could pass underneath the Rock Island Bridge through the wide raftspan rather than through the draw.

Within 20 years, 100 raftboats were at work on the Upper Mississippi. By 1893 rafts were also using smaller boats, known as bow boats, lashed sideways to the front of the raft, to provide additional steering control, especially when passing bridges. But the lumber industry was already moving west. After 1893 only four new raftboats were built, although some old ones were rebuilt (a common practice on the upper river).[73] The end of the rafting business was a topic of much conversation among rivermen, who knew it was coming. It came in the summer of 1915, when the Ottumwa Belle under Captain Walter L. Hunter took a last load of lumber down the river.[74] People along the river turned out to watch.

The Port of Minneapolis

When Minneapolis and St. Paul were both small settlements, it seemed that St. Paul, at the head of navigation, would become Minnesota's great commercial center, while Minneapolis, surrounding the Falls of St. Anthony and its tremendous water power potential, would become the manufacturing center. Until the 1870s, that was how the two cities developed. Even before Minneapolis began, St. Paul had been a trade center. Minneapolis soon attracted several productive flour mills to the falls. In the 1870s, the mill owners developed better ways of milling Minnesota's spring wheat and flour production rose, from 200,000 barrels a year to 7,000,000 by 1890. Minneapolis became the world's leading wheat market.[75]

Little of this flour left Minneapolis by river. The falls and seven miles of shallow, very swift water separated the mills from the head of navigation at St. Paul. Of the 1,000 or more boats visiting St. Paul annually by the 1850s, only about 50 made it up to Minneapolis.[76] In addition, by 1880, Minneapolis was connected to the Great Lakes and the eastern markets by the Milwaukee and St. Paul Railroad. The city also depended on railroads to reach out to northern and western Minnesota, and soon became the hub of an important rail network. Minneapolis passed St. Paul in population in 1880 and went on to become by far the larger of the two cities.

Logging operations in northern Minnesota eventually brought Minneapolis into competition with St. Paul as a river port. The first logs came down the Mississippi from Fort Ripley in 1848 to a sawmill at the falls. That first season, 500,000 to 700,000 board feet of lumber were cut.[77] Sawmill operations at the falls grew rapidly after the Civil War, until by the 1890s Minneapolis had become the nation's leading sawmill as well as flour milling center. Table 2-8 compares the sawmill output at Minneapolis with the other Upper Mississippi sawmills. In 1899, Minneapolis sawmills reached a peak of 594,373,000 board feet before gradually declining. Production had fallen to 64,798,000 feet by 1915, and in 1921 the last Minneapolis sawmill closed.[78] By then the government had begun to improve the channel below the falls, so Minneapolis was able to anticipate a future return of river traffic to replace its lumber shipments.

TABLE 2-8. SAWMILL OUTPUT FROM MINNEAPOLIS TO ST. LOUIS, 1894

Locality	Lumber (Feet)	Locality	Lumber (Feet)
Minneapolis	491,256,793	Clinton	101,662,000
Hastings	2,750,000	Fulton	14,120,000
Red Wing	8,059,000	Moline	28,188,000
Alma	900,000	Davenport	50,500,000
Winona	119,500,000	Rock Island	84,500,000
Lansing	15,000,000	Muscatine	56,000,000
Prairie du Chien	12,500,000	Burlington	27,000,000
Guttenberg	14,000,000	Fort Madison	16,000,000
Cassville	1,000,000	Keokuk	10,000,000
Dubuque	51,650,000	Canton	4,700,000
Bellevue	2,037,000	Quincy	21,500,000
Lyons	12,006,000	Hannibal	20,000,000

Source: Merritt, Creativity, Conflict and Controversy, p. 164.

THE DECLINE OF RIVER TRAFFIC

Almost every one of the many river improvement conventions which met along the Upper Mississippi after the Civil War had someone or something to blame for the decline of river traffic, and some solution which would turn the industry around again. Congress was to blame; the Corps of Engineers was to blame--for doing nothing, for doing the wrong thing, for doing it the wrong way. Strangely, many of the conventions left unnamed one important culprit, but rivermen were quick to single out the railroad as the villain. The rivermen, in turn, were reluctant to assume their share of the blame. Hindsight makes it easier to discern the causes for the decline.

River Conditions

From 1823 until the 1870s, steamboatmen worked hard designing boats increasingly adapted to the conditions of the Upper Mississippi. They achieved amazing results in increasing cargo capacity on shallower drafts, but eventually the state of the art reached its apex. The steamboat had become as light, powerful, and maneuverable as it could.

About that time, in 1866, the Corps of Engineers arrived, on a permanent basis, to begin a series of navigation improvements. Beginning with the worst stretches, the Rock Island and Des Moines Rapids, eventually expanding to the entire river between Minneapolis and St. Louis, the

Corps slowly deepened the channel. Nevertheless, as the channel improved, traffic continued to decline; and natural conditions over which neither steamboatmen nor Engineers had any control were contributors.

Midwest winters were determining contributors to the decline. While St. Louis could depend on being ice free for nearly the entire year, St. Paul at the northern end of navigation was closed by ice for an average of 143 days each year. This became a critical factor for river traffic when the goods shipped changed from furs and lead--which could wait for the spring thaw--to grain and farm produce--which needed to get to market when the price was right.

In nearly every year, a low water season of up to several months further limited the shipping season. Low water was undependable, too. It could come in June and again in October. To add to the problem, seasons of exceptionally low water tended to come for several years at a time, followed by several years of floods and high water. There were several years in the 19th century when boats could not get within 100 miles of St. Paul. In 1863-64, when the low water mark was reached, becoming the basis of all future measurements, no boats made it above La Crosse, Wisconsin, for the entire season.[79] By making navigation difficult, the low water season increased freight rates by as much as 50%, driving even more freight to the railroads.[80]

Low water made steamboat service impossible at times, unpredictable at other times. Shallow water on long stretches of the river, even as improved by the Engineers, kept the Upper Mississippi boats smaller than their more economical big sisters down south, but another problem no amount of water could help: the Mississippi pointed in the wrong direction. The Midwest's ties to the East were both emotional and commercial. The East was the market for nearly all the produce and raw materials of the Upper Mississippi Valley, and the supplier of manufactured goods. Small settlements along the river imagined themselves as future "Lowells of the Mississippi" rather than future Mobiles. Especially following the Civil War, residents of the river valley came to resent both St. Louis and New Orleans for their strategic locations on the river which gave them control over all goods shipped by water. Chicago and other Great Lakes ports fed on this resentment; the railroads, too, used it to advantage.

The Lack of Steamboat Organization

Natural obstacles were givens, and had to be endured, but for the lack of organization and cooperation which characterized the steamboat

industry throughout its history, steamboatmen themselves must take responsibility. The ease of entry into the boat business contributed to that lack. The public character of the inland waterways--open and free to all without expense and maintenance--allowed almost any group or individual with a small amount of capital to build a boat and enter the trade, where clearly there was money to be made. Henry Shreve's exploits with the Washington in 1817 whetted more than a few appetites. Even that primitive boat, in two round trips between New Orleans and Louisville, paid its running expenses, the original cost of the boat, and returned a profit of $1,700 to her owners.[81] In 1818 the Fulton-Livingston boat Vesuvius on a single trip to Louisville earned $47,000 in freight charges--half of it profit.[82]

The result of these temptations was that new boats would flood a lucrative trade route and lower rates through competition until they were lower than expenses. For example, shipping lead from Galena to St. Louis cost 92¢ per hundred pounds in 1841, but competition had driven it to 8¢ by 1844, and it eventually fell to 3¢.[83] When enough competitors went bankrupt at this rate and dropped out, rates rose once again. Boat owners were always on the verge of making a killing or losing their shirts.

Not even the organization of boats into packet lines after the Civil War helped much. These lines, however large, were seldom more than loose arrangements between owners of separate boats; at the most they were partnerships or associations. They were also underfinanced, so that the slightest dip in the economy forced reorganization or consolidation. Even at the height of the packet business, the lines ran into competition from wild boats which could charge what they wanted and go where they wanted, undercutting the lines. Unlike railroads which arrived in the Midwest with boards of directors and eastern capital, steamboating remained a world of fiercely independent operators, reluctant to organize, make agreements, or set rules which would make river traffic better business, but less free. The steamboat industry resisted attempts to regulate boats, create safety standards, and mandate regular inspections. Not until 1852 was there any kind of government regulation of boats, and then only to limit boiler pressure, define passing rules, and provide escape routes on the boats.[84]

The independence of steamboat owners and operators also made transfer of goods from one route to another difficult. Boat owners seldom cooperated on rates or permitted through shipping via more than one boat or line, even though such cooperation would have kept them more competitive with railroads. Terminal facilities were another problem caused in part by such independence. There were none. Steamboatmen expected the communities on their route to

provide warehouse and terminal facilities; the towns, in turn, expected the companies to build them. Until 1865, for example, St. Louis had not a single grain elevator to store grain for shipment down river. There were no docks or wharves, no unloading machinery, no credit or banking facilities for the boat traffic. Most stops along the river did not even have enclosed warehouses or provisions for shipping goods inland from the port. Goods unloaded by steamboats sat in the open, subject to theft and bad weather, until the owner came to pick them up.[85]

While the steamboat grew more sophisticated, steamboat operations did not. What worked satisfactorily in the river economy of the 1820s worked less well as commerce in the Upper Mississippi Valley grew more complex. While their cargo capacity was increased, the boats were not modified to handle specialized freight as were railroad cars from the beginning. Boats continued to carry both passengers and freight, and to carry all kinds of freight together. There were no passenger boats, until the excursion traffic of the early 20th century.

Railroad Competition

On February 22, 1854, the tracks of the Chicago and Rock Island Railroad reached the Mississippi River at Rock Island. That spring to celebrate the occasion, the contractors invited the press and a number of distinguished citizens on a joint rail-water tour to the Falls of St. Anthony. Early in June, the guests assembled at the Tremont House in Chicago. They included President Millard Fillmore, Samuel J. Tilden, George Bancroft--already a national historian--and other prominent social and political figures. Nearly every important eastern newspaper was represented.

On June 5, the party left Chicago in 2 trains of 9 coaches each. They were met at each stop by bands, fireworks, and military parades. At Rock Island, 1,200 of the guests boarded 7 boats of the Minnesota Packet Company for the trip to St. Paul and the falls. With cows on the lower deck for milk and boats often lashed together for visits and dancing, this Grand Excursion, as it came to be called, turned into "the most brilliant event of its kind ever witnessed in the west."[86]

This cooperation between rail and water traffic was continued for several years as other railroads reached the river. Steamboat traffic even increased from the extra passenger and freight brought by the railroads. At first, the railroads in the Midwest were short lines connecting two waterways, as was the case with Chicago and Rock Island. By 1856, however, the Chicago and Rock Island Railroad had crossed the Mississippi over a bridge located in such a way as to make it hard for boats to fight

the current through the drawspan; a boat had already hit a pier, caught fire and sunk; and it was this symbol of competition rather than cooperation that came to represent the two transportation systems. As most rivermen knew, the railroad was the chief single reason for the decline of river traffic.

Railroads easily and rapidly attracted traffic away from the river. Within a year after Chicago and Rock Island were linked by rail, tracks had reached the Mississippi at three other locations: at East Burlington; at Dunlieth, opposite Dubuque; and at Fulton, opposite Clinton, Iowa. In 1856 the Burlington Railroad reached Quincy, and by 1858 Milwaukee had rail lines to both Prairie du Chien and La Crosse. At the same time, only three rail lines had reached the Mississippi south of Quincy, at St. Louis, Cairo, and Memphis. River traffic therefore declined much sooner on the Upper Mississippi. By 1880, 13 railroad bridges crossed the river between St. Paul and St. Louis. When Mark Twain visited Minneapolis on his 1882 visit, he found that 16 separate rail lines met there, with 65 arrivals and departures of passenger trains daily.[87] Railroads not only began crossing the river, they began paralleling it. By 1880, St. Paul and St. Louis were linked by rail, taking away even the short haul business that had been left to the steamboats.

The effect on river traffic was immediate and drastic. Corn shipped to Chicago rose from 2,991,011 bushels in 1852 to 7,490,753 bushels in 1854 when the rail route to Rock Island was completed.[88] Each railroad reaching the river siphoned off more traffic. By 1879, over 85% of the surplus produce of the trans-Mississippi states went east by rail and the Great Lakes, and only the remainder went south by water.[89] By 1890 the total rail business out of St. Louis was 12 times the river traffic; by 1900 it was 32 times; by 1906 it was 100 times.[90]

The railroads were able to make such inroads easily for several reasons apart from the lack or organization among their competitors. Rail routes were invariably shorter than water routes between the same two points. St. Paul and St. Louis were 683 miles apart by water, but only 585 miles apart by rail. Railroads were also relatively free to go where they wanted to go, including across country to rural and urban centers inaccessible by boat. Especially, they could go east and west. Wherever they went, each railroad had a virtual monopoly on its own routes, unlike the steamboat which had competition at every port. Trains could go more rapidly than boats. They could go daily with as many or as few cars as needed. And, they could go all year round, on time. The railroads also had public sentiment on their side for the above reasons and because the railroads stimulated local economies in a way boats did not.

In addition to these advantages, the railroad companies were highly aggressive. They quickly improved their own services by such things as more comfortable passenger cars and specialized freight cars. They built a variety of terminal and transfer (rail to rail) facilities, and arranged for through tickets on each others' lines. Railroads were even more aggressive toward their competition, as, of course, the steamboats had been toward their predecessors on the river. Regularly, where they competed with water routes, railroads lowered rates to drive boats out of business, a practice not regulated until the Interstate Commerce Act of 1887. Again, until forced, railroad companies provided no booms or other navigation aids to get boats through their bridges. Most bridges were designed and placed with little attention to navigation needs. When the railroad did make shipping agreements with packet lines, they did so only until rail lines had been extended and the boats made unnecessary. Several railroads bought packet lines, but only to get rid of the competition, a practice that became so serious that Congress, by the Panama Canal Act of 1912, divorced railroads from ownership of any competing water carriers.[91] Even more serious than these forms of competition were the rail lines running parallel to the river, as close to the waterfront as possible. This effectively separated boat traffic from levees and landings and made it difficult for boats to load and unload. Along these lines at most waterfronts, the railroads bought land and constructed terminals, preventing such future development by river traffic.[92]

It was no contest. The urgent hustle of the railroad quickly dominated the more leisurely steamboat traffic. The steamboat industry responded, not by banding together to fight the railroad competition, but by competing even more fiercely with each other for what traffic remained. In 1890, the Diamond Jo Line, the lone survivor of the competition, could not declare a reasonable dividend, and the end was in sight. The railroads had won.

St. Louis vs. Chicago

Nowhere can the story of this rail-water competition be seen more clearly than in the 19th century rivalry between Chicago and St. Louis. Each city early picked its champion--St. Louis the river and Chicago the railroad--and went into the lists. St. Louis was the southern city, romantic and well-mannered; Chicago the northern city, brash and all business. St. Louis was the commercial center of the Upper Mississippi Valley, Chicago the young upstart. But Chicago knew what was at stake. "Chicago offers her best wishes to her anxious sister," said a Chicago newspaper editorial directed at St. Louis, "and asks only a fair field and an honorable struggle for the prize of commercial supremacy--the position of the great central city of the continent."[93]

St. Louis' mistake was not taking rail competition--or Chicago--seriously, and continuing her dependence on the river for commercial prosperity, with little effort to improve her waterfront. A St. Louis editorial in 1855 bragged about the busy waterfront with 58 steamboats loading and unloading at once; 240 drays and 2,000 men were busy with 20,500 packages. At the same time, Chicago's lake port was handling even more business with no drays and only a quarter of the men St. Louis needed. Already, Chicago's excellent water and rail terminal facilities were undercutting the expensive and old fashioned operation at St. Louis,[94] all of which was being done by hand.

The Civil War worked to Chicago's advantage by shutting down the river below St. Louis and by increasing the importance and number of railroads. When river traffic to New Orleans resumed after the war, even the less expensive water rate--68¢ per bushel of wheat from Dubuque via Chicago to New York compared to 38¢ via St. Louis and New Orleans to New York--could not restore traffic. Shippers considered the railroad safer and the water route "unhealthy," and goods in increasing amounts left the river and went east to Chicago. By 1869, shipments and receipts at Chicago exceeded shipments and receipts at St. Louis for every single major commodity, including lumber. That year Chicago received 23,475,000 bushels of grain compared to 3,320,712 bushels for St. Louis, with shipments in the same proportions. Even in lumber, so adapted to transport by river, receipts at Chicago surpassed St. Louis, 997,737,000 to 176,082,000 board feet.[95] When St. Louis finally realized it might be in trouble, a St. Louis booster wrote: "But alas! St. Louis that used to be a Samson of strength, and a ruling master of the commercial domain from the Allegheny to the Rocky Mountains . . . has fallen a sleepy victim into the lap of the artful Delilah that is cunningly watching in the garden city on Lake Michigan."[96]

St. Louis eventually did become a railroad center in the 1870s. Its position at the foot of the Upper Mississippi system, at a point where boats had to transfer cargo anyway, should have made it a great rail-water center, but by then it was too late. In 1869 Chicago became the great link in the newly-completed transcontinental railroad and solidified her position as the rail center of the Midwest, if not of the nation. The 1870 census showed St. Louis' population of 310,864--4th largest in the United States--slightly more than 10,000 ahead of Chicago, but Chicago was already tired of competing. It knew it had won.

Even at St. Louis, the river eventually lost to the railroad. Table 2-9 compares the shipments and receipts by river and rail at St. Louis from 1871 to 1906. The river traffic remained as high as it did primarily because of traffic from the Lower Mississippi. Of the 1890 shipment

TABLE 2-9. SHIPMENTS AND RECEIPTS BY RIVER AND RAIL AT ST. LOUIS, 1871-1906, IN TONS

	Water		Rail	
Year	Shipments	Receipts	Shipments	Receipts
1871	770,498	884,401	959,882	2,298,321
1875	639,095	663,525	1,301,450	3,232,770
1880	1,037,525	893,860	2,755,680	6,096,524
1885	534,175	479,065	3,537,133	6,794,168
1890	601,862	663,730	5,270,850	9,969,291
1895	303,355	508,830	5,349,327	10,489,344
1900	245,580	512,010	9,180,309	15,375,441
1905	90,575	289,850	15,225,973	23,915,690
1906	89,185	327,670	17,672,006	27,292,617

Source: Dixon, A Traffic History of the Mississippi, p. 53.

total of 601,862 tons, for example, only 22,547 were shipped to points on the Upper Mississippi.

On a smaller scale, Minneapolis and St. Paul engaged in the same kind of rivalry in the 1870s. St. Paul depended on her position at the head of navigation to maintain her position as a thriving commercial center, while Minneapolis turned to railroads. Between 1870 and 1880, Minneapolis reached east to Milwaukee by the Milwaukee and St. Paul Railroad, south by the Minneapolis and St. Louis Railroad, and west and north through the operations of railroad giant James J. Hill, whose St. Paul, Minneapolis, and Manitoba Railroad eventually became the Great Northern. During those ten years the population of Minneapolis rose from 18,080 to 46,887. In 1880 it passed up St. Paul and assumed a dominant commercial and manufacturing position it has never lost. Although as both St. Louis and Chicago had done, Minneapolis and St. Paul eventually developed both water and rail traffic, Minneapolis today handles more rail traffic while St. Paul does more business as a river port.

Chapter 3

RIVER IMPROVEMENT WORK

At the birth of the United States, almost every stretch of its inland waterway network needed some improvement. The main stems and tributaries which formed the water highways for early settlement and commerce were perversely filled with all sorts of obstacles to navigation. The Lower Mississippi was peppered with snags--trees that had washed off the banks and become stuck, often submerged, in the channel--which reduced the life of a steamboat to an average of five years. The Upper Mississippi had rapids, shallow water, and bars, and a twisting channel that moved from bank to bank.

However, even Presidents favorable to federal involvement in internal improvements--Jefferson, Jackson, and Van Buren--doubted the constitutionality of such work. The explorations of Lewis and Clark, and the trips up the Mississippi by Pike and Long, did serve a number of non-military purposes, but they were made under the guise of national defense. National defense--particularly lessons learned from the War of 1812--also justified the establishment of a board of one naval and two Corps of Engineers officers to study the logistical, including transportation, needs of the military. The resulting report, sent to Congress in 1818 and approved by John C. Calhoun, the Secretary of War, proposed a detailed scheme for building roads and canals and for improving navigation in inland waters. The plan, naturally enough, assumed that Army Engineers would provide the necessary surveys, plans, and supervision for these improvements, thus laying the groundwork for the involvement of Engineers in nearly all subsequent river improvement work.[1]

Congress appropriated some money for surveys on the Ohio and Lower Mississippi as early as 1820, but there were no regular "rivers and harbors" appropriations until 1824. That year Congress, under pressure from western politicians and interests, passed the General Survey Act "to procure the necessary surveys, plans, and estimates, upon the subject of roads and canals."[2] The act gave the President authority to employ officers of the Corps of Engineers to make surveys he deemed to be of national importance.

EARLY SURVEYS AND EXPERIMENTS, 1824-1860

Prior to 1829, the benefits of the General Survey Act were felt only on the Ohio and Lower Mississippi, where a lively steamboat traffic was already developing. Henry Shreve designed and built a twin-hulled snagboat on government contract in 1829, but aside from a small amount of

snag removal between St. Louis and the mouth of the Ohio, this boat, the Heliopolis, operated on the lower river. North of St. Louis, traffic and settlement were too sparse to require improvements.

The voyage of the Virginia in 1823 was followed by a rapid increase in traffic, however, and in 1829, Chief of Engineers, Brigadier General Charles Gratiot, ordered Lieutenant Napoleon B. Buford, 3d Artillery, on Topographical duty, to "make reconnaissance and survey of the Des Moines and Rock River rapids, with a view to overcoming the obstacles to the navigation of the river at those points."[3] This was the first of many surveys of the rapids, the two worst obstacles to Upper Mississippi navigation, made during the next 30 years.

Buford's surveys, made in February of 1829 with the Mississippi covered by a foot of ice and 9 inches of snow, produced simple but rather accurate topographical maps. Although he explored the possibility of canals at both rapids, he found the technological problems "almost insurmountable" and recommended improving the natural channel by blasting. He noted the military advantages of such improvement by pointing to the lead mines at Galena, just beginning heavy production, but Congress took no action.

At the same time, another problem was troubling St. Louis. By 1830, the river current passing St. Louis was building a long bar that threatened to close off the St. Louis waterfront just as serious river traffic was beginning to develop. The city of St. Louis spent $3,000 in 1833 to hire ox teams to plow up the bars, but this did not work. A request by St. Louis to the House of Representatives Committee on Roads and Canals brought General Gratiot himself to the city. Gratiot consulted Henry Shreve about the St. Louis problem and also requested him to examine the Des Moines and Rock Island rapids. Shreve drew up plans for cutting a channel through the Rock Island Rapids, recommended a lateral canal around the Des Moines Rapids, and, together with Gratiot, worked on a plan to divert current from the Illinois shore toward the St. Louis waterfront to wash out the bar, but his snagging responsibilities prevented him from carrying through with any of these plans.

Instead, the following year, 1837, General Gratiot sent a young, eager lieutenant in his Washington office, Robert E. Lee, to St. Louis, where he was to improve the waterfront. Lee was also ordered to resurvey the two rapids and begin improvement work there. As Lee's assistant, Gratiot appointed Lieutenant Montgomery C. Meigs, who later became Quartermaster General of the Union Army. Lee spent three seasons in St. Louis. In 1837, with $35,000 to spend on the St. Louis waterfront and $40,000 to spend on the rapids, he and Meigs surveyed the rapids more

carefully than Buford had done and drew up plans for the St. Louis project. During the surveys, they experienced the difficulties of the rapids first hand, going aground on the Des Moines Rapids and making their office at Rock Island on a steamboat sunk in the channel up to the second deck.[4] Lee recommended that Shreve's plan for the Rock Island Rapids be followed, but he rejected Shreve's plan for a canal at the Des Moines Rapids, suggesting instead that the natural channel would be easier to excavate to the required 200-foot by 5-foot passage. Lee estimated that improvement of the Des Moines Rapids would require $189,622, while the Rock Island project would require $154,658, an estimate that turned out to be short by about $5,000,000. In planning and carrying out this work, Lee and Meigs were doing pioneer work. Federal work before this had been limited to snagging.

Lee, now a captain, returned to St. Louis with his new assistant, Horace Bliss, in 1838 to begin the actual work. Sending Bliss north to work on the Des Moines Rapids, Lee turned to the St. Louis project. Generally, he followed Shreve's suggestions for diverting water toward St. Louis. The plan was to construct a dike from the Illinois shore to Bloody Island, a sandbar in the middle of the Mississippi, closing off the Illinois channel, and another dike at the foot of the island to force the water toward Duncan's Island, the bar which threatened St. Louis. Money was not available for the entire project in 1838, so Lee constructed only the dike at the foot of the island. It was primitive but effective, composed of two rows of pilings 40 feet apart, filled in with brush and rocks. This 2,500-foot dike produced immediate results. 700 feet of Duncan's Island had washed away by October, and the shoal water between the two bars had deepened 7 feet.[5] At this point, congressional appropriations ended and were not renewed for the 1839 season. Lee continued work in 1838 with money raised by the city of St. Louis, but by the end of the 1839 season the project had not been completed.

At the Des Moines Rapids, Bliss had less satisfactory results. Changing river conditions and the experimental nature of the work made blasting and rock removal slow. Lee and Bliss gained valuable experience at underwater blasting, and developed several innovative methods that would prove helpful to future improvement work, but when the money was gone at the end of the 1839 season, only a small section of the Des Moines Rapids--a passage 50 feet wide and 4 feet deep through a single reef--had been completed.

During the next 15 years, from 1840 to 1855, economic conditions and congressional inclinations kept surveys and improvements to a minimum. In 1838 the Corps of Topographical Engineers became a separate organization, remaining so until 1863, and to them fell most of the responsibility

for these works. The Rock and Des Moines rivers were surveyed between 1838 and 1841 by Topographical Engineers. In 1843 Major Stephen H. Long became Superintendent of Western River Improvements. Under his direction the first harbor improvement work above St. Louis was begun in 1844 when Congress appropriated $7,500 for deepening the harbor at Dubuque to "accommodate steamers of the largest class." A small amount of work was done at Dubuque with a steam ladder dredge designed for that project by Long, but the Mexican War, 1846-1847, ended appropriations and drew many of the Engineers away from civil works.

The passage of the Western Rivers Improvement Act in 1852 brought renewed activity to the Upper Mississippi. Congress appropriated $90,000 for navigation work below the rapids, $100,000 for work on the two rapids, and $15,000 to complete the Dubuque harbor project. During 1854, however, problems with high water and a lack of available contractors kept spending to only $15,000, all of it for rock excavation at the two rapids. The act of 1852 also brought Major Long to St. Louis to superintend these projects. Work on the Dubuque harbor resumed in 1853. The project consisted of cutting a channel from Dubuque across the Mississippi to the main channel along the Illinois shore. Now there was a new urgency: the railroad was approaching from the east.

Major Long detailed one of his assistants, Lieutenant Gouverneur K. Warren, to make yet another survey of the rapids. Warren, after graduating from West Point, had gained his field experience as an assistant on an 1850 survey of the Lower Mississippi. He surveyed both rapids during the 1853 season and produced the first careful, detailed maps of them. Because of support among rivermen for Shreve's plan for a canal at the Des Moines Rapids, Warren made an especially careful study there. At low water, boats with drafts deeper than 24 inches could not pass the rapids. The channel along the Iowa shore had only 10 to 12 inches of water, and was used only by "lighters," small horse-drawn boats used to transfer cargo from packets so the larger boats could cross the rapids. Warren agreed with Shreve that a canal might be an eventual permanent solution, but felt that excavation of the natural channel would provide immediate relief--needed because of the rapid increase in steamboat traffic in the 1850s--while a canal would not be useful until it was completed. The use of lighters was both time-consuming and expensive. Warren reported that the lighters needed "luck and eight horses" to make the trip from Keokuk to Montrose at the head of the rapids in six hours.[6] Lightering charges in 1853 were $1 per ton down the rapids and $1.25 up; in addition, the boat crew had to be paid regular hourly wages while waiting during the transfer of cargo. Travel over the 14 miles of Rock Island Rapids was not much faster. Warren and his crew were forced by the current to tow their boat along shore from Davenport up to the head of the rapids at Le Claire. They

arrived 3 hours ahead of a steamboat that had left Davenport at the same time.[7]

Contract work on both rapids began in 1854 and continued for three seasons, but by the end of the season in 1856 the projects were far from complete. The work was slowed by the usual unfavorable river conditions and by a new difficulty, that of getting workers, most of whom had gone off to work at higher wages for the railroad companies in the area. The railroad bridge completed at Rock Island in 1856 created an additional hazard at the Rock Island Rapids. Major John Floyd, the officer in charge of that project, felt the bridge to be such an obstruction that he stopped work on the channel.[8] He had some reason; of the 1,667 boats and rafts passing the bridge in 1857, 50 collided with the structure.

At the close of the 1856 season, work stopped on the rapids and on Dubuque harbor, ending all improvement work until after the Civil War. Only the St. Louis harbor project was in working order, following repairs by Major Long in the late 1840s to the original project. The Mississippi had more of an effect on the Engineers than they had on it. They had experimented with new equipment, much of which they had designed themselves; developed new improvement methods; and gotten to know the river well enough to prepare for more permanent and extensive improvements which would come after the war.

THE BEGINNING OF PERMANENT IMPROVEMENT, 1866-1878

The Civil War had been good for the railroad, but it also pointed up the need for inland waterway improvements. Congress saw the Mississippi, especially, as a means of uniting North and South. Furthermore, the Republican Party had begun its career in favor of such improvements, unlike the reluctant Democrats who controlled Congress from 1840 to 1860. Increasing pressure on Congress also came from representatives of cities along the Upper Mississippi. A convention convened by the St. Louis Merchant's Association at the end of 1865 pointed out that during that year, river commerce had lost $500,000 at the Des Moines Rapids alone by detention and accident. If the river was to remain competitive, it would have to be improved.

Responding to this pressure and their own inclinations, congressmen soon began approving larger projects. The beginning of permanent navigation improvement on the upper river came in the act of June 23, 1866, which appropriated $200,000 for the Des Moines Rapids, $100,000 for the Rock Island Rapids, and $100,000 for other channel improvements and surveys north of St. Louis. To carry out this work, Chief of Engineers Andrew A. Humphreys appointed three Engineer officers to separate posts. He

assigned Warren, by then a brevet major general and a major in the Corps of Engineers, to duty at St. Paul to examine the Upper Mississippi above the Rock Island Rapids, as well as its tributaries (the St. Croix, Minnesota, Cannon, Chippewa, Zumbro, and Wisconsin), to determine the best means of bridging the Mississippi with the least obstruction to navigation, and to determine the best means of obtaining a 4-foot channel from St. Louis to the Falls of St. Anthony. Lieutenant Colonel John N. Macomb was made Superintendent of Western Rivers Improvement outside the Ohio, with offices at Cincinnati, and with the primary duty of designing and building snagboats. Lieutenant Colonel James H. Wilson was ordered to Keokuk to superintend the improvement of the Des Moines and Rock Island rapids and to survey the Rock and Illinois rivers.

During August and September of 1866, Warren examined the whole length of the river from Rock Island to St. Paul both from shore and by packet. He considered several methods of dredging before deciding on a scraper designed earlier by Major Long. The following year he bought two steamboats, outfitted them with the Long scraper, and refitted them as dredge and snagboats. Warren's experiments with these boats during the 1868 season showed promising results. When he began work in July, the water was so low large boats could not navigate. Scraping sandbars made it possible for river traffic to operate for the rest of the season. Scraping, however, was not permanent; the next cycle of high water would replace sand on the bars. As part of his duties, Warren pioneered in the marking of the channel to guide pilots. Guide boards six feet square and painted white with a large red cross were placed along the banks, fastened 20 or 30 feet from the ground. Steamboat pilots at first ridiculed the guides, but soon came to depend on them.[9]

In 1868 Warren was sent west to examine the construction of the Pacific railroads. When he returned in 1869 he was placed in charge of the new railroad bridge at Rock Island, replacing the original structure which had been deemed a hazard to navigation and which was in the way of the new national arsenal then under construction on Rock Island. Warren made several innovative changes in the bridge design, including a 366-foot drawspan operating on a pivot, by far the heaviest drawspan operating on that principle yet built.[10] General Warren ended his years of service on the Upper Mississippi the following year when he was transferred to the Lakes Survey in Detroit.

Meanwhile, Colonel Wilson had begun work on both rapids projects. At the Rock Island Rapids, Wilson decided to follow the improvement method suggested by Buford, Lee, Shreve, and Warren, a channel 200 feet wide and 4 feet deep through the natural channel. The problem at Rock Island was not shallow water, but a treacherous channel created by fingers of rock

which extended from each shore. These rock fingers created narrow channels and cross-currents which made it hard for a boat to steer through them. The Rock Island Rapids had created a unique occupation headquartered at Le Claire. Here boats approaching the rapids stopped to take on a rapids pilot who know the channel. After taking a boat through, the pilot would leave the boat at Davenport, and wait to be hired by a boat coming upstream through the rapids back to Le Claire. Of the 14 miles of rapids, 11 had good deep water; only 3 miles were difficult. Knowing where those three miles were was the problem.

Cutting off the projecting rock points, creating a channel from pool to pool, seemed to be the obvious solution. There was, however, some apprehension from rivermen that cutting a channel would in effect allow the deep pools to drain, making the entire rapids shallow. The Board of Engineers convened by Wilson was sure this would not happen, and so the improvement work began.

Three methods were used to excavate rock at the rapids. A limited amount of submarine blasting was carried on at St. Louis and Moline Chains (as the rock fingers were called) using techniques developed by Lee in 1837. Some excavation by chisel boat and dredge was carried on at locations where the water was deep or the area to be excavated was small, but this was slow and almost as undependable as submarine blasting. Most of the excavation was done by erecting coffer dams around the area to be excavated--as small as 2.26 acres on Upper Chain; up to 43.07 acres on Campbell's Chain--and then emptying the water in order to quarry the rock. Even with coffer dams, the work went slowly. The Upper Mississippi was subject to quick rises of water which often flooded the site, and passing steamboats were not as careful as they should have been in avoiding the dams; but for the first time the improvement work began to show significant results.

With this work on the Rock Island Rapids, the Corps of Engineers developed a procedure they have often used since. Rather than beginning at one end of the rapids and moving methodically to the other, cutting the channel to the required dimensions as they went, they began with the worst obstruction first, then moved on the second-worst, and so on. This little-here, little-there policy looked uncoordinated to outsiders, and it seldom showed immediate and dramatic results, but it was appreciated by rivermen.

The Des Moines Rapids presented a different problem and there Wilson determined on a different solution. At the Des Moines Rapids, the river, in wearing a channel down, had exposed an 11-mile strip of rock much harder than the rock above and below it. This was a layer of cherty limestone of the Keokuk series inclined at the same slope as the river. This

smooth rock bed acted like an artificial dam with deep water behind it and very shallow water over its surface. There were undulations in the surface, and the high points were called chains, but they were not like those at Rock Island, with a channel through them. The water surface showed none of the ripples characteristic of rapids, making it difficult for pilots to guide boats through what deep spots there were. Cutting a channel through the Des Moines Rapids would have meant excavating the entire 11-mile length through hard rock. For this reason, Wilson decided to return to Shreve's recommendation for a lateral canal along the Iowa shore.

A lateral canal had several advantages over the other possibilities. A series of locks and dams would have slowed traffic the entire season and prevented boats from using the main channel during high water, when the rapids presented no problems. This was especially important now that rafting had become the main item of river traffic. The wide rafts were far more maneuverable on an open channel. Raising the water level by constricting the channel through wing dams would have made the current too swift for upstream boats. In addition, a canal would not interfere with navigation while it was under construction, it would leave the main channel open for rafts and for boats in high water, it would provide guide walls that not even an improved channel would have, and it would provide a slack water channel, especially important for boats coming upstream. The lateral canal was favored by rivermen and Keokuk residents. In 1848 a Keokuk company had drawn up extensive plans for such a canal, which would also have provided water power for industry, but financing gave out.

Construction of the Des Moines Rapids Canal began on October 18, 1867. An earth embankment was built in the river to serve as the outer canal wall. The area between the embankment and shore was then excavated to the required 5-foot depth, with the embankment serving as a coffer dam. Wilson's original estimate $3,390,000 and two years to complete was low. Funding by annual appropriations made contract work difficult, and contractors not used to the Mississippi and its vagaries slowed the work. The canal was not opened to traffic until 1877. The completed canal ran for 7.6 miles from Keokuk to Montrose. Beyond that, a 200-foot wide by 6-foot deep channel was cut through the 2,400-foot Upper Chain to the head of the rapids. The canal was 300 feet wide by 5 feet deep, with two lift locks and one guard lock, each 310 feet long and 80 feet wide, large enough for all but one boat then operating on the Upper Mississippi.[11] The cost of its construction was $4,155,000.

The Des Moines Rapids Canal surmounted what had been the worst navigation obstacle on the upper river, and it soon came to be used extensively, even by rafts and raftboats. It continued to handle traffic until 1913, when it was drowned out by the Keokuk and Hamilton Water Power Dam.

As each bad stretch of river was improved, other areas which had, relatively, not been problems, came to seem so. That was the case with the Des Moines and Rock Island Rapids. By 1873, even the partially-improved Rock Island Rapids were less of an obstruction than the channel north to St. Paul. Colonel John Macomb, then District Engineer at Rock Island, began to experiment that year with jetties, or dams, as a means of constricting the channel so that the current would scour out shallow stretches. The crew of the District snagboat Montana closed a chute at the head of Pig's Eye Island, 5 miles below St. Paul, after navigation had become blocked by a sandbar. The jetty built for the job was composed of piles driven close together and faced with planks on the upstream side. It gave way shortly after completion. C. W. Durham, Principal Assistant Engineer at Rock Island and supervisor of the project, decided to experiment with the construction of such wing dams. His replacement dam was built of willow brush weighted down with rock and stone. This 600-foot dam held, and within days the channel was scoured open. More important, it remained that way, unlike dredging improvements, and became the first permanent channel improvement above the rapids. In preparation for the expanded use of wing dams, Colonel Macomb also had the channel from St. Paul to La Crosse surveyed, locating 44 sandbars, 23 of them giving less than 3 feet of water during the low season.[12]

South of the Des Moines Rapids, the river channel was relatively free of obstructions, and no work began on this stretch until 1870. That year, the Office of Western River Improvements moved from Cincinnati to St. Louis. Between 1870 and 1873, this office carried out surveys of the harbors at St. Louis and Alton and of the river bank opposite the mouth of the Missouri. The river traffic in this area from both Upper and Lower Mississippi demanded a deeper and more regular channel to these ports. In 1872, the Engineers raised and strengthened three existing dikes, and protected Sawyer's bend north of St. Louis. The bend was washing away and threatening the city's northern wharfline.[13] The Engineers also built a low dam to divert current toward the harbor at Alton, washing away a threatening sandbar forming there.

The improvements at St. Louis were carried out by the Western River Improvements office until 1873, when a separate St. Louis District, Corps of Engineers, was formed. The new District Engineer, Colonel James H. Simpson, continued work on the projects as well as on another bar threatening the St. Louis waterfront from the south.[14]

THE 4½-FOOT CHANNEL PROJECT

With the opening of the Des Moines Rapids Canal in 1877, the Corps of Engineers had established themselves as a permanent part of the fortunes

of the Upper Mississippi River. There were still critics who talked about "Humphreys and his corpse of Engineers,"[15] but they were generally not rivermen. Among commercial river interests demands to Congress for even more improvements increased. River conventions at St. Louis in 1867, 1872, 1873; at New Orleans in 1869, 1876; at St. Paul in 1875, 1877; and at Prairie du Chien in 1868 kept the pressure on to expand the work of the Corps. River traffic was fighting for its life with the railroads.

Congress responded on June 18, 1878, by authorizing a 4½-foot channel from St. Paul to St. Louis, to be accomplished by contracting the natural channel through wing and closing dams. The channel eventually was to be deepened to 6 feet. Congress appropriated $250,000 for improving the channel from St. Paul to the Des Moines Rapids, and $100,000 for improvements from there to the mouth of the Ohio River.

In the 5 years since Colonel Macomb had surveyed parts of the river, the channel had changed so much that a new survey was required. Consequently, Major Francis U. Farquhar, District Engineer at Rock Island, undertook the first comprehensive survey of the Upper Mississippi from St. Paul to Grafton in 1878. This survey was indicative of the shift in Engineer operations from many scattered duties to one unified project. The 4½-foot channel project also required an expanded Engineer boat fleet and supporting equipment. The Rock Island District began to acquire a fleet of steamboats, steam launches, drilling scows, dredges, derrick boats, and a large number of barges. At its height in 1910, the Rock Island fleet comprised 20% of all steamboats operating on the Upper Mississippi.[16]

To service this growing fleet, the Engineers constructed a dry dock and boatyard adjacent to the Des Moines Rapids Canal in 1883. Such a repair dock was badly needed on the upper river; in spite of the number of packet lines and independent boats operating, not one commercial or public dry dock existed, another example of the casual way boat companies did business. Commercial boat companies were therefore allowed to rent the dry dock and shops when not in use for the Corps fleet.

Work on the 4½-foot channel began in earnest in 1879 with construction of several thousand feet of wing and closing dams at eight locations. Wing dams were not new on the Upper Mississippi. Rivermen had long been suggesting such a project because of the success the logging industry had with similar dams. Raftsmen often constructed brush wing dams up on the tributaries during low water to constrict the water to wash out bars so that logs could pass. Wing dams had also been used on the Ohio and Illinois Rivers to deepen the channel, but they seldom lasted more than several seasons before ice and flooding did them in. In Europe, however, on rivers such as the Rhine, wing dams had proved very effective.

The wing dams constructed were relatively simple affairs composed of alternate layers of willow mats and crushed rock. The mats were composed of bundles of willow poles tied together and lashed into a 12-foot mat. The rock served to weight the mats down. Similar layers of mat and rock were used to protect banks from washing out. The dams went up quickly. The willow and rock quarries along the shore were plentiful and inexpensive, and the dams were durable. Sticking out perpendicular from the bank on each side of the river, the dams constricted the channel to 1,200 feet or less, as needed to produce the necessary 4½ feet of water. During low water the dams rose above the surface, sending all the available water into the constricted channel, both deepening and scouring it; in high water, the dams were submerged so that the water flowed freely.

By 1907 when the 6-foot channel project was authorized, Engineers had built 336.40 miles of wing and closing dams, and 197.30 miles of shore protection above the Des Moines Rapids. They had used 12,323,067 cubic yards of brush, and had spent just over $11 million.[17] The first experimental wing dams in the 1870s were built by hired labor, but when regular appropriations arrived as a result of the comprehensive 4½-foot project, the work was done by contract. Contractors needed assurance of regular appropriations in order to invest in equipment. Wing dam construction provided several large contractors with their entire business from 1878 to 1915, but there was room also for small contractors, those with one or two boats, to build a dam or two. Single individuals even contracted for winter work, repairing holes in wing and closing dams. In this way, nearly all of the money spent by the Government on the project went into local economy through the pockets of laborers and contractors.

In the St. Louis District during this period, a smaller amount of channel contraction was needed. Here Captain Oswald H. Ernst, District Engineer, designed a system of "hurdles" to replace the stone dams formerly used by Lee and others. Hurdles were dams of pilings with spaces in between. They worked by slowing the current, which then deposited its suspended silt around the hurdle. In this way the dam created its own fill.[18]

RESERVOIRS

As early as 1850 another method of controlling water depth on the Upper Mississippi had been suggested. In 1850 the Secretary of War had authorized a famous civil engineer, Charles Ellet, Jr., to make surveys and prepare a report on navigation and flood control on the Mississippi and Ohio rivers. Among his recommendations was a series of reservoirs on small Mississippi tributaries in northern Minnesota which could be

used to regulate the flow of the main stem. Flood waters could be impounded and held until low water, and then released to maintain enough channel depth.[19]

The Secretary of War also designated Engineer officers Captain Andrew A. Humphreys and Major Long to conduct a survey of the Mississippi. The work, delayed by Humphrey's sickness and subsequent reassignment, was not completed till 1861. Co-authored by Humphreys and Lieutenant Henry L. Abbot, the Report Upon the Physics and Hydraulics of the Mississippi River became a classic in the development of hydraulic engineering. Humphreys and Abbot criticized Ellet's plan as costly and of little benefit to either navigation or flood control, insisting that levees alone could tame the Mississippi.

In 1870 General Warren, nevertheless, had officially supported the idea of headwater reservoirs to enhance navigation on the Upper Mississippi in a report he sent to Humphreys, by then a brigadier general and Chief of Engineers. Warren had recommended the construction of 41 reservoirs on the St. Croix, Chippewa, Wisconsin, and Mississippi rivers. However, Congress was not yet prepared to fund such projects; some congressmen continued to raise constitutional questions. When William D. Washburn was elected to the House of Representatives in 1878, he immediately resurrected the idea. In the House, Washburn fought for a federally-funded reservoir system, partly to counter the growing railroad dominance of transportation, and not incidentally because he owned flour mills at the Falls of St. Anthony which would benefit from a more uniform water supply.[20] St. Paul interests opposed it, as might be expected, but in 1880 Congress appropriated $75,000 for a dam at Lake Winnibigoshish. Construction of the dam began in 1881, and additional appropriations in the 1880s built four more dams: at Pokegama Falls and Leech Lake in 1883, at the Pine River outlet of the Whitefish chain of lakes in 1885, and on the Sandy River in 1895. In 1907 Congress authorized a sixth dam at Gull Lake. These reservoirs provided water for the falls, but the effect on navigation was apparent only at St. Paul and for several miles downstream.

LOCKS AND DAMS

Although locks and dams were not originally part of the 4½-foot channel project, two stretches of river could not be improved by wing dams alone. The first of these was the stretch of shallow water between St. Paul and the Falls of St. Anthony. As early as 1857 a group of Minneapolis businessmen planned to build a lock and dam in that area to extend the head of navigation from St. Paul to Minneapolis. The rivalry between the two cities prevented the project for more than 30 years. Finally, on August 18, 1894, Congress approved the construction of Lock

and Dam No. 2 near Meeker Island. Design and construction of the project took longer than expected, but the 80 by 334-foot lock opened for traffic in 1907.[21]

At Rock Island, the rapids had again become an obstruction relative to the now-improved channel from there to St. Paul. The rapids were especially an obstruction for the city of Moline, where a growing farm equipment industry pointed up the need for better waterfront access. The approach to Moline was nearly impossible for boats coming upstream. The Moline and Duck Creek chains had steeper slopes and swifter water than anywhere else on the rapids. Congress authorized construction of a lock here in 1905. The project called for dredging a channel 250 feet wide and 4 feet deep in low water from Moline to the head of the Arsenal Dike above the city, and a similar channel from Moline to the main channel by means of a lock and dam, with a lock chamber 325 by 80 feet. Original plans called for a lock depth of 5 feet, but anticipating the coming 6-foot channel project, the depth was increased to 6 feet. The lock was completed late in 1907, and for the next few years saw intensive use by ferryboats and government equipment; but a rapid decline in river traffic coincided with the opening of the lock, and during its peak month of use, only 182 tons of freight passed through.[22]

OTHER IMPROVEMENT ACTIVITIES

Between 1878 and 1907 the Corps of Engineers carried out several improvement projects unrelated to the 4½-foot channel. The harbor at Dubuque was finally completed in 1885. Twenty-two other harbor projects were completed during this period, including harbors of refuge on Lake Pepin, where storms created huge waves dangerous to lumber rafts and even to steamboats. Congress also authorized improvement of the Galena River which had silted in so that boats could no longer reach Galena. The Rock Island District dredged a small channel 35 to 100 feet wide to just below Galena in 1877 before appropriations stopped. The Galena River was in that borderline area between a navigable river (which was the Corps' responsibility) and an unnavigable river (which came under the jurisdiction of state or local authorities). By a compromise, on September 18, 1890, Congress authorized a joint project in which the city of Galena would keep the channel open to a depth of 3 feet, while the government would build a dam and a 280 by 52-foot lock at Galena. The Rock Island District opened the Galena Lock and Dam in 1894, and for the first year it was well-used, with 471 boats, 5,000 passengers, and 2,000 tons of freight locking through. Traffic slowly disappeared; no traffic of record used the lock after 1921; and the Rivers and Harbors Act of March 3, 1925, directed removal of the structures,[23] ending the port of Galena.

In 1866, Congress had given the Corps of Engineers authority to determine the location, height, and drawspan openings for bridges on the Upper Mississippi. On July 5, 1884, the Engineers were given the added responsibility of ensuring that bridge companies met a requirement to install and maintain adequate booms during the navigation season to guide boats through the draws. The Corps retained control over these bridges until 1966, when the Coast Guard was assigned that duty.[24]

THE 6-FOOT CHANNEL

Not long after authorization of the 4½-foot channel in 1878, many congressmen began to envision a 6-foot channel. By 1905, as the Moline Lock neared completion, it became clear that the increasing use of barges and the competition from railroads meant a deeper channel if the Upper Mississippi were to maintain any kind of river traffic. During the railroad crisis of 1906, when a record crop throughout the Midwest could not be moved to market because of an insufficient number of railroad cars, even James J. Hill suggested increasing the use of the inland waterways.[25] In November 1906, a St. Louis river convention formed the Lakes-to-Gulf Deep Waterway Association, which sent representatives to Washington to urge President Theodore Roosevelt to draw up a plan for comprehensive, basin-wide improvement of the inland waterways. This petition was seconded by every important river town north of St. Louis, and on March 14, 1907, Roosevelt appointed the Inland Waterways Commission composed of representatives of the Corps of Engineers, conservation groups, and others interested in river development. President Roosevelt, members of the commission, representatives of the Corps, and other interested groups made an inspection tour down the river from Keokuk to Memphis in 1908, occasioning the largest steamboat parade in history.

Meanwhile, on March 2, 1907, Congress authorized a 6-foot channel on the Upper Mississippi. (South of St. Louis, the St. Louis District was already trying to maintain an 8-foot channel to the mouth of the Ohio River.) The project was to be accomplished by dredging, wing dams, and additional locks, as had been done for the 4½-foot channel, but it was more complicated than simply making the river deeper. Not only would it require, Congress estimated, 10 years and $20 million, it would affect more than navigation concerns. In establishing the Inland Waterways Commission, President Roosevelt wrote, "It is not possible to properly frame so large a plan as this for the control of our rivers without taking account of the orderly development of other natural resources."[26]

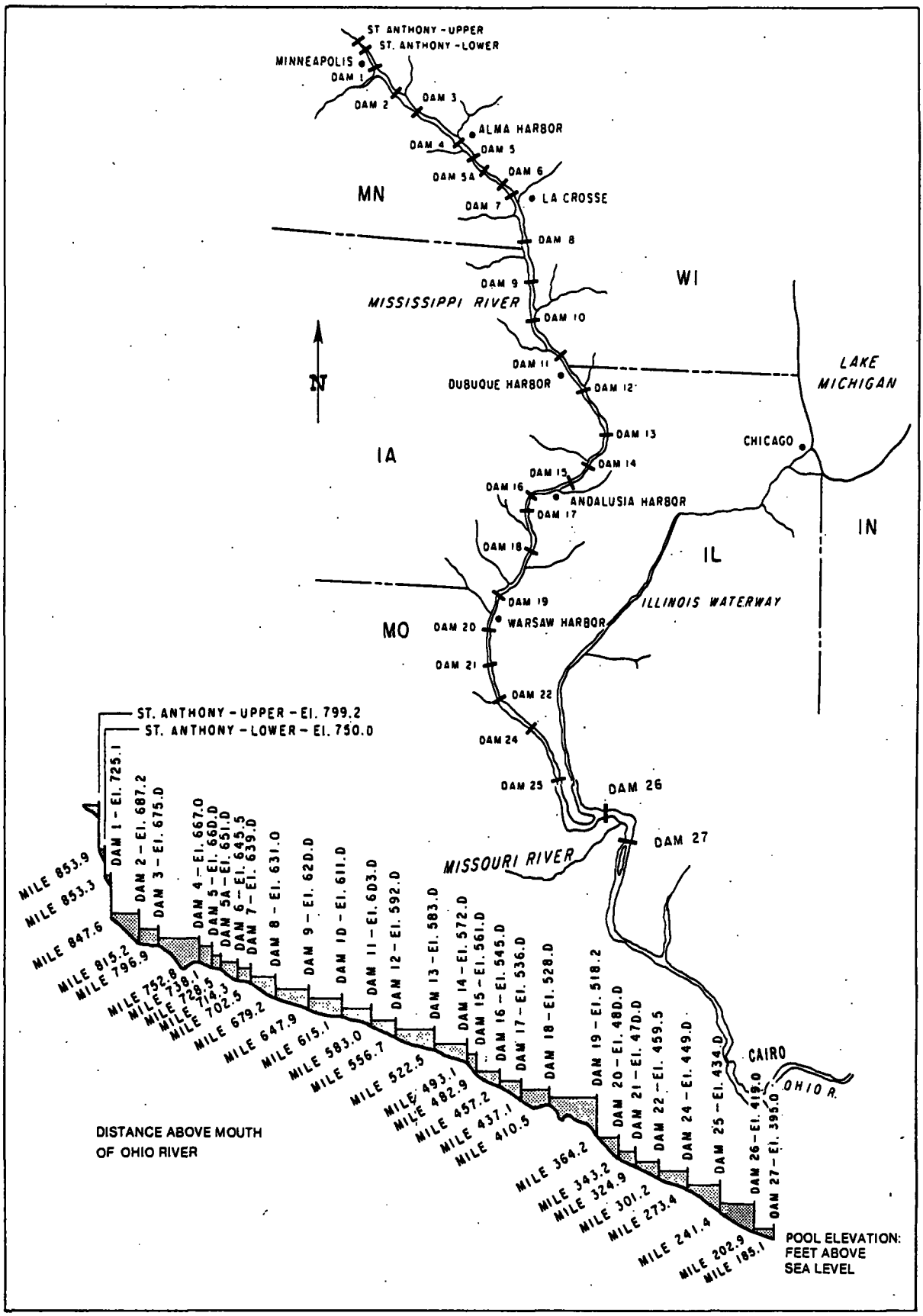
Wing dam construction and dredging proceeded as they had with the 4½-foot channel. The most visible river improvement projects during

this period were three new locks which aided navigation of three separate stretches of the river. The first of these was Lock and Dam No. 1 above Minnehaha Creek between St. Paul and Minneapolis, which had originally been authorized in 1899. Before construction could begin, business interests in both Minneapolis and St. Paul successfully pressed for a higher dam. Although a high dam would drown out Lock and Dam No. 2, which was upstream and had just opened in 1907, it would also generate electricity for Twin Cities' industry. Construction of the "high dam" began in 1910 and was completed in 1917. Lock No. 1 had a lift of 38 feet, and a lock chamber 400 feet by 56 feet. It provided navigation access to Minneapolis, but it was used only by pleasure craft until 1925--Minneapolis still lacked terminals and a turning basin.[27] The name was changed to Twin Cities Lock and Dam No. 1, and then to the Fort Dam, because of its proximity to the Ford plant which used much of the power generated by the dam.

A second lock constructed during this period took care, once and for all, of the Des Moines Rapids. In 1903, Congress approved a plan by the Keokuk and Hamilton Water Power Company to construct an electric generating dam across the Mississippi at Keokuk, a major departure from the free channel on the Upper Mississippi. The Rock Island District consulted river transportation interests before recommending the dam. They discovered that it would slow down those boats (about 15%) that bypassed the Des Moines Rapids Canal and went directly over the rapids, and that it would be hard on rafts which would be kept from using the regular channel. Rafts, however, were clearly on the decline in 1903, and the remaining traffic, which used the canal, would benefit from the single large lock proposed by the power company to replace the three locks of the canal. The saving in time would translate into a savings of six mills perton of freight.[28] The dam would also deepen the channel upstream for 50 miles, covering the entire rapids and saving the government nearly $1 million in improvements that would have otherwise been necessary for the 6-foot channel. The Keokuk Lock opened in 1913. It had a 40-foot lift, and single lock, 400 feet by 90 feet, with a minimum depth of 7 feet over the sill, the most spacious lock then on the river.

The third project in this series improved a stretch at the head of the Rock Island Rapids by a lateral canal and lock around 3.6 miles of rapids at Le Claire. The Le Claire Canal project was authorized on March 5, 1914, although plans for such a canal had been drawn up by a Board of Engineers as early as 1888. The project consisted of a canal 3.5 miles long along the Iowa shore, using Smith's Island extended by a dike upstream, and a single lock 350 by 80 feet, with a 7-foot depth. Construction did not begin until 1921. The Le Claire project opened in 1924. By then, there was already talk among river interests on the Upper Mississippi of a new, even more comprehensive project, the 9-foot channel.

PROFILE OF UPPER MISSISSIPPI RIVER NAVIGATION POOLS



Note: Sites of locks and dams are shown by a name or number.

By 1930, when the 6-foot project became the 9-foot project, the Corps of Engineers had spent nearly $70 million on improvement work, including $52 million on the 6-foot channel project (1907-1930).[29] and almost $12 million on the 4½-foot channel project (1878-1906). None of this, however, had arrested the decline of river traffic, and there were those who viewed the entire improvement work as a boondoggle. The 9-foot channel project, therefore, was not a logical outgrowth of previous efforts.

Chapter 4

EAST-WEST ROUTES AND THE ILLINOIS RIVER

The first suggestion for improving the Upper Mississippi system occurred during the initial voyage of discovery by Marquette and Jolliet in 1673. Jolliet noted the advantages of cutting a slice of prairie between the Chicago and Des Plaines rivers to open a route between Lake Michigan and the Mississippi. La Salle exploring the area early in the next decade agreed, and, in 1705, the French acquired the necessary land from the Indians.[1] Following the Louisiana Purchase in 1803, the Americans, too, became interested in improving on nature. Major Long suggested a canal between the two rivers following his visit for the Topographical Bureau in 1817.

Little was done on an east-west route until the canal craze following the success of the Erie Canal in 1825 awakened several schemes and the rapid settlement of northern Illinois in the 1830s made such schemes desireable. From the beginnings of exploration and the fur trade, the natural routes to market were east or northeast via the Great Lakes to New York or Canada. Goods went south to St. Louis or New Orleans because they had no other place to go. Three east-west schemes developed in the 1830s, one on the Wisconsin River-Green Bay route, one on the Rock River-Milwaukee route, and one on the Illinois River-Chicago route.

In the fall of 1837, the Wisconsin Territorial Legislature incorporated the Milwaukee and Rock River Canal Company, to be funded by a land grant and borrowed money. The company's plan was to run a canal 40 miles between the head of slack water on the Menominee River to the Rock River in the region of Lake Koshkonong, providing a route from Lake Michigan to the Mississippi at Rock Island. Some canal work began on the Menominee River and around the Rock River Rapids at the mouth of the Rock River, but tight money ended the project by 1842.[2]

At the same time further north, on the Wisconsin-Green Bay route by which the French had generally entered the Mississippi Valley, the Fox and Wisconsin Improvement Company began a major canal and lock project to connect Green Bay with the Wisconsin and Mississippi via the Fox River and Lake Winnebago. When this company failed, the project was taken over by the Green Bay and Mississippi Canal Company. By 1866, when the Corps of Engineers arrived in the area, the company had constructed 20 locks and dams on the Upper and Lower Fox rivers, each 100 feet by 35 feet, with a 4-foot depth, providing a channel from Green Bay to the Wisconsin River. The Wisconsin River, however, was blocked by numerous sandbars which gave no more than 2 feet of water,

and settlements built along it in anticipation of heavy use of that route were dying out.[3]

The most successful of the three canal ventures was the Illinois-Michigan Canal, built by the State of Illinois between 1836 and 1848. This canal connected the Chicago River (and Lake Michigan) to the Illinois River at La Salle, then the practical head of navigation. The remainder of the unimproved Illinois was shallow but free of obstructions from there to its mouth at Grafton. The 97 miles of canal had 16 locks 110 feet long, 18 feet wide, and 6 feet deep. Even before the rail connection between Chicago and Rock Island in 1854, this canal had begun to divert traffic from St. Louis to Chicago.

The Illinois-Michigan Canal showed a profit its first year, reaching a peak of $200,000 in tolls in 1862, helped by the Civil War. Then it began a slow decline as a result of railroad competition, general deterioration, and an increasing number of vessels whose dimensions exceeded those of the canal. Canal boats could not be used on the Illinois River proper, and goods had to be transferred at La Salle. Cooperation between canal boat and steamboat companies on schedules and rates was nonexistent; the lack of terminal and landing facilities added further frustrations. The canal sustained a loss every year after 1879.[4]

EARLY FEDERAL SURVEYS AND IMPROVEMENTS

While the Milwaukee and Rock River Canal Company was planning its Rock River project, Congress authorized its own survey of that route. In 1838, Captain Thomas Jefferson Cram of the Topographical Engineers carried out a preliminary investigation of the Rock River and Rock River Haven (a chain of lakes near the present city of Madison, Wisconsin) for a project to connect the Rock River to Lake Michigan by canal, with the 4 lakes serving as feeders for that canal. Cram's brief survey outlines the rapids and bars that would have to be removed in order to make the river navigable, but Congress took no action.[5]

No further federal surveys for an east-west route were made until 1866, when Colonel Wilson and General Warren arrived to carry out improvements on the Upper Mississippi. In addition to this work, Warren was ordered to survey the Wisconsin River for a possible route to Lake Michigan and Colonel Wilson was ordered to make similar surveys for the Rock and Illinois rivers.

The Rock River survey came first. Wilson assigned an assistant, James Worrall, to make this survey, which required him to collect information "sufficient for a project by the Rock River route with all

its details, adapted to the construction of Locks, Dams, feeders, and reservoirs, for a waterway admitting the largest boats now navigating the Western and Eastern waters that form the entrance to such a Canal Route."[6] Such an extensive project was more the result of the canal craze sweeping the country than of reason and realities. Worrall caught the fever. His plan called for 117.5 miles of canal, with 56 lift and 9 guard locks ranging in size up to 200 by 30 feet, and for extensive improvements of the Rock River channel. He imagined a day when ore from Lake Superior and limestone and coal from the lower Rock River would combine, and there would arise "Birminghams, Pittsburghs, along the Rock River."[7]

Both the Wisconsin and Illinois rivers were more likely candidates for an east-west route, but even here both Wilson and Warren were skeptical that such a project would be feasible. They carried out their surveys in 1866-1867, but realized that Congress probably would not fund any such major project. More certainly, two such projects would not be authorized, and a friendly rivalry grew up between the two, each officer taking the side of his region. According to Warren, he "had a private understanding with General Wilson that neither of us should go into his business."[8]

Warren completed an extensive survey of the Wisconsin route in 1867, and laid down a canal route from Portage to Prairie du Chien, using the Wisconsin River for crossings. Wilson's survey, meanwhile, ran into problems. In 1865, Chicago had begun a project to take water from the Chicago River in order to send its growing amount of sewage to the Illinois and Michigan Canal and down the Illinois River. This extra water coming from Lake Michigan would affect the water level on the Illinois to some degree, making any survey and plan for improvement useless. The traffic potential of the canal also needed to be considered in any plan. Wilson and an assistant, William Gooding, began the survey in the summer of 1867 in order to prepare plans for "a system of navigation by way of the Illinois River, between the Mississippi and Lake Michigan, adapted to military, naval, and commercial purposes."[9]

Much to Wilson's surprise and Warren's chagrin, Congress in 1868, appropriated $85,000 for Wilson to begin actual improvement work on the Illinois River. Warren responded by requesting money for a boat for the Wisconsin River project. The Green Bay and Mississippi Canal Company was even more displeased, and perceived the appropriation as a "trick of the Illinois politicians to steal a march upon them."[10] Warren and his successors continued work on the Wisconsin River, constructing 108,000 feet of wing dams by 1886, but a Board of Engineers in 1887 recommended against further improvement, ending the hopes of

the Wisconsin-Fox River route.[11] Long before then, the Illinois River route had won.

THE ILLINOIS RIVER ROUTE

Traffic History

Pressure from Illinois politicians may have helped Congress select the Illinois River route, but well-developed steamboat traffic by 1867 and the growing importance of Chicago as a Great Lakes port and railroad center certainly counted. The Illinois had been busy for some time. As early as 1720, small amounts of produce came down the Illinois by flatboat, bound for New Orleans. In the winter of 1746, a scarcity of provisions at New Orleans brought 800,000 pounds of flour from the French settlements along the river.[12]

Steamboat traffic on the Illinois began in 1828 when a boat came upriver to Pekin. A second boat reached Peoria a year later. At that time there were no settlements upriver from Peoria. In the next 7 years, settlements sprang up at Depue, Hennepin, Henry, Lacon, and Chillicothe. The meat packing plant at Lacon was soon sending steamerloads of meat to New Orleans without breaking bulk.[13] Downstream from Peoria, Beardstown had become an important trade center by 1831. By 1840, additional steamboat trade centers existed at Ottawa, Peru, Pekin, Havana, Naples, Florence, and elsewhere, though Peoria remained the most important.[14] Ten steamboats operated in the Illinois trade, with others making occasional trips as far up as Peru. From July 1841 to July 1842, 432 steamboats arrived at Peoria, not counting the daily Peru packet. Of these boats, 143 came from Peru and elsewhere upstream; the overwhelming majority of the remainder arrived from St. Louis.[15] By 1850, 59 boats operated in the Illinois trade.[16] Revenues during this period came primarily from farm produce and from immigrants streaming into the area from the eastern states.

Packet service developed on the Illinois at about the same time as on the Upper Mississippi. In 1848, E. W. Gould organized the Naples Packet Company which ran two boats, the Time and Tide and the Anthony Wayne, between St. Louis and Naples. Each boat made three trips a week with connections to the Sangamon and Morgan Railroad.[17] The Five Day Line was organized in 1852 to run between St. Louis and La Salle. This line was especially successful because of increased traffic out of the Illinois and Michigan Canal. The largest of the packet companies was the Illinois River Packet Company organized in 1858 with 16 boats and many barges. This company controlled traffic on the Illinois until it sold out in 1867 to the St. Louis and Illinois River Packet Company.[18]

As statistics such as those in Table 2-2 show, traffic on the Illinois River held its own with other tributaries, and even the Upper Mississippi.

With the opening of the Illinois and Michigan Canal, freight began to come upriver as well as down to St. Louis. In its first year of operation, the canal drew off 316,625 bushels of corn and 237,588 bushels of wheat which would otherwise have gone to St. Louis.19 It soon began to attract lumber as well.

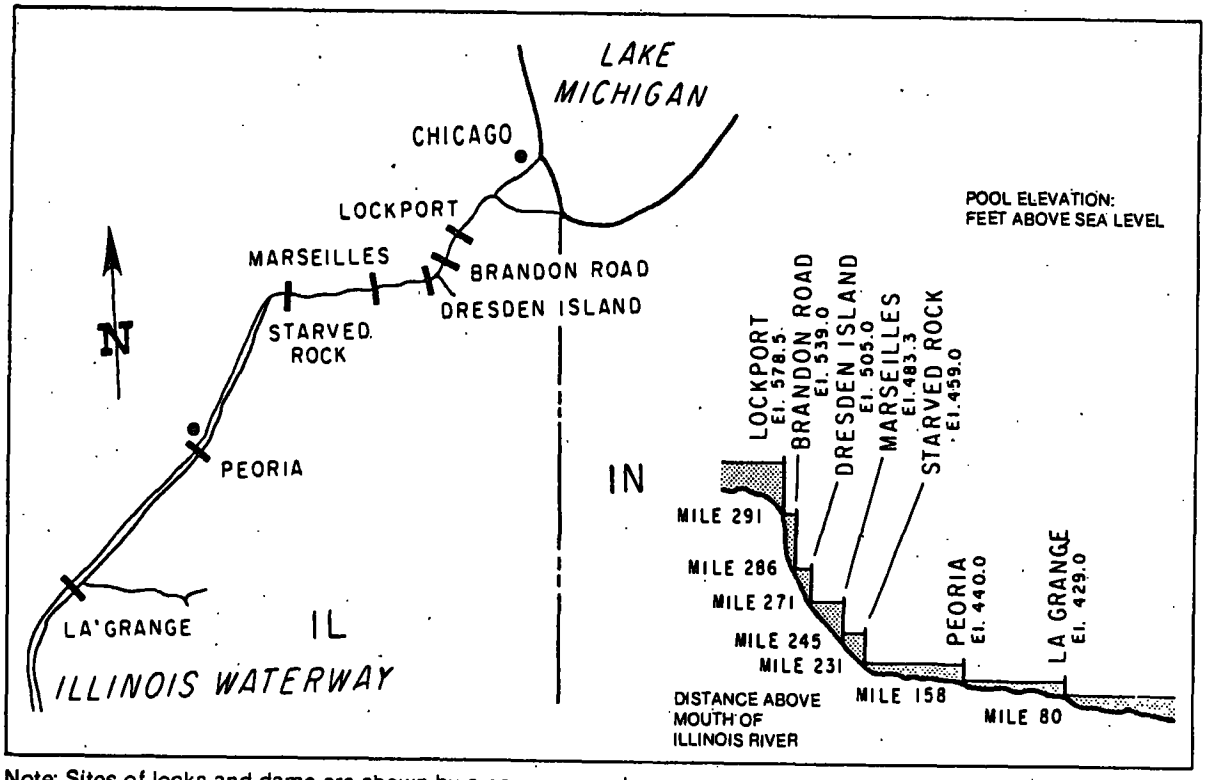
Improvement of the Illinois River

Colonel Wilson's report of 1867 called for a 7-foot channel through a system of locks and dams, but the $85,000 appropriated in 1868 was not enough to do even a part of the project. Congress appropriated an additional $84,000 in 1869, but by then the State of Illinois had begun its own project. Under the direction of the Illinois Board of Canal Commissioners, work began on a lock and dam at Henry, Illinois, as the first step in a slack water system from LaSalle to the mouth of the Illinois at Grafton. The Henry Lock and Dam was completed in 1871 following specifications laid down in Wilson's report. The lock was 350 feet by 75 feet over the miter sills. The pool above the dam could be raised to 7 feet in low water by flashboards placed along the dam. The dam at Henry provided Peoria with good access to Chicago via the Illinois and Michigan Canal.

Wilson meanwhile used the modest appropriation he had received to dredge a channel from the Henry dam to Copperas Creek, site of the next proposed dam in the Illinois state system. A smaller project on the Illinois from 7 to 4 feet, to be accomplished by wing dams and dredging rather than by dams.

Wilson's replacement in 1870, Colonel John Macomb, continued the Illinois project. In 1875 he laid the foundations for the Copperas Creek dam, 59 miles downstream from Henry. The project was then turned over to the State of Illinois, which completed it in 1877. The dimensions were identical to the Henry Lock and Dam. The State regarded both dams as an extension of the Illinois and Michigan Canal, and, as on the canal, charged tolls. By 1878, dredging by the Corps of Engineers below the state projects had produced a 4-foot channel to the mouth of the river, but trouble with sandbars made upkeep constant. Captain Garrett J. Lydecker, District Engineer at Chicago, recommended two more dams, one at La Grange, 58 miles below Copperas Creek, and another at Kampsville, 48 miles below La Grange.

PROFILE OF ILLINOIS RIVER NAVIGATION POOLS



Note: Sites of locks and dams are shown by a name or number.

Work on the Kampsville project began in 1880, followed a year later by the La Grange project. The La Grange Lock and Dam was completed in 1888 and the Kampsville Lock and Dam in 1893. Meanwhile, in 1882, Illinois had offered to cede the Illinois and Michigan Canal to the federal government, which would then enlarge the now-too-small and rapidly deteriorating waterway, but in 1886 a Board of Engineers recommended against accepting the state offer. An attempt to improve the La Salle-Lake Michigan section of the waterway came in 1888 when Congress authorized a survey of the Illinois River for a channel "not less than 160 feet wide and not less than 14 feet deep from La Salle to Lake Michigan."[20] The Engineer report on this project was negative.

By 1893, the State of Illinois had again changed its mind, no longer favoring locks and dams as a means of improving the Illinois River. Rather, Illinois proposed increasing the depth of the river by drawing water from Lake Michigan and diverting it to the river. This project would involve reversing the flow of the Chicago River, and no one knew what that might do to the water level of Lake Michigan. In 1892, the Chicago Sanitary District had already begun work on the Chicago Sanitary and Ship Canal. Completed in 1900, the canal reached from the Chicago River at Robey Street, 6 miles from Lake Michigan, to Lockport on the Des Plaines River, generally paralleling the Illinois and Michigan Canal. Its 22-foot depth and 162 to 290-foot width at the surface made it the most navigable stretch of Illinois waterway; but it left the stretch from Lockport to Utica undeveloped, with traffic forced to use the small Illinois and Michigan Canal. In 1899, the Secretary of War had given the Chicago Sanitary District temporary permission to divert no more than 5,000 cubic feet per second from Lake Michigan down the Sanitary Canal. This was lowered in April of 1901 and raised in December; the rate continued to fluctuate throughout the remaining improvement projects on the Illinois Waterway, making projections for such improvements difficult.

The extra water coming into the Illinois River raised the water level enough to make the federal dams at La Grange and Kampsville unnecessary. The Secretary of War authorized the Chicago Sanitary District to lower the navigation pools behind these dams by 2 feet between 1905 and 1907, so that boats could use the main channel during high water.

Meanwhile, the Chicago Sanitary District began a second route through the Chicago area to Lake Michigan. An 1890 report on a 14-foot channel by Chicago District Engineer Captain William L. Marshall, later Chief of Engineers, although negative about the 14-foot channel, had suggested a new route to Lake Michigan following the lines of the Calumet feeder (which had supplied water for the Illinois and Michigan Canal), the Little Calumet River, through Lake Calumet, to the Calumet River, and

eventually to Calumet Harbor on Lake Michigan. This route would avoid the increasingly congested central Chicago area, where traffic was slowed by many lift bridges, and also would reach the growing industrial area of south Chicago, which contained, among others, the Morton Salt Company, the Chicago Shipbuilding Company, and grain storage terminals.

The State of Illinois gave the Chicago Sanitary District permission to construct an auxiliary sanitary channel in 1903 along the lines suggested by Captain Marshall. Work began on the Calumet Sag Canal in 1911 and was completed in 1922. The new canal required an additional 4,000 cubic feet of water per second from Lake Michigan. It was 20 feet deep, 60 feet wide through rock sections and 116 feet wide through earth. It ran for 16.5 miles to the Little Calumet River just east of Blue Island. Here a 50 by 360-foot lock regulated the flow of water.

One section of the waterway now in serious need of improvement was the Lockport to La Salle stretch of the Des Plaines and Illinois rivers served by the old Illinois and Michigan Canal. In 1908 the State of Illinois voted to enlarge that canal, but funding proved insufficient. In 1920, therefore, the state government returned to the idea of locks and dams as a means of improving this stretch. The War Department approved the plan for five locks and dams, and construction began in 1921. The new locks were 110 by 600 feet, with an 8-foot depth, similar to those under construction on the Ohio River. The project began at the Sanitary Canal exit at Lockport. A new lock was built alongside the smaller Illinois and Michigan Canal lock. Six miles below Lockport came the Brandon Road Lock and Dam. Here the dam created a pool higher than the streets of Joliet through which the waterway passed, requiring the construction of concrete retaining walls from the dam to the upper city limits. The Dresden Island Lock and Dam came 14 miles below Brandon Road. Twenty-four miles below Dresden Island, an old hydropower dam was replaced by a higher one, and the rapids at Marseilles were bypassed with a 2.5-mile lateral canal and lock. The fifth dam was the Starved Rock Lock and Dam, 16 miles below Marseilles. The federal project on the Illinois River began 600 feet below this point and continued to its mouth.

In 1927 Congress authorized a 9-foot channel 200 feet wide on the federal section of the Illinois from Utica to Grafton. The project used the existing federal dams at Kampsville and La Grange, and involved the transfer of the state dams at Henry and Copperas Creek to federal control. The Corps of Engineers partially removed these dams to permit boats to pass over them.

The act of July 3, 1930, authorizing the 9-foot channel project on the Upper Mississippi also extended the federal project on the Illinois waterway upstream to the heads of federal projects in the Chicago and Calumet rivers. The act thus gave the federal government charge of the state projects and the canals of the Chicago Sanitary District. For the first time, the Corps of Engineers gained responsibility for the entire waterway from the Mississippi River to Lake Michigan, a distance of 333 miles. By that time, the State of Illinois had completed 75% of the work on the 5 locks and dams it had begun in 1921. These were completed by the Engineers between 1930 and 1933. The Illinois Waterway opened to navigation in March 1933. On June 22, 1933, the first two of barges from New Orleans arrived at the Michigan Avenue Bridge in Chicago.

With the rest of the waterway improved, the dams at La Grange and Kampsville were now too low to provide slack water navigation, and the locks too small for the large tows expected to begin using the river. In 1932, Colonel Daniel L. Sultan, Chicago District Engineer, proposed a channel 9 feet deep and 300 feet wide on the waterway, with two new locks between La Salle and Grafton. One would be near La Grange, and the other at Peoria. The new Lock and Dam 26 at Alton, under construction as part of the 9-foot channel on the Mississippi, was located just below the mouth of the Illinois River, and it would provide enough water depth up to the La Grange Dam to do away with the need of a new dam at Kampsville. The dams at La Grange and Peoria were to be wicket dams, which could be lowered against the river bottom during high water, permitting boats to use the main channel. In low water, they would rise to provide 9 feet of water in their pools. Congress authorized the project in the Rivers and Harbors Act of August 30, 1935, and the locks and dams were constructed between then and 1938, when, along with the Alton Dam, they were put into operation.

A question now arose as to which channel to Chicago and Lake Michigan should become the main route. The Sanitary and Ship Canal was a wide 160 feet, but it ran through the congested city; the Sag Canal, which went through more open country to Calumet Harbor, was only 60 feet wide. A Board of Engineers concluded in 1933 that the Sag Canal offered greater possibilities, but not enough benefits to convert it into the main route. Nevertheless, Congress, on August 30, 1935, authorized some improvement of the Sag route, including three passing places along the canal, 150 feet wide and 9 feet deep, and a navigation channel from the head of deep-draft navigation on the Calumet River to the eastern end of the Sag Canal. This work was completed in 1939.

By 1946, the federal project had attained a 300-foot channel on the Illinois River, except for the canal at Marseilles. The Little Calumet River had been widened to 300 feet from the Sag Canal to a turning basin at Lake Calumet. Traffic on the Sag route, however, was limited to towboats which could pass under bridges with 14 feet of headroom. Improvement of this channel was now necessary. Traffic on the Calumet-Sag route had increased from 67,000 tons of freight in 1932 to 885,056 tons by 1940, a jump of 1,200%. In 1944, freight carried passed 1,000,000 tons.[21]

In 1946 Congress authorized the upgrading of the Grand Calumet River to handle the increasing traffic, but work did not begin until 1955. Between 1955 and 1971 the Corps of Engineers widened 16.2 miles of the Calumet Sag Canal from 60 to 225 feet, and redesigned the constricting bridges. Part of the work involved a new lock and controlling works at Blue Island, replacing the old 50-foot lock there. This lock, the Thomas J. O'Brien Lock is 110 feet wide and 1,000 feet long, permitting 14 standard barges and a towboat to lock through at one time. It was put in operation in 1965. Aside from continued maintenance and dredging, this project completed the Illinois Waterway project.

Recent Traffic on the Illinois Waterway

The return of river traffic on the Illinois River since World War II has generally paralleled the same return on the Upper Mississippi. The 1920s and 1930s marked a low point for Illinois traffic. The railroad had long ago taken all of the high class freight and much of the low class. Traffic on the Illinois River in the 1920s totalled only 100,000 to 200,000 tons annually. In 1933, until the first tow came up from New Orleans, there was no traffic at all between Lockport and Starved Rock.[22] Although tonnage on the Illinois River section of the waterway increased to 620,000 in 1935, much of it was sand and gravel on short haul. Most of the traffic was also upbound, and included coal from the area around Havana headed for electric plants in the Chicago area, and sulphur from Louisiana and Texas bound for Chicago and for Great Lakes vessels. Some petroleum came up from the south, but even more came by pipeline to Lockport, where it was refined and sent on to Calumet Harbor and other lake ports.[23]

With the completion of much of the Illinois Waterway project in 1939, traffic began to grow, setting records nearly every year. In 1945, 7 million tons moved on the waterway; by 1955 this had reached 21 million tons; and in 1974, 43.3 million tons of freight moved on some portion. Appendix B, which gives the tonnage figures for the Illinois River portion of the waterway (the remaining portion to Lake Michigan would add 10% or

so to the figures), shows this healthy increase in river transportation. Much of the business is through traffic, but the Illinois, like the Upper Mississippi, handles short haul traffic at private commercial terminals all along the river. Illinois River traffic is now at the point where additional improvement of many of the lock structures appears necessary.

THE ILLINOIS AND MISSISSIPPI CANAL

One of the most ambitious projects to arise from the 19th-century push for an east-west route today lies unused on the Illinois prairie east of Rock Island. This is the Illinois and Mississippi Canal, or, as everyone called it, the Hennepin Canal.

From the point of view of residents in northern Illinois, the Illinois River made a wrong move when it turned south at the "great bend" in central Illinois near the village of Hennepin and headed toward St. Louis. Rock Island lay almost directly west of Hennepin, less than 80 miles away, separated by a low, fairly uniform valley. As early as the 1830s, groups of citizens in the area imagined the possibility of a canal along that valley.[24] Goods traveling from Rock Island to Chicago via the Mississippi and then up the Illinois had to go 607 miles; via a canal to Hennepin and then up the Illinois, 188 miles, a savings of 419 expensive miles. Such a canal would give the growing towns of Burlington, Rock Island, Davenport, Dubuque, and, of course, any other river points north of Rock Island, a commercial advantage.

When the Illinois and Michigan Canal opened in 1848, a Hennepin canal made even more sense. Traffic between Chicago and St. Louis increased, to the envy of Upper Mississippi interests. A canal convention in Davenport in 1864 convinced the Iowa General Assembly to petition Congress for the canal. The number and importance of such conventions grew. For this reason, Colonel Wilson was ordered to examine possible routes for a canal in 1870, and the survey was made by his successor, Colonel Macomb, that year. Macomb's report contained plans for a canal 160 feet wide and 7 feet deep, with locks 350 by 75 feet, at an estimated cost of $12.5 million. No work was authorized on this "ship canal".

Meanwhile, canal conventions increased in number and strength. Their strategy was to highlight the national character of the project, a necessity if Congress was to react favorably. In 1882, the New York Board of Trade sponsored a bill in Congress calling for $1 million to begin construction, but this was killed by St. Louis interests opposed to the canal.[25] Pressure from proponents and opponents kept the idea of a canal alive, but prevented authorization of anything but surveys in 1882, 1886, and 1888.

Opposition also came from railroad interests. As with all other navigation projects at this time, one reason given for a canal was the role it would play in regulating rail rates. There was some evidence for this position. In 1880 coal was shipped from Buffalo and Erie to Chicago by water--900 miles--for 64¢ per ton. This same coal was then loaded on trains and shipped to Rock Island and Dubuque--150 to 200 miles--for $2.00 per ton. Canal proponents believed that a canal along that same route would bring rail rates down to 50¢ per ton.[26] This argument was still being used after it became apparent that the canal was a commercial failure.

By 1890, traffic on the Upper Mississippi had begun to decline, the Illinois and Michigan Canal had deteriorated so badly that it was hardly usable, and a major new navigation project seemed uncalled-for; but the Rivers and Harbors Act of September 19, 1890, authorized the first $500,000 for a Hennepin canal. The dimensions of the canal were much smaller than Macomb's 1870 plan. Instead, they followed the recommendations of a report drawn up in 1886 by Major Thomas Handbury of the Chicago District. The canal was to be 80 feet wide at the waterline, with a depth not less than 7 feet. The locks were to be 170 by 30 feet, not large enough for most of the boats then operating on either the Upper Mississippi or Illinois ivers. Construction of the canal was placed in charge of Major Marshall and the Chicago District.

Engineers had surveyed several possible routes for the canal during the many earlier surveys. Three possibilities had emerged: a 64.5-mile route through a low area known as Marais d'Osier, to Albany, 14 miles above the Rock Island Rapids; a 65.2-mile route to Watertown near Campbell's Island in the middle of the rapids; and a 74.5-mile route ending at the mouth of the Rock River at Rock Island. The Engineer reports generally favored the Marais d'Osier route as easier and more beneficial to traffic above the rapids, but the Secretary of War and the Chief of Engineers, Major General John Newton, selected the Rock Island route, believing that the canal would generate more traffic from below than from above the rapids.

District Engineer Marshall began locating the canal line in November 1890. The line began at the great bend of the Illinois, 1.75 miles upstream from Hennepin. From here it ran along the valley of Bureau Creek to the summit level 18 miles west. From the summit level, the canal ran west to the Rock River just above the mouth of the Green River. It followed the bed of the Rock River until it reached the rapids near Milan; here it left the river and continued around the rapids to the Mississippi. A feeder canal 29.3 miles long, ran from the summit level north to the Rock River at Sterling.

Work progressed steadily on the canal, but it was slowed by problems ranging from land acquisition to defaulting contractors, and the canal was not completed until 1907. The completed canal contained 33 locks, including a guard lock to regulate water at the head of the feeder. The locks were 35 by 170 feet, with a depth of 7 feet. Major Marshall's experimental use of structural concrete rather than the usual masonry construction for the lock chambers saved enough money to expand the original 30-foot lock width to 35 feet.[27] The canal required several other major structures in addition to the locks. Nine aqueducts were required where the canal crossed other streams. The canal also crossed 11 railroads and 67 roads and highways, with bridges needed at each location. These were needed because the one route most natural for the canal had already been taken in 1854 by the Chicago and Rock Island Railroad, and the canal had to go second best all the way. The total cost of the canal and related structures was $7,319,563.39.

From the beginning, usage of the canal was disappointing. The small Milan section of the canal, including the 4.5-mile section around the Rock River Rapids, had been completed first, and opened in 1894 so that it could be used to provide supplies to the rest of the project. In 1894 Rock Island was still a primary coaling station for steamboats on the Upper Mississippi, and the Milan section gave access to the Illinois coal fields. For the next 5 or 6 years, this section of the canal saw more use than the rest of the canal was ever to see. The peak years came in 1899-1900. During July 1899, when lockages on the Illinois River fell below 100, 84 different steamers and 59 barges locked through the Milan section a total of 292 times. There were 454 lockages in October of that year. By 1901 the coal fields had begun to close, victims of competition from better coal elsewhere, and traffic declined.

The Illinois and Mississippi Canal was a victim of its own size, of the bottleneck at the east end caused by the Illinois and Michigan Canal, of the new large-scale navigation projects which were improving the Illinois River, and of the general decline in river traffic. Two grain elevators were built along the canal in 1910, but the potential grain traffic never developed. The Morton Salt Company which had intended to use the canal stopped after sending two tows of salt to Davenport. While the theoretical capacity of the canal was three boats per hour each way, or 144 boats per day, carrying 640 tons each during a navigation season of 200 days, for a total of 18,432,000 tons,[28] traffic actually averaged about 10,000 tons per year. In 1929 the canal reached its peak use--30,161 tons, far less than its theoretical potential.

By 1949 use had dropped to 394 tons, hardly justifying the use of lock personnel at each of the 33 locks. In 1948 the canal was placed

on limited operation, with advance notice required for passage. It was closed for good in 1951. Following several years of discussions between the Corps, the State of Illinois, and local conservation groups, the canal was turned over to Illinois, and became the Hennepin Canal State Parkway in 1970. The state maintains it today as an example of an earlier transportation era, but it is also a monument to the canal craze of the 1830s and to the frantic search for an east-west route which characterized transportation patterns throughout the 19th century.

Chapter 5

THE RETURN OF RIVER TRANSPORTATION

The Upper Mississippi, wrote the Iowa novelist Herbert Quick in 1909, is a river with "a five-foot project, six-foot ambitions, nine-foot possibilities, a great history, and a dwindled commerce."[1] Most people in and out of the river trade would have agreed with him. So would most of the statistics, which showed that the number of boats on the river remained constant until the turn of the century and then began a swift decline. All but one packet company had disappeared and the one left was in ill health. Appendix A shows that freight tonnage in the St. Louis area of the river plunged to only a few thousand tons annually by 1900 and remained at that low level for 20 years. In 1916 the total tonnage on the entire Upper Mississippi fell below 1 million tons for the first time since the 4½-foot channel project began, and remained at about 750,000 tons annually for the next 15 years.[2]

By 1924, only five freight boats were still making regular trips in the St. Paul-to-St. Louis trade: the Mississippi and Ohio Steamboat Company with one boat, the River Transit Company with three self-propelled barges, and the St. Louis and Tennessee River Packet Company with one boat. The Eagle Packet Company and the Carnival City Packet Company also made occasional trips during the fruit season.[3]

Preparations for a wake, however, were premature. What statistics such as these don't show is that much of the dramatic decline pictured by the figures came from the rapid loss of rafts and raftboats. Take those away and the statistics are not so bleak. The raw statistics also accurately depict the decline in long haul traffic; they don't show the shift from the more glamorous long haul business to short haul workboats hauling sand, gravel, and other low class bulk commodities. From 1880 to 1908, freight carried by long haul packet lines did decrease from 567,180 tons to 66,255 tons. But, during this same period, local and short distance freight hauled on the Upper Mississippi increased from 197,922 tons to 1,783,470 tons. In 1915 traffic records were broken in every division of the Rock Island District, except for the section between Hannibal and the Missouri River where a decrease resulted from abandonment of a gravel plant at Hannibal.[4] River traffic in the first quarter of the 20th century was not glamorous, but neither was it dead.

A more serious decline occurred as a result of World War I--crews became difficult to find. When the economy recovered after the war, industry had lost the habit of shipping by water, and river traffic remained low. In 1925, the Inland Waterways Corporation initiated a

program to reintroduce shippers to water, and river transportation began a long climb back.

RENEWED INTEREST IN RIVER TRANSPORTATION

River improvement conventions have been a regular part of the scene on the Upper Mississippi River almost since the beginning of steamboat traffic. Held at towns and cities along the river which owed their existence or, at least, economy to river traffic, conventions brought together business representatives, shipping interests, and political figures to petition Congress for specific projects, annual appropriations, and relief from railroad competition. Many of these were little more than cheering sections for the groups themselves, but others, like the Upper Mississippi Improvement Association which met annually in different towns from 1875 to 1900, helped to form policy and lobby for projects such as the 4½-foot channel. They helped to insure annual appropriations during a period when such monies were not a certainty.[5]

Even before the great rafting industry came to an end, however those interested in river transportation realized that they were fighting a slow decline and possible demise. Rafts made river traffic appear healthier than it was. Their projected end was especially ominous for the many towns whose economy was dependent on the logs which supplied their sawmills. Improvement conventions became broader in scope and more national in character. The first International Waterways Convention at Cleveland in 1895 had delegates from Canada as well as the United States. In 1901 Baltimore hosted the first National Rivers and Harbors Congress. A new Upper Mississippi River Improvement Association was formed at Quincy, Illinois, in 1902 to push for the 6-foot channel sought since 1878. Even more ambitious was the Deep Waterway Convention at St. Louis in 1906, when delegates formed the Lakes-to-the-Gulf Deep Waterway Association to lobby for a 14-foot channel between Lake Michigan and New Orleans.

Renewed interest from these groups and a specific recommendation from the 1906 Rivers and Harbors Congress in Washington, D.C., led to President Roosevelt's appointment of the Inland Waterways Commission in 1907. The report of this commission in 1908 noted that "the rivers of no other civilized country are so poorly developed, so little used or play so small a part in the industrial life of the nation,"[6] and urged a "coordinated and continuous" plan for restoring water transportation.[7] The commission recommended appointment of a National Waterways Commission to coordinate government agencies involved in the waterways. Congress authorized this commission in 1909.

More than any other single event, perhaps, the opening of the Panama Canal in 1914 awakened the Midwest to the need for restoring a healthy river transportation system to the Mississippi. Suddenly, freight could be shipped more cheaply coast-to-coast by water than by rail, even though railroads were allowed to reduce their rates to remain competitive. The canal stimulated inter-coastal transportation, but the Mississippi Valley, in the center of the country, did not benefit as much as the rest of the United States. The Midwest lost sales, and even manufacturers and factories because it cost less to ship to San Francisco from New York than from Moline. Equipment from the John Deere factory in Moline cost $1.86 per 100 pounds to ship direct to San Francisco by rail. The same freight could go to New York by rail and then by ship to San Francisco for $1.18; with an adequate channel on the Upper Mississippi, it could go all the way by water, via New Orleans, for $.75 in 1931.[8] A revived and improved river traffic would benefit Moline, keeping it and similar towns along the river competitive.

Cities like Minneapolis had even more to gain from a modern river transportation system. In the early 1920s, Minneapolis was still the nation's leading flour-milling center, producing nearly 20 million barrels a year. Then in 1922, the Interstate Commerce Commission, ruling in the Indiana Rate Case, declared that "water competition on the Upper Mississippi north of St. Louis is no longer recognized as a controlling force."[9] This permitted the railroads to raise their rates along the river to the point where Minneapolis found itself at a disadvantage. It became less expensive to ship the wheat from the fields to Duluth for Great Lakes shipment than to process it in Minneapolis and then ship the flour by rail. In less than 15 years, flour production at Minneapolis had dropped to less than 8 million barrels a year.[10] Business interests in Minneapolis naturally became quite interested in river improvement.

The Inland Waterways Corporation

In spite of renewed interest, a 6-foot channel project, commissions, and petitions, however, traffic continued to decline in quantity and quality. By 1910 much of the commercial traffic on the Upper Mississippi consisted of coal coming from the Ohio River to power plants north of St. Louis. The majority of traffic was not even commercial; after 1914, and until 1940, the largest user of the river was the Corps of Engineers engaged in improvement projects.[11] In 1921, 94% of the tonnage carried on the river was sand, gravel, and rock.[12] Even after World War I had demonstrated a need for river transportation, commercial concerns seemed reluctant to invest the energy or capital necessary to do so. A 1918 survey of port terminals and transfer facilities by District Engineers at St. Paul, Rock Island, and St. Louis revealed that the only public

terminals on the Upper Mississippi were at Minneapolis and St. Paul, with an additional terminal at Stillwater on the St. Croix.[13] It was an old story on the river; neither the ports nor the boat companies were willing to invest hard cash, and so they talked.

Some small attempts were made to restore river traffic. In 1922, several Minneapolis-St. Paul businessmen formed the River Transit Company which began operations with a single barge carrying high class package freight between Minneapolis and La Crosse at 75 to 80% of rail rates.[14] The company prospered and expanded for the next few years, shipping John Deere equipment from Moline and Ford automobiles from St. Louis, but other commercial shippers did not follow their lead. In the end, it was not commercial shippers but the federal government which led the way back to health for river transportation.

The shortage of rail transportation facilities during World War I bled most of the available rail cars from the Mississippi Valley and led the Council of National Defense, in June 1917, to form a Committee on Inland Transportation chaired by the Chief of Engineers to examine ways in which water transportation could be used to relieve freight congestion on the railroads. This committee concluded that much rail freight could be moved by water with proper terminals, and recommended that the federal government itself begin such service.[15] Later that year, the United States Shipping Board allotted $3.9 million for the Emergency Fleet Corporation to build and operate towboats and barges between St. Paul and St. Louis, the first actual federal operation of equipment on the Mississippi.[16] In 1918 a new Committee on Inland Waterways under the U. S. Railroad Administration also recommended federal government construction and purchase of floating plant and terminals to create an integrated, working system.

Such a system was made possible by the Federal Control Act of 1918, which provided authority to carry out these recommendations. That act commandeered all floating equipment on the Mississippi and Warrior rivers and on the New York Barge Canal, and appropriated $12 million for new construction. This was the beginning of the Federal Barge Service which eventually came to be known on the Upper Mississippi as the Federal Barge Line. This fleet was operated by the Railroad Administration until 1920, when it was turned over to the Secretary of War. The 1920 Transportation Act authorized continuation of the experiment under the Inland and Coastwise Waterways Service, and broadened its responsibilities. The Secretary of War was to investigate boats suited to different stretches of river, to investigate terminals for both short and long haul traffic, to advise cities on the design and location of new terminals, and to compile statistics on river traffic.

In 1923 the chief of this service, Colonel T. Q. Ashburn, requested that the fleet be reorganized more along the lines of a private transportation agency in order to be able to operate more economically and less restrictively. Accordingly, in 1924 Congress passed the Inland Waterways Transportation Act creating the Inland Waterways Corporation, a wholly federally-owned corporation organized and capitalized along the lines of the railway companies. This new corporation was to continue operating the Federal Barge Service on the Lower Mississippi from St. Louis to New Orleans, and on the Warrior River. In addition, the Inland Waterways Corporation was given two objectives: to demonstrate to commercial shippers the economic feasibility of river transportation, and to pioneer in the development of new routes, new methods, and new equipment.[17] This was something commercial shippers had just not done. In fact, by 1924, after an expenditure of $175 million on the various Mississippi River improvement projects, not one common-carrier barge company was operating on that river.[18]

The Dennison Act of 1928 increased the capitalization of the Inland Waterways Corporation to $15 million and expanded its responsibilities to include establishing joint rail-water rates (in which, railroads were ordered to cooperate). Further, the corporation was to continue operations until an adequate navigation channel had been achieved, terminal facilities adequate for joint water-rail service had been built, and private companies were willing to assume regular service on the river. At that point, the Secretary of War could lease or sell the equipment.

Until 1926, the Federal Barge Line operated only below St. Louis. Service on the Upper Mississippi was to begin only after there was a navigable channel and adequate terminals. However, pressure from several Upper Mississippi groups to extend service beyond St. Louis caused this to change. In 1925, a Minneapolis-St. Paul group formed the Upper Mississippi Barge Line Company which requested the corporation to serve the upper river. By 1927, an agreement had been reached by which the private group was to build a fleet of towboats and barges which would then be leased by the Inland Waterways Corporation and operated north of St. Louis. As this fleet was being completed with money subscribed by nearly every town along the upper river, the corporation took over operation of the River Transit Company in 1926, and carried slightly less than 1,000 tons of freight that year. Early in 1927, the Dubuque Boat and Boiler Works completed three towboats for the Barge Line Company. In August, one of these boats, the S.S. Thorpe, took three 500-ton barges of sugar up to Minneapolis, Minneapolis celebrated the arrival, and the return of regular barge traffic, with a Minneapolis-to-Gulf Day.[19]

Traffic on the Upper Mississippi rose from 14,061 tons in 1927 to 119,648 tons in 1928. The 60 barges and five towboats in semiweekly service above St. Louis were unable to handle all of the cargo--chiefly grain--that shippers were prepared to ship. In addition to the grain, sugar, sisal, and agricultural implements quickly became important freight items.[20] In 1928, the Inland Waterways Corporation bought the leased boats from the Upper Mississippi Barge Line Company, leaving the latter free to lobby for the 9-foot channel project.

New Equipment Design

The Inland Waterways Corporation was equally successful in its experiments with new towboat and barge designs, and with encouraging the construction of public and private terminals. Under its prodding, new terminals opened at Minneapolis in 1927; at Dubuque, Burlington, and St. Paul in 1928; and at Rock Island in 1931. By 1935, 12 upper river cities had built terminals with either the direct aid or encouragement of the corporation.

In the late 1920s, the Inland Waterways Corporation turned its attention to the design of barges and towboats. By 1928, it had designed a much more efficient barge which could carry 1,000 tons on the Upper Mississippi 6-foot channel, and 2,000 tons on a 9-foot channel. Not only was the barge a standard design, and therefore less expensive to built, but it could also be used on both the Upper and Lower Mississippi, thus avoiding the usual transshipment at St. Louis. In 1929, the corporation designed three new towboats for specific sections of the Mississippi: a 1,000 horsepower boat for the 6-foot channel, a more powerful boat for the 8-foot channel between St. Louis and Memphis, and an even larger boat for the Lower Mississippi to New Orleans.

The most notable feature of these new towboats was a shift to diesel engines in place of steam and to propellers in place of a paddlewheel. The problem with the old sternwheeler was that the wheel limited the power the boat could produce, while propellers required a deeper draft than was available on the Mississippi. To handle propellers in the upper river channel, designers evolved a "tunnel stern design" in which the propeller was located inside a spoon-shaped recess in the bottom of the boat, with part of the propeller actually above the water surface. With the propeller operating, vacuum action filled this tunnel. The designers added a second propeller and devices for applying side thrust, producing a powerful, maneuverable boat which could operate in water as shallow as a paddlewheeler could. Very quickly the commercial carriers reappearing on the river adopted both the diesel engine and the tunnel stern design. Like the 9-foot channel, these innovations helped make river transportation once again competitive. A 6,000 horsepower diesel towboat could

move tows of 40,000 to 50,000 tons each; a 6,000 horsepower diesel locomotive could haul 150 cars of 50 tons each, for a total of 6,000 tons.[21] In a few years, then, the Inland Waterways Corporation accomplished what a century of commercial carriers had been unwilling or unable to do: adapt to modern needs. In the 1920s and 1930s, this corporation was "virtually the sole source"[22] of technological innovation in water transportation.

THE NINE-FOOT CHANNEL

As both government and private interest in river transportation reawakened in the 1920s, the idea of a 9-foot channel on the Upper Mississippi grew from a hope to a possibility. In 1910 Congress had authorized a 9-foot channel, with 110 by 600-foot locks, on the Ohio River. A more modest 9-foot project was begun on the Illinois River in 1914. By the mid-1920s, these projects were both nearing completion, and groups along the upper river began to push and plan for a similar project. Strong pressure for the 9-foot channel came from the Upper Mississippi and St. Croix Improvement Commission, the Upper Mississippi Waterway Association, Senator Henrik Shipstead of Minnesota, and industrial and real estate interests in Minneapolis who believed the 9-foot channel would boost local economy.[23] In addition, President Herbert C. Hoover openly favored the new project, and Congress, following the onset of the Depression, viewed it as a public works project which would provide lasting benefit to the public long after it was through giving work to the unemployed.[24]

Rock Island District personnel, who had charge of the river from St. Paul to St. Louis, were more cautious. The 1927 Rivers and Harbors Act had authorized a 9-foot channel from the mouth of the Ohio to St. Louis and a survey of the river north of St. Louis for a 9-foot channel. The survey report in 1928, by Major Charles L. Hall, District Engineer at Rock Island, found that the project was not economically warranted. Hall's report was supported by conservation and recreation groups such as the Isaac Walton League who worried that the project would destroy much of the 300-mile Upper Mississippi Wildlife and Fish Refuge authorized by Congress in 1924. The report also had some support from the Chief of Engineers, Major General Edgar Jadwin, but it met with a storm of protest elsewhere. It became clear following Hoover's election as President in 1929 that the project was going through. Hoover replaced General Jadwin with a Chief of Engineers more favorable to the project, Major General Lytle Brown.

The various surveys for the 9-foot channel from 1927 to 1930 explored two methods of achieving that depth. One plan called for huge storage reservoirs with supplementary construction at difficult stretches to

regulate the flow and provide 9 feet of water. A part of this plan called for damming up the Wisconsin River and turning it into one large reservoir. This improved navigation system on the Wisconsin River would also become part of a new east-west route to Lake Michigan at Green Bay.[25] The second plan called for a slack water navigation system by lock and dam for the entire 653 miles.

As late as April of 1930, the list of public works awaiting action by Congress did not include the 9-foot project. It appeared as part of the Rivers and Harbors Act of July 3, 1930, without final examination, survey or recommendation by the Corps of Engineers--a victory, suggests Raymond Merritt, St. Paul District historian, "in which glory was shared by President Hoover, his secretary of war, the Mississippi Valley Association, the Minneapolis Real Estate Board, the Mississippi and St. Croix River Improvement Commission and congressional representatives from Minnesota."[26] The 9-foot channel project called for 26 locks and dams from Minneapolis to St. Louis. Two of these, Lock No. 1 (the Ford Dam) and Lock No. 19 (in the hydropower dam at Keokuk) were already completed, and Lock No. 2 at Hastings opened to traffic in 1930. The remaining locks were to be a uniform 110 by 600 feet, with a minimum 9-foot depth, consistent with those on the Ohio River.

The design work for the new locks and dams was begun at the Corps of Engineers Upper Mississippi Valley Division Office at St. Louis. The plans for all the locks and the first two dams (Nos. 15 and 20) were drawn up there. Design responsibility for the remaining dams was left up to the Engineer Districts in which those dams were located. The design, location, and number of dams were all determined by both natural conditions and the population along the river. The Upper Mississippi was contained by low banks cutting through a heavily used flood plain, precluding the use of a few high dams. On the other hand, the extremely shallow channel precluded wicket dams such as those on the Ohio, which could be lowered into the water during high stages. Frequent flooding caused by simultaneous discharges from the entire basin, made dams which could be raised entirely above the water level during floods desireable. Ice jams nearly every spring meant the dams would have to be strong, with openings wide enough to pass ice and prevent the jams.

There were other considerations besides navigation and flooding. From the beginning, Engineers worked with other agencies to minimize the damage to fish and wildlife. The roller gate design selected by the designers permitted migration of fish, passed silt and sewage, helped to aerate the water to keep oxygen levels up, and stabilized the water levels in the pools. The Corps worked with the National Park Service to insure that areas needed for navigation, but not continuously flooded, would be

put to the best recreational use.[27] Such cooperation brought support for the 9-foot channel from organizations, such as the Izaac Walton League, which had originally opposed the project.[28] The roller gates at all of the dams were patented in Germany and were relatively new in the United States in 1930. These gates were hollow cylinders which could be raised or lowered as needed to permit the correct amount of water to pass underneath to maintain proper pool elevation above the dam. Most of the dams contained a combination of roller gates, Tainter gates (pie-shaped wedges of cylinder), dikes and spillways as needed. Wherever possible, the dams were located just above river towns to minimize changes in the waterfronts. Shorelines changed least just below the dams, and most just above them where the channel was the deepest.

Small variations in the lock designs depended on the surface on which the lock rested. Otherwise, each lock was 110 by 600 feet, with electrically operated miter gates and a gravity fill system in which water entered and left the lock chamber through tunnels underneath the bottom of the lock. Each of the dams also contained an uncompleted auxiliary lock 100 feet wide and 269 feet long. Only the auxiliary locks at Dam 15 and Dam 26 were made operational.

The entire 9-foot channel project was completed between 1930 and 1940. Work on the project began with funds left over from the 6-foot project, but it proceeded as rapidly as it did because of money from sources outside the regular rivers and harbors appropriations. In 1933, the National Industrial Recovery Act allotted $33.5 million to the project, and, in 1934, the Federal Emergency Administration of Public Works supplied an additional $50.5 million. Not until the Rivers and Harbors Act of August 20, 1935, did Congress authorize an appropriation of the entire amount needed to complete the project. By 1940 more than $170 million had been spent on the 9-foot channel.

As in previous projects, the Engineers constructed most of the locks and dams in the order of the seriousness of obstructions each dam would alleviate. The first lock and dam was No. 15 at the foot of the Rock Island Rapids which, in 1930, still impeded navigation. Lock and Dam 15 was the first finished, in 1934. At the head of the Rock Island Rapids, where the Le Claire Canal had already made the rapids passable, Lock and Dam 14, completed in 1939, was among the last. With the completion of Lock and Dam 24 in 1940, the project was complete.

In addition to the new locks and dams, the 9-foot project included two other items. Between 1931 and 1933, a second lock, 56 feet by 400 feet, was added to the existing lock at Dam No. 1, in anticipation of the increase in traffic from the 9-foot channel. In 1935 Congress expanded

the project to include a 9-foot channel up the St. Croix River as far as Stillwater, replacing the old 4½-foot channel authorized in 1878.

TRAFFIC ON THE NEW CHANNEL

Even before the 9-foot channel was complete, traffic on the Upper Mississippi had begun to return. In 1935, commercial traffic on the section of the river between Minneapolis and the mouth of the Missouri River was 804,490 tons upbound and 739,505 tons downbound. These figures climbed to 2,226,452 tons up and 1,268,576 tons downbound in 1940. This was a beginning, but this figure in 1940 represented only ½ of 1% of the total inland and coastal water transportation in the United States.[29] During World War II, traffic north of St. Louis leveled off at a modest 2 million tons or so a year. Then in 1947 the towboat Alexander Mackenzie took a cargo of 18,500 tons up to St. Paul in a single trip. By comparison, 22 packetboats which arrived at St. Paul in 1857 brought 2,500 tons of freight. The Alexander Mackenzie's tow amounted to half the tonnage towed annually by the four packetboats of the Diamond Jo Line between 1900 and 1910.

By 1950, the total tonnage carried north of St. Louis had passed 10 million tons; in 1962 it passed 30 million tons, and reached 50 million tons in 1970. On August 11, 1977, the towboat W. S. Rhea set a record of 17 barges in a single tow through the Rock Island District. This record tow has since been matched many times, but is not likely to be surpassed, as it is the largest possible tow that can be locked through the standard 600-foot locks in two lockages.

The industry has responded to the 9-foot channel, especially since World War II, by developing more powerful and sophisticated towboats and more efficient and specialized barges--something they were reluctant to do before. Before 1946 most barges were single units with a rake, or drag. Modern tows, by contrast, are integrated units with little more drag than a single vessel. Only the barges at the head of the tow have a slope; barges in the middle have both ends square; while the trailing barges have a slight slope at the stern end.[30] Towboat companies have also developed specialized use barges: open hopper barges for coal, thermos bottle barges for chemicals, dump scows for dredged rock, car floats for railway cars. Even more specialized barges exist to move cargo that can only be practically moved long distances by water: tanks, kilns, space vehicles.

The standard Upper Mississippi barge today is 195 feet long, 35 feet wide, with an 8 to 9-foot draft. A barge like this can carry 1,500 tons of coal, 10,000 barrels of petroleum products, or 45,000 bushels of grain,

the equivalent of 25 to 35 railroad cars. A typical tow of 14 barges carries cargo equivalent to that carried by 140 packet steamboats of the kind popular on the river in 1866 when the Engineers arrived to improve navigation.

Pushing these barges up and down the river today is a diesel towboat of from 2,000 to 9,000 horsepower. They average around 165 feet long and 35 feet wide, with an 8-foot draft, operating on about 5,000 horsepower. They carry radar, short wave, depth-finder, and a full complement of other electronic equipment, giving a modern pilot control his 19th century counterpart never had. It also gives him an equally awesome responsibility. He is piloting a boat worth well over a million dollars that may be pushing a cargo worth more than three million.

NAVIGATION IMPROVEMENTS SINCE 1940

With river traffic able to stand on its own by the end of World War II, the Inland Waterways Corporation sold the Federal Barge Lines to a private company in 1953 and got out of the transportation business. The Corps of Engineers, however, has remained operating and maintaining the locks and dams for the 9-foot channel, and undertaking a number of improvement projects ranging from harbor work to new locks and dams. The old Lock 2 at Hastings, completed in 1930 and only 500 feet long, too short for regulation tows, was upgraded to 600 feet in 1948. Two years later, work began on a lock at the Falls of St. Anthony. During the 9-foot channel project, Minneapolis had requested improvement of its harbor and terminal facilities, and in 1937 Congress authorized an extension of navigation beyond the falls. The lower lock at the falls was completed in 1959. The Falls of St. Anthony upper harbor project, which included a second lock with a 49.2-foot lift (highest on the Mississippi), was completed in 1963, making Minneapolis a more competitive port than it had been. Appendix C shows the increase in tonnage at Minneapolis following completion of the locks.

Another project authorized by the same act that created the 9-foot channel was the replacement of the lock in the power dam at Keokuk by a regulation 110 by 600-foot lock. Planning on this project continued through the 1930s, but was postponed by the war. By the time the war ended, there had been a change of plans. Completion of the 9-foot channel had created a bottleneck at Lock 19, with lines of tows often waiting hours to lock through the small lock. Corps of Engineer studies predicted even more traffic in the future. In addition, the 38.2-foot drop at Keokuk was then the largest on the river, and double locking large tows was especially time-consuming. For these reasons, Congress authorized a 1,200-foot lock in 1945. Plans for new Lock 19 were begun

in 1950, but construction was postponed during the Korean conflict, and the lock was not open to traffic until 1957. As had happened again and again on the Upper Mississippi, the worst obstruction became the most improved stretch.

Further south, between St. Louis and the mouth of the Missouri River, a 7-mile stretch of ragged rock ledges known as the Chain of Rocks had made navigation difficult in low water for many years. A canal by-passing this stretch had been considered in 1904, and the Corps had proposed a dam in 1933, but other stretches of river were much worse at that time. After 1940, however, it became an increasing annoyance as tows often had to break up to go through. In 1945 Congress authorized a canal and locks for the Chain of Rocks. Original plans called for a standard 110 by 600-foot lock, and a 110 by 360-foot auxiliary, but increased traffic from both the Upper Mississippi and Illinois Rivers by the late 1950s forced an expansion to 110 by 1,200 feet for the main lock and 110 by 600 feet for the auxiliary lock, both located just over one mile from the lower canal entrance. Then, because of difficulty maintaining a 9-foot depth below Lock 26 at Alton, the St. Louis District constructed a low-water, fixed-crest rock dam, 3,240 feet long, across the main channel at the canal site. Dam 27 was the first complete barrier across the Mississippi.[31] The Chain of Rocks locks were opened to traffic in 1963.

None of these improvement projects on the Upper Mississippi ran into serious trouble until the Corps of Engineers attempted to replace Lock and Dam 26 at Alton with new, larger locks and a dam two miles downstream. Located just below the mouth of the Illinois River, with its increased traffic added to that of the Mississippi, the locks at Alton had a hard time meeting the demands placed on it. The main lock at Alton could handle 25 boats per day, and the auxiliary lock only 6--a total capacity of about 73 million tons annually. In addition, frequent breakdowns at the deteriorating facility backed up traffic for miles in both directions. Operating under the authority of the Rivers and Harbors Act of 1909, which allowed for the replacement of existing deteriorated facilities without specific Congressional approval, the Engineers proposed a dam with two 110 by 1,200-foot locks, capable of passing boats of 11.5-foot drafts. In 1970 Congress approved $350,000 to draw up plans for this structure.

Design work on the Alton project was 90% complete in 1974, when the Izaac Walton League, the Sierra Club, and 21 railroad companies filed a suit in Federal District Court, Washington, D. C., to halt the project. Late in 1974 the court ruled that the Alton project would require congressional approval. During the next four years of litigation, opponents of the plan--the railroads worried about competition and the

conservation groups worried about the 12-foot depth which they saw as a forerunner of a 12-foot project on the entire river--succeeded in getting towboat companies to pay for a share of the costs through a tax on diesel fuel used on the river, and in getting the plans reduced to a single 1,200-foot lock. Work resumed in 1978 and is scheduled for completion in 1989. Meanwhile, the old lock continues to malfunction. In April 1976 the main lock was damaged, creating a back up of more than 800 barges. Because of this single tie-up, prices for coal and grain shipped to and from the Rock Island-Davenport area jumped 20%.

In addition to these major improvement projects, maintaining the 9-foot channel requires old-fashioned dredging and wing dam repair. Lock gates damaged by ice and barges need frequent lifting and repair too. Aside from this, the present 9-foot channel seems destined to remain for a long time. During the 1970s, two Corps of Engineer surveys, one for a 12-foot channel and another for year-round navigation on the Upper Mississippi, suggested that neither was economically feasible or desireable. Navigation on the river has become one aspect of a more comprehensive plan for water development in the way envisioned by President Theodore Roosevelt when he established the Inland Waterways Commission in 1907. Recent study and planning by such groups as the Great River Environmental Action Teams and the Upper Mississippi River Basin Commission involve navigation, recreation, water quality, and environmental concerns. The problems created by multi-purpose use of the river are complex and not easily solved, but the very existence of problems is a sign of the health to which modern river transportation has returned.

CHARACTERISTICS OF MODERN TRAFFIC

From a single barge company operating out of Minneapolis in 1922, river traffic had grown to more than 700 transportation companies operating on the Mississippi River system and the Gulf Intracoastal Waterway by 1953, the year the Federal Barge Lines was sold.[32] More than a hundred towboat companies are headquartered at St. Louis alone, with many others scattered along the Upper Mississippi and Illinois rivers. As in the packetboat days, nearly all of the companies are small, operating an average of 5 or 6 boats and their accompanying barges. Among the largest is The Valley Line Company at St. Louis, with 22 towboats ranging from 850 to 10,500 horsepower.[33] Using an analogy to aviation, the structure of modern river traffic is more like the commuter airlines than like the major carriers. Frequently, small lines originated in order to carry the freight of a single company. Such was the case with the Alter Company in Davenport which began building boats and barges to haul its own scrap metal, and the Cargill Company of

Minneapolis operating out of Port Cargill on the Minnesota River. The Alter Company and others soon became important river carriers for more than their own products.

Traffic Patterns

Terminals

Although St. Louis, St. Paul, and Minneapolis, in that order, remain as the major river ports on the Upper Mississippi as they were in the 19th century, the smaller towns and cities along the river have not lost out to the modern 9-foot channel. Short haul traffic, often only a few miles between stops, remains an important characteristic of the river today. Rather than large clusters of terminals at the major ports, the terminals on the upper river are spread rather uniformly throughout the whole length of river. On the Upper Mississippi, above the mouth of the Ohio, there are 253 public and private terminals ranging from coal dumping stations to sophisticated loading and warehouse facilities. Similarly, on the Illinois River 151 terminals are scattered from Chicago to Grafton. Twenty-seven on the Upper Mississippi and 28 on the Illinois are public terminals; the rest are private and generally single-purpose. Considering population density, the major ports have little more than their share of facilities. St. Louis has 74 terminals, 6 of them public; St. Paul has 20, 3 of them public; and Minneapolis has 10, one of them public. By comparison, the Iowa side of the river alone, from Keokuk to Lansing, with no city of even 100,000, had 67 terminals. Small concentrations of these came at Burlington, Muscatine, Davenport, Bettendorf, Clinton, and Dubuque, but even smaller towns such as Lansing have their terminals, too. Similarly, on the Illinois, the largest single number are at Peoria, with 13, but that is a small part of the total. Both upbound and downbound traffic on the upper river originates and ends at points all along the channel. Table 5-1, which gives the traffic through each lock, shows that of the 54 million tons shipped above the mouth of the Ohio in 1970, less than 2 million tons originated at or arrived at Lock 1 in Minneapolis.

TABLE 5-1. TRAFFIC THROUGH LOCKS 1 TO 27, 1970

Lock	Tonnage (in millions)	Lock	Tonnage (in millions)
1	1.6	14	14.4
2	7.4	15	14.8
3	8.9	16	15.7
4	9.2	17	16.2
5	9.9	18	16.9
5A	9.9	19	18.7
6	10.1	20	19.4
7	10.1	21	20.0
8	10.4	22	20.5
9	10.7	24	21.3
10	10.9	25	21.3
11	11.7	26	46.5
12	12.3	27	52.0
13	12.9		

Source: Lambert and Hougland, The Economic Impact of Waterborne Commerce on the Upper Mississippi River Basin, p. 167. Lock 23 has not been constructed.

Ports

Excluding the Great Lakes ports, St. Louis today is the leading port on the inland waterway system as well as the northernmost year-round inland port. The city experienced a period of economic stagnation following World War II, losing 100,000 residents between 1940 and 1950. Between 1930 and the late 1950s, not a single new office building rose in the downtown area. By the late 1960s most urban specialists had given St. Louis up as lost. During this whole period, however, river traffic remained healthy and growing, and civic organizations, such as the St. Louis Metropolitan Planning Commission, in the early 1970s included waterfront improvement in their urban renewal plans. The official port of St. Louis extends for 70 miles from the southern boundary of Jefferson County (Mile 138.8) to the northern boundary of Madison County, Illinois (Mile 208.8). Many of the 74 private and municipal docks need to be modernized to keep up with the increasing river traffic.

By far the largest proportion of the 22 million tons or more handled annually by the Port of St. Louis comes upriver from the New Orleans-Baton Rouge area, but St. Louis sends and receives cargo from nearly every waterway in the Midwest and East, primarily Pittsburgh-Wheeling; Huntington, West Virginia; Minneapolis-St. Paul and Chicago-Upper Illinois

River. Goods arriving at St. Louis are primarily, in order, petroleum products, coal, grain, and primary iron and steel.

The ports of Minneapolis and St. Paul remain important, but far behind St. Louis, as they were in the 19th century. Of the two cities, St. Paul retains her control over most of the river traffic, her primacy dating back to when Minneapolis was not even accessible by boat. St. Paul's harbor naturally developed first. It was part of the 9-foot channel project, with a turning basin authorized in 1935 and a small boat harbor added to that authorization in 1939. The Minneapolis upper harbor was not accessible until 1963, with completion of the upper lock at the Falls of St. Anthony. Of the 9.4 million tons of commercial traffic in the Twin Cities in 1974, 6.7 million tons transferred at St. Paul, while 2.7 million tons went on to, or originated from, Minneapolis. More than half (1.5 million tons) of the Minneapolis figure consisted of western coal from Wyoming and Montana which began arriving at the Minneapolis upper harbor in 1972 for transfer to barges for shipment south.[34]

Tributaries

During the golden age of steamboating in the 1850s, nearly every tributary along the Upper Mississippi was filled with boat traffic. Boats hauled freight not only on the Des Moines, Rock, St. Croix, and Wisconsin, but on streams like the Pecatonica in Illinois which was so small it had cattle fences across it. One by one, traffic on these smaller tributaries died out in the 19th century. Traffic exists today on only four upper river tributaries.

On the first, the Illinois, river traffic has become so heavy that it competes with the main stem. For example, Table 5-1 shows that in 1970, 46.5 million tons of traffic passed through Lock 26 at Alton, while only 21.3 million tons passed through Lock 25 above Alton. What disappeared between the two locks was Illinois River traffic, a dramatic indication of just how busy the Illinois is. Appendix B shows both Upper Mississippi and Illinois traffic. The Illinois figures are less than those for the Upper Mississippi, but it must be remembered that a good portion of the Illinois traffic has passed through a portion of that section of the Mississippi and is counted there too.

The Minnesota River, as busy as the Mississippi during the period of immigration in the mid-19th century, came back again in World War II when boat-building facilities were constructed at Savage, Minnesota. After the war, traffic increased because Port Cargill, near Savage, became an important grain shipping center. As can be seen from a comparison of statistics in Appendices B and C, the Minnesota River rivals Minneapolis

in tonnage shipped and received. Another tributary, the St. Croix, is also a busy river, but only as far as Stillwater, 8 miles upstream from the Mississippi.

In the 1960s a small tributary which had never been improved became the subject of a major project. The 1962 Rivers and Harbors Act authorized the construction of a lock, 84 by 600 feet, and dam at the mouth of the Kaskaskia River in southern Illinois, between St. Louis and Cairo, to provide for a 9-foot channel upriver to Fayetteville. The project also included canalization of the main channel, reducing the distance to Fayetteville from 50.2 to 36.2 miles. The purpose of the Kaskaskia River project, completed in 1974, was to reach the dormant coal fields in that region and stimulate mining. In 1976, the federal government constructed a $273 million experimental coal gasification plant at New Athens on the Kaskaskia River.[35] Table 5-2 indicates the growth of traffic through the lock since 1974.

TABLE 5-2. TRAFFIC THROUGH THE KASKASKIA LOCK

Year	Tonnage
1973	25,236
1974	216,268
1975	194,750
1976	589,508
1977	1,286,808
1978	1,832,961

Source: Annual Reports of the Chief of Engineers.

Cargo

Grain today makes up the highest percentage of commercial traffic on both the Illinois and Upper Mississippi rivers. Midwest grain production expanded at the same time as the railroads, and the river never cornered that large market in the 19th century. Today, enough of it has returned to provide more tonnage than any other commodity. By 1976, of the 28,062,852 tons which passed south through Lock 25 above the Illinois River, 94% was grain--corn, soybeans, and wheat--most of it headed for the Lower Mississippi ports to be exported. In 1977, 42% of the traffic carried between Minneapolis and the mouth of the Illinois was grain. The percentages were only slightly less on the Illinois and on the Mississippi between the Illinois and the Ohio.

The number two commodity carried on the Illinois and the Upper Mississippi today is coal, mostly upriver on the former and both upriver

and downriver on the latter. Coal makes up about 30% of the traffic on the Upper Mississippi and 18% of the traffic on the Illinois. Coal is followed by petroleum coming upriver on both the Illinois and Upper Mississippi, and then by fertilizer and chemicals on the Mississippi and by steel products on the Illinois. A variety of other freight accounts for about 18% of the traffic on both rivers.

On both rivers, the primary direction of commodity traffic is upbound (petroleum, coal, fertilizer and chemicals), two to three times the downbound traffic (grain) on the Illinois and on the Mississippi above the Illinois, and one and one-half times the downbound on the St. Louis section (mouth of the Missouri to mouth of the Ohio).

Future Traffic Predictions

If Corps of Engineers projections for river traffic by the year 2003 turn out to be accurate, freight hauled on both the Upper Mississippi and Illinois will increase to near capacity at most locks--an increase of as much as 122% at some places. On the Illinois River, Grafton to Lake Michigan, traffic is expected to increase from just over 60 million tons to from 98 to 108 million tons. All of the locks, however, except the Thomas J. O'Brien Lock are already highly congested. The older ones are also in need of repair. On the Upper Mississippi, the new Lock 26 under construction at Alton, 110 by 1,200 feet, is projected to reach capacity by 1995, unless an auxiliary lock is added during construction. Capacity at Lock 22 is also expected to be reached before the turn of the century.

River transportation, then, seems to have revived. If Mark Twain could return to the Upper Mississippi today for yet another trip, exactly 100 years after he pronounced river traffic dead, he would be pleasantly surprised. He might find modern towboat and barge traffic less romantic than the gingerbread palaces he once worked on, but he would certainly admit--paraphrasing one of his own remarks--that reports of its death were highly exaggerated.

Appendix A

ESTIMATES OF COMMERCIAL TONNAGE ON THE MISSISSIPPI RIVER BETWEEN THE OHIO AND MISSOURI RIVERS, 1824-1952

Year	Tonnage	Year	Tonnage
1824	90,000	1862	950,000
1825	80,000	1863	1,100,000
1826	90,000	1864	1,650,000
1827	120,000	1865	2,251,523
1828	118,000	1866	2,246,492
1829	108,000	1867	1,988,797
1830	120,000	1868	1,932,976
1831	135,000	1869	2,243,499
1832	145,000	1870	2,136,300
1833	170,000	1871	1,653,899
1834	174,000	1872	1,669,201
1835	246,000	1873	1,654,899
1836	439,000	1874	1,440,090
1837	450,000	1875	1,302,620
1838	440,000	1876	1,288,970
1839	426,000	1877	1,242,155
1840	488,000	1878	1,329,370
1841	500,000	1879	1,365,415
1842	450,000	1880	2,129,700
1843	550,000	1881	2,092,455
1844	716,000	1882	1,843,475
1845	735,000	1883	1,537,850
1846	816,000	1884	1,275,590
1847	1,169,000	1885	1,267,100
1848	1,376,000	1886	1,332,885
1849	1,268,000	1887	1,503,105
1850	1,280,000	1888	1,276,182
1851	1,270,000	1889	1,413,594
1852	1,300,000	1890	1,299,679
1853	1,310,000	1891	1,125,432
1854	1,370,000	1892	1,208,205
1855	1,440,000	1893	1,057,599
1856	1,500,000	1894	1,003,710
1857	1,470,000	1895	838,900
1858	1,400,000	1896	1,319,688
1859	1,465,000	1897	1,115,850
1860	1,420,000	1898	959,953
1861	800,000	1899	700,531

Year	Tonnage	Year	Tonnage
1900	810,230	1926	1,005,979
1901	703,054	1927	1,110,402
1902	658,361	1928	1,430,183
1903	596,484	1929	891,756
1904	421,607	1930	926,957
1905	440,154	1931	1,303,034
1906	470,093	1932	1,577,390
1907	435,542	1933	1,998,963
1908	374,093	1934	1,858,011
1909	352,055	1935	1,729,093
1910	191,965	1936	1,944,536
1911	369,295	1937	2,251,497
1912	265,720	1938	3,056,945
1913	258,709	1939	2,536,513
1914	204,118	1940	3,094,612
1915	258,501	1941	3,488,269
1916	240,643	1942	3,147,476
1917	293,248	1943	3,156,530
1918	264,149	1944	4,775,489
1919	288,286	1945	4,449,200
1920	363,082	1946	4,190,570
1921	481,151	1947	5,746,160
1922	548,114	1948	9,464,196
1923	723,068	1949	9,427,505
1924	738,728	1950	11,577,850
1925	1,003,569	1951	11,040,875
		1952	13,285,980

Source: Dobney, River Engineers on the Middle Mississippi, pp. 164-65.

Appendix B

COMMERCIAL TRAFFIC ON THE UPPER MISSISSIPPI, ILLINOIS, AND MINNESOTA RIVERS SINCE 1939

Year	Tonnage		
	Upper Mississippi (Mpls. to mouth of Mo.)	Illinois (Grafton to Lockport)	Minnesota
1939	2,411,151	3,115,595	----
1940	3,495,028	3,745,294	----
1941	4,501,144	4,592,946	----
1942	4,248,101	4,826,059	556
1943	3,441,978	4,779,045	325
1944	4,844,640	6,054,490	272
1945	4,587,125	5,387,682	none
1946	5,246,902	5,278,684	none
1947	6,545,169	8.814,456	none
1948	8,648,980	10,779,074	none
1949	8,393,089	10,663,235	none
1950	11,025,006	13,714,751	102,155
1951	11,949,839	14,693,868	138,793
1952	12,855,945	14,040,615	291,206
1953	14,741,315	16,492,564	434,696
1954	16,295,544	15,354,052	666,980
1955	18,635,366	17,390,360	785,251
1956	20,671,428	19,636,685	682,602
1957	22,394,726	20,229,707	958,830
1958	24,393,587	20,562,464	1,236,367
1959	25,901,449	22,116,641	1,280,213
1960	27,393,934	22,807,633	1,367,502
1961	28,068,729	23,353,572	1,626,754
1962	30,526,628	25,358,514	1,923,190
1963	30,943,237	23,613,308	2,231,671
1964	34,108,482	26,614,651	2,339,271
1965	37,841,593	27,213,136	2,207,908
1966	41,311,941	27,973,248	2,816,376
1967	44,648,094	29,850,944	2,584,873
1968	45,846,463	31,270,327	1,721,555
1969	49,650,331	35,896,534	2,585,728
1970	54,022,749	34,322,043	3,601,743
1971	52,773,097	33,669,954	3,626,132
1972	60,746,385	39,183,957	4,314,833

Year	Tonnage		
1973	58,064,198	40,122,307	4,284,012
1974	62,013,644	41,229,825	4,778,630
1975	63,238,667	43,595,825	3,842,850
1976	68,420,307	43,065,859	3,898,291
1977	67,218,142	40,836,496	3,407,261
1978	68,976,381	37,251,157	2,078,067

Sources: Annual Report of the Chief of Engineers, 1949, part II, Commercial Statistics, pp. 785,806,1463; Waterborne Commerce of the United States, 1959, part II, pp. 137,201,172; Waterborne Commerce, 1969, part II, pp. 9, 134, 157; Waterborne Commerce, 1979, part II, pp. 9, 125, 134

Appendix C

TONNAGE SHIPPED AND RECEIVED AT UPPER MISSISSIPPI PORTS SINCE 1939

Year	Minneapolis	St. Paul	St. Louis
1939	279,350	333,581	1,167,787
1940	376,293	598,481	1,302,614
1941	530,787	669,272	1,377,272
1942	599,207	625,521	1,115,652
1943	362,533	578,017	980,544
1944	371,613	651,457	1,361,565
1945	354,429	656,689	1,395,769
1946	699,424	1,075,507	1,839,482
1947	593,031	1,025,336	2,259,894
1948	562,163	961,548	4,632,657
1949	512,558	1,218,350	4,364,981
1950	986,781	1,303,106	4,822,494
1951	447,277	1,326,234	4,953,412
1952	305,549	1,300,708	5,362,811
1953	540,042	1,403,599	5,968,958
1954	446,090	2,340,268	5,926,958
1955	550,584	2,896,341	6,810,940
1956	584,237	3,113,797	7,408,279
1957	773,605	2,658,963	6,755,802
1958	762,136	3,088,649	7,198,627
1959	849,865	3,592,913	9,254,125
1960	606,073	3,991,232	9,091,940
1961	770,525	3,588,910	9,392,899
1962	569,610	3,910,305	9,791,897
1963	825,429	4,210,106	9,517,328
1964	996,144	4,268,045	9,541,159
1965	1,005,875	4,233,897	1,797,503
1966	1,512,800	4,941,242	9,426,324
1967	1,453,217	5,056,501	11,017,965
1968	1,407,548	4,174,915	11,101,424
1969	1,687,949	4,474,863	10,463,032
1970	1,692,717	4,759,904	10,442,758
1971	1,303,132	4,827,607	11,215,807
1972	1,671,323	5,059,621	22,008,151*
1973	1,849,783	5,080,428	18,319,148
1974	2,528,968	5,143,251	21,662,116
1975	3,177,355	4,925,554	23,082,359
1976	3,086,506	5,977,521	23,954,882

Year	Minneapolis	St. Paul	St. Louis
1977	2,513,142	6,809,376	22,478,309
1978	2,150,674	9,682,785	22,425,157

*Beginning in 1972, the Port of Metropolitan St. Louis includes both sides of the Mississippi.

Sources: Annual Report of the Chief of Engineers, 1949, part II, Commercial Statistics, p. 1507; Waterborne Commerce of the United States, 1959, part II, p. 191; Waterborne Commerce, 1969, part II, p. 148; Waterborne Commerce, 1979, part II, p. 137.

CHRONOLOGY

THE UPPER MISSISSIPPI AND ILLINOIS WATERWAYS

1673 - Louis Jolliet and Father Jacques Marquette became the first white men to see the Upper Mississippi on June 17. Entering the Mississippi at the mouth of the Wisconsin River, they visited Indian tribes along the shore southward to within 700 miles of the Gulf of Mexico. They returned to Lake Michigan via the Illinois River, and became the first to suggest the advantages of a canal connecting the Illinois River to the lake.

1679 - Having received a royal patent, La Salle set out to explore the entire Mississippi. After establishing Fort Crèvecoeur on the Illinois River, he continued south. Reaching the Gulf of Mexico on April 9, 1582, La Salle claimed the whole Mississippi Valley for France and named it Louisiana.

1680 - Father Louis Hennepin led a small group of La Salle's party down the Illinois and up the Mississippi to the area of the future city of Minneapolis, where he discovered and named the Falls of St. Anthony.

1705 - The first recorded cargo--15,000 bear and deer hides--came down the Mississippi River.

1762 - At the close of the Seven Years War, France ceded Louisiana to Spain.

1763 - In the Treaty of Paris, England gained control of the land east of the Mississippi.

1764 - St. Louis was founded as a fur trading post by Pierre Laclede and Auguste Chouteau.

1783 - In the Treaty of Paris, at the close of the Revolutionary War, England ceded the Northwest Territory, the land east of the Mississippi, to the new United States.

1800 - The Treaty of San Ildefonso retroceded control of Spanish Louisiana to France.

1803 - The United States bought all of French Louisiana from Napoleon for $15,000,000 and 12 years of duty-free commerce for French and Spanish vessels through the Louisiana Purchase Treaty of April

30. The actual transfer of Upper Louisiana took place at St. Louis on March 9, 1904.

1805 - Lieutenant Zebulon Pike left St. Louis on a military mission to explore the Upper Mississippi, discover its source, note the location of Indian tribes and mineral deposits, to select sites for three military posts between St. Louis and the Minnesota River, and to purchase these sites from the Indians.

1810 - Henry Shreve became the first American to take a keelboat load of lead from the mines at Galena to New Orleans.

1811 - The first steamboat on the Mississippi, the New Orleans, built by the Fulton-Livingston company, arrived on the Lower Mississippi.

1817 - A small, underpowered steamboat, the Zebulon M. Pike, became the first to steam up the Mississippi north of the Ohio River as far as St. Louis.

1817 - Brevet Major Stephen H. Long ordered to explore the Upper Mississippi to map the channel as far as Prairie du Chien, examine the Wisconsin-Fox River water route to Lake Michigan, and to recommend one of the fort sites near the mouth of the Minnesota River purchased by Pike in 1805.

1819 - Fort St. Anthony, later Fort Snelling, was established.

1820 - The first steamboat above St. Louis was the federal government boat, the Western Engineer, designed, built, and initially commanded by Major Long, which reached Keokuk at the foot of the Des Moines Rapids.

1823 - The first steamboat above the rapids on the Upper Mississippi was the Virginia, which made two trips to Fort St. Anthony and back, carrying military supplies to the garrison at the fort. For the next few years, nearly all boats traveling above the rapids were engaged by the federal government or by the American Fur Company.

1824 - Congress enacted the General Survey Act "to procure the necessary surveys, plans, and estimates, upon the subject of roads and canals." The act gave the President authority to employ Corps of Engineer officers to make surveys he deemed of national importance.

1829 - Lieutenant Napoleon B. Buford, on Topographical duty, made the first government survey of the rapids at Keokuk and Rock Island.

1836 - The State of Illinois began construction of the Illinois and Michigan Canal, connecting Chicago with La Salle on the Illinois River. The canal was completed in 1848.

1837 - Lieutenant Robert E. Lee and an assistant, Lieutenant Montgomery C. Meigs, were appointed to a post at St. Louis, to improve the St. Louis waterfront where a sandbar was making access difficult, and to survey and begin improvements on the Rock Island and Des Moines rapids. Lee returned for the next three seasons. His work at St. Louis successfully washed away the sandbar, while his experiments at the Des Moines rapids set the stage for future improvement work there.

1839 - The first white pine logs from Wisconsin floated down the St. Croix, the beginning of the single most important industry on the river from 1870 to 1910. By 1843, logs were coming downriver as far as St. Louis.

1849 - St. Paul became the capital of the new Territory of Minnesota, stimulating steamboat passenger traffic on the Upper Mississippi.

1850 - Charles Ellet, Jr., recommended a system of reservoirs in northern Minnesota and elsewhere to control flooding and to aid navigation on the Mississippi during low water.

1852 - Passage of the Western Rivers Improvement Act brought Major Long to St. Louis as superintendent of renewed attempts to improve the Des Moines and Rock Island rapids, the St. Louis waterfront and the Dubuque harbor. As assistant, Long appointed Lieutenant Gouverneur K. Warren, whom he had met on the Mississippi Survey in 1851.

1854 - The Chicago and Rock Island Railroad became the first railroad to reach the Mississippi River. Two years later it crossed the Mississippi, initiating a long period of rail-water rivalry.

1861 - The first comprehensive survey of the Mississippi Basin was made by Captain Andrew A. Humphreys and Lieutenant Henry L. Abbot. This Delta survey was published in 1851 as Report Upon the Physics and Hydraulics of the Mississippi River; Upon the Protection of the Alluvial Region Against Overflow; and Upon the Deepening of the Mouths, and became a model for future reports.

1861 - The Civil War cut off river traffic to the south and fostered the habit of shipping goods east by rail. St. Louis was especially

affected by the military surveillance placed on all river traffic by the Union.

1864 - An all-time low water mark was reached on the Upper Mississippi which became the mark by which subsequent measurements are still made.

1865 - The city of Chicago began a project for pumping sewage from the Chicago River down the Illinois and Michigan Canal to the Illinois River. The project was completed in 1871. The additional water made planning for navigation improvements on the Illinois difficult.

1866 - Brevet Major General Gouverneur K. Warren and Lieutenant Colonel James Wilson arrived on the Upper Mississippi to begin the first permanent improvement work by the Corps of Engineers. This marked the beginning of the Rock Island and St. Paul Districts.

1867 - Minneapolis was chartered as a town, already having begun its career as an important flour-milling center. St. Paul, however, was still the head of navigation on the Upper Mississippi.

1870 - General Warren recommended 41 navigation reservoirs be built on the St. Croix, Chippewa, Wisconsin, and Mississippi rivers.

1871 - The State of Illinois completed its first lock and dam on the Illinois River at Henry. Between 1871 and 1927, improvement work on the Illinois remained a joint state-federal effort.

1877 - The Des Moines Rapids Canal opened to navigation, surmounting one of the worst obstacles to navigation on the upper river.

1878 - Congress authorized a 4½-foot channel on the Upper Mississippi from St. Louis to St. Paul, to be accomplished by dredging, and by wing and closing dams.

1880 - Congress appropriated $75,000 for a dam at Lake Winnibigoshish. Four additional dams were built in Mississippi headwaters by the turn of the century.

1890 - Congress authorized a 75-mile canal from Hennepin on the Illinois River to Rock Island on the Mississippi. The canal involved 33 locks. Construction of these locks marked the first use of structural concrete to replace masonry. The project was completed and opened to traffic in 1907.

1892 - The peak year for steamboat traffic on the Upper Mississippi saw 5,468 steamboats, about 1,000 barges, and 2,000 log and lumber rafts pass under the Winona, Minnesota, bridge.

1892 - The Chicago Sanitary District began work on the Chicago Sanitary and Ship Canal along the general route of the Illinois and Michigan Canal. The project reversed the flow of the Chicago River, sending water from Lake Michigan into the Illinois, and provided a spacious water route at least 160 feet wide by 22 feet between the Chicago River and Lockport.

1907 - Responding to a shortage of rail transportation and the dwindling river commerce, President Theodore Roosevelt appointed an Inland Waterways Commission to study problems related to river development.

1907 - The Illinois and Mississippi Canal between Hennepin and Rock Island opened to traffic--too small and too late.

1907 - On March 2, Congress authorized a 6-foot channel on the Upper Mississippi, to be achieved by wing dam construction, and by new locks at Minneapolis and the Rock Island Rapids.

1913 - Completion of the Keokuk and Hamilton Water Power Company dam across the Mississippi at the foot of the Des Moines Rapids marked a radical departure from the free and open river policy up to that time. The dam provided a single lock to replace the three locks of the old Des Moines Rapids Canal.

1914 - The opening of the Panama Canal left producers and shippers in the Upper Mississippi Valley at a competitive disadvantage compared to the coasts, and increased the demand from commercial interests for a 9-foot channel on the Upper Mississippi similar to that authorized for the Ohio River in 1910.

1915 - The steamboat Ottumwa Belle under Captain Walter Hunter took the last raft of white pine down the Mississippi bringing an end to the great rafting industry which had dominated river economy for so long.

1917 - Lock and Dam Number 1 at Minneapolis provided both electrical power and boat access to Minneapolis.

1922 - The Le Claire Canal and Lock opened, by-passing the upper 3.5 miles of Rock Island Rapids.

1922 - The Chicago Sanitary District completed an auxiliary Sanitary and Ship Canal from the Des Plaines River to South Chicago and Lake Calumet harbor. The Calumet Sag Canal project provided boats with a channel at least 60 feet wide and 20 feet deep between Lake Michigan and the Illinois River.

1924 - Congress authorized an Inland Waterways Corporation to run a Federal Barge Fleet on the Lower Mississippi, and to explore ways of restoring commercial river traffic by encouraging construction of terminals, opening new routes, and designing more efficient boats and barges.

1925 - Commercial interests in Minneapolis and St. Paul formed the Upper Mississippi Valley Barge Line Company to encourage the Inland Waterways Corporation to extend barge service to the Upper Mississippi.

1927 - Congress authorized a 9-foot channel on the federal section of the Illinois River improvement, and on the Mississippi between the mouth of the Ohio and St. Louis. Congress also approved surveys for a 9-foot channel between St. Louis and Minneapolis.

1929 - The Inland Waterways Corporation designed and launched three new diesel-powered, propeller-driven towboats on the Mississippi, leading the way in the design of more powerful towboats which soon took over river transportation.

1930 - Congress authorized a 9-foot channel on the Upper Mississippi, to be achieved by a series of 26 locks and dams north of St. Louis. The project was completed in 1939.

1951 - Its traffic dwindled to zero, the Illinois and Mississippi Canal was closed for good.

1953 - Commercial traffic having returned to health on the Upper Mississippi, the Inland Waterways Corporation sold the Federal Barge Lines to a private corporation for $9,000,000.

1957 - A new 110 by 1,200-foot lock at Keokuk opened, replacing the sub-size Lock 19 built by the Keokuk and Hamilton Water Power Company in 1913.

1963 - The Chain of Rocks Lock, Lock Number 27, opened just above St. Louis, by-passing the last serious obstacle to navigation on the Upper Mississippi.

1970 - Congress approved $350,000 to replace the deteriorating Lock Number 26 at Alton with a larger 110 by 1,200-foot lock. A suit by railroad companies and conservation groups halted work on the project from 1974 to 1978, and eliminated an auxiliary lock. As a part of the compromise permitting work to resume, towboat companies assumed a part of the cost of operation and maintenance of the locks and dams through a tax on diesel fuel used on the river.

1973 - A lock and dam project at the mouth of the Kaskaskia River provided barge access to southern Illinois coal fields.

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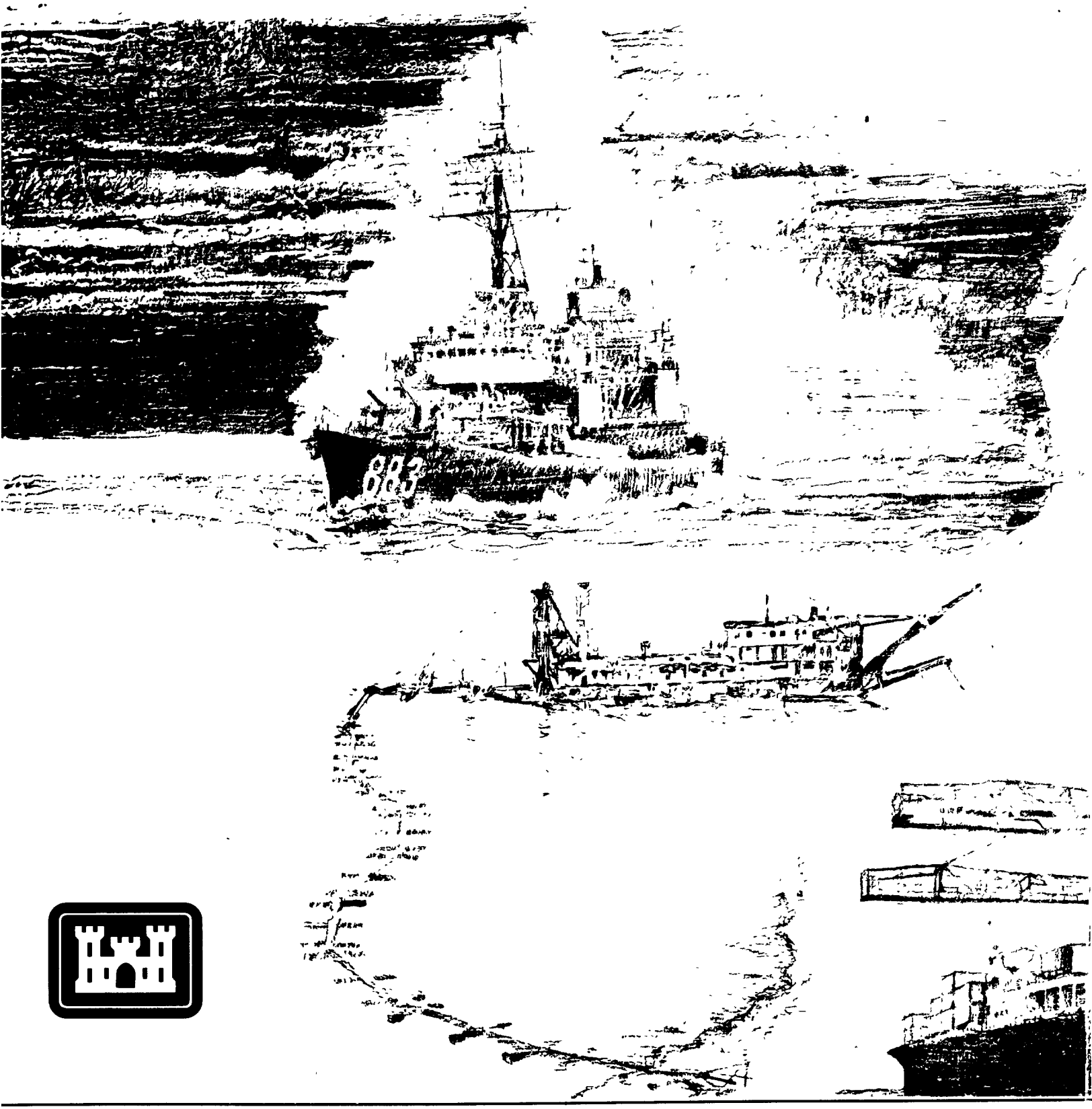
☆ U.S. GOVERNMENT PRINTING OFFICE: 1983-399-072

January 1983
Navigation History NWS-83-6



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