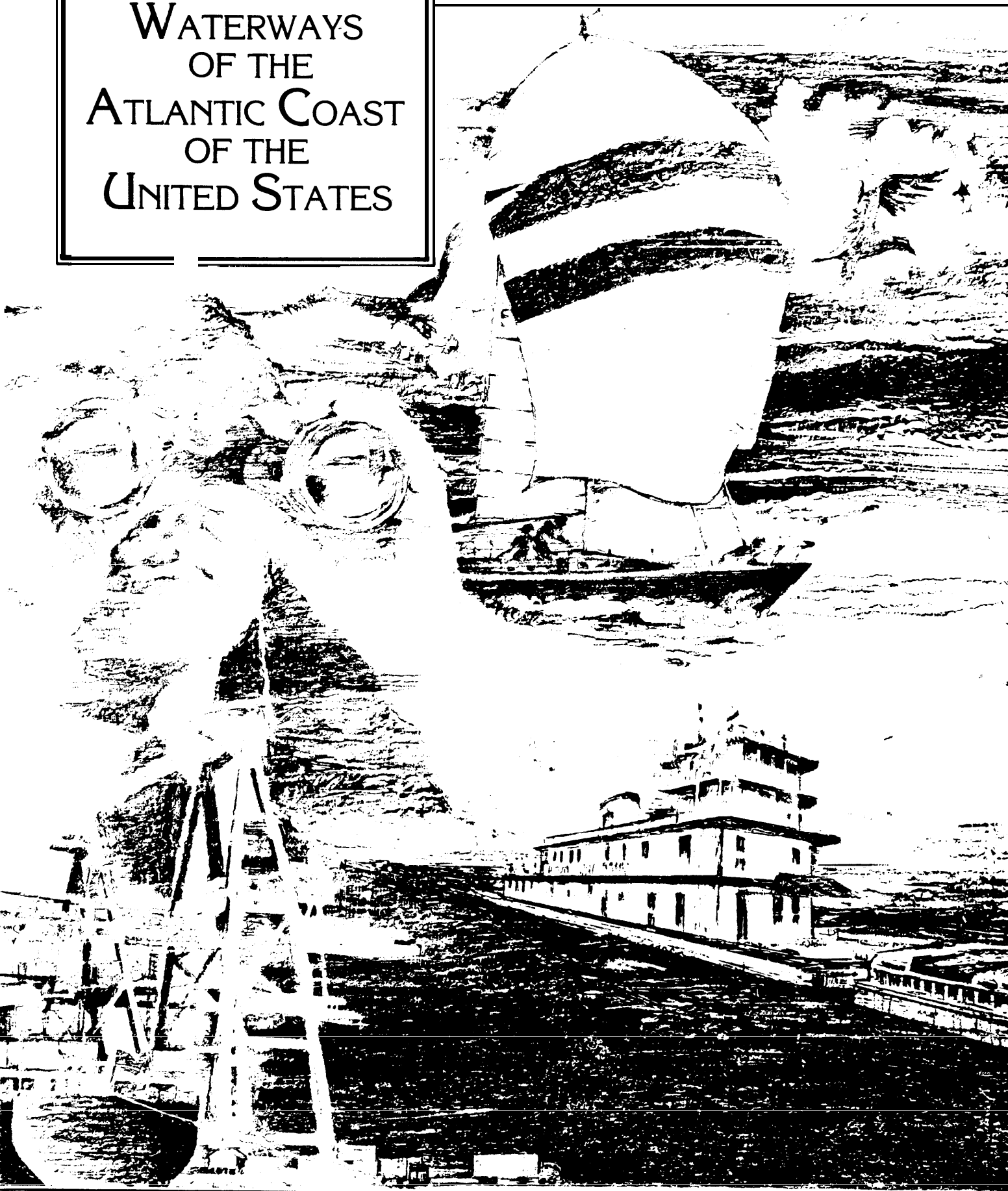
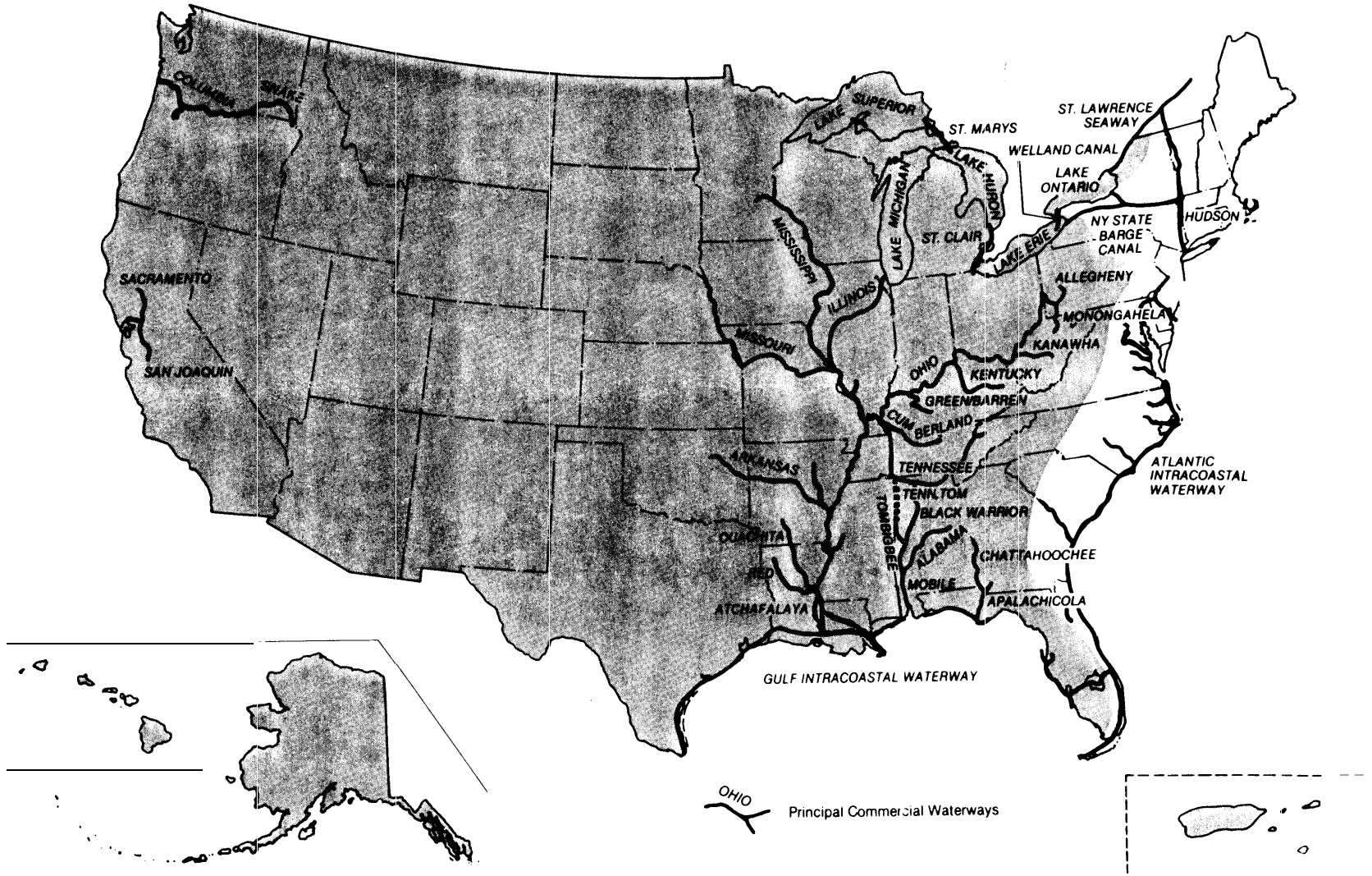
History of the Waterways of the Atlantic Coast of the United States



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

THE NATIONAL WATERWAYS
ATLANTIC COAST



HISTORY OF THE WATERWAYS OF THE ATLANTIC COAST OF THE UNITED STATES

Aubrey Parkman

January 1983
Navigation History NWS-83-10

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

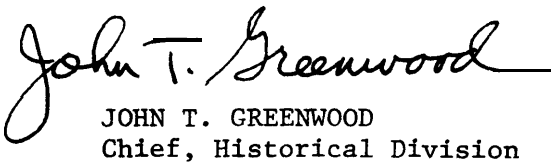
AUTHORITY FOR THE NATIONAL WATERWAYS STUDY

The Congress authorized the National Wateways 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
Chief, Historical Division

TABLE OF CONTENTS

Chapter I

THE AGE OF DISCOVERY AND SETTLEMENT

EXPLORATIONS

Early in the sixteenth century, only a few decades after Columbus accidentally discovered America, European navigators began sailing into the Atlantic coastal waters of the future United States. In March and April 1513 the Spanish adventurer Juan Ponce de Leon, searching for a fabled spring that restored youth and vigor to the old and impotent, and with an eye also peeled for gold, sailed from Puerto Rico, threaded his way through the Bahama Islands, and landed near Daytona Beach in the land that he named Florida. Hugging the shore to avoid the northward-flowing Gulf Stream, he coasted down the length of the peninsula, rounded the Florida Keys, and sailed up the Gulf Coast as far as Charlotte Harbor.

Giovanni da Verrazano, the first recorded navigator to voyage along the coast of the United States from the Carolinas to Maine, was on a very different mission. A Florentine mariner sailing for Francis I of France in the spring and summer of 1524, Verrazano was seeking a water route through an unwanted continent to the riches of Cathay. The Americas were an annoying obstacle in Europe's course westward to the East, and when it became clear that no passage existed through South or Central America, European logic and desire imperatively insisted that a strait to the Pacific Ocean--the Northwest Passage--must somewhere cut across North America. Looking across what he thought was a narrow isthmus, apparently the barrier sandspits that separate Pamlico Sound from the Atlantic, Verrazano believed that the Pacific Ocean was only a few miles distant. Somehow, probably prudently avoiding shoal water and sailing far out to sea, he missed the great Chesapeake and Delaware bays. He entered New York Harbor, but evidently deciding that the Hudson River was not the strait, hastily departed when unfavorable winds blew up. Putting into Narragansett Bay, he stayed for a fortnight in the sheltered harbor of Newport, Rhode Island. The treacherous shoals eastward of Nantucket and Cape Cod were so much to his disliking that he called them "Armellini," after Francesco Cardinal Armellino, a prelate hated for his avarice and success in collecting papal taxes. Stretching across Massachusetts Bay, he hit the coast of Maine at or near Casco Bay and continued northeasterly past Nova Scotia and Cape Breton Island to Newfoundland, whence he returned to France. He failed to find the strait to the Orient, but by describing the long East Coast of the United States and Canada he influenced North American cartography--not always beneficially-- for over a century.

Verrazano had many followers on the same errand. Every inlet, estuary, bay, or river mouth on the Atlantic coast might be the route to the Indies, either through the Northwest Passage or by way of another illusory but durable entity, the Western Sea. Fashioned by hopeful imagination from Indian stories of inland waters, amazingly extensible and migratory on contemporary maps, yet held to be a certainty by the beginning of the seventeenth century, the Western Sea became an indispensable link connecting rivers flowing into the Atlantic with rivers leading to the Pacific.

Verrazano's failure to report a strait south of Nova Scotia directed exploratory navigations largely northward. John Cabot, a Genoese under patent from Henry VII of England, had already probed there a quarter of a century before Verrazano, but had left little to geographic knowledge beyond uncertainties. Believing that the Far East could best be reached by sailing westward in the short high latitudes, Cabot, in 1497, had gained the coast of America at Cape Breton, Newfoundland, or Labrador--scholars debate just where--and returned home convinced that he had visited an outlying region of China. He tried again the next year, and disappeared. After Verrazano's voyage, Jacques Cartier, Martin Frobisher, Humphrey Gilbert, John Davis, George Waymouth, Henry Hudson, Samuel de Champlain, and many other mariners about whom less is known explored northern waters from Baffin Bay to the Gulf of St. Lawrence, all seeking the passage that had to be there.

Not everyone thought that the passage must lie to the north, and hard behind Verrazano into our own waters came three navigators pursuing the same dream. Estevan Gomez and Lucas Vasquez de Ayllon were sailing for the King of Spain, and John Rut was out to discover the strait for England. Gomez, putting out from Spain only two months after Verrazano had returned to France, was directed "*to search whether amongst the multitudes of windings and vast diversities of our ocean any passage can be found leading to him who we commonly call the Grand Khan."[3] He raised land at or near Cape Breton in February 1525, sailed up the Penobscot River to the head of navigation at the site of Bangor, hoping it was the passage, and coasted on to Massachusetts. Among the numerous capes and inlets that he sighted, scholars have identified Pemaquid Point and Boothbay, the Kennebec and Merrimack rivers, Ipswich Bay, and Cape Ann and Cape Cod. The rest of his voyage is less clear, but he may have continued down the coast to Florida. Ayl1on, armed with a patent from the king to explore some 2,500 miles of coast, to follow any oceanic strait that he might find, and to establish a colony, headed north along the coast from the Spanish colony of Santo Domingo at the same time that Gomez was sailing southward.

He commanded a small armada of five ships carrying 500 men, women, and children, and 80 to 90 horses; but the results of his venture mocked his ambitions. He entered a river, which remains unidentified, where his flagship ran aground and became a total loss. Forty to 50 leagues up the coast he found another river, evidently the Cape Fear, where he planted his colony. Here everything went wrong, Ayllon died of fever, and only 150 survivors made it back to Santo Domingo. John Rut, who also was out "to discover the land of the Great Khan," sailed from England in 1527 along the northern latitudes. But having no relish for the ice-filled seas he found, Rut cast about to the south and ranged along the coasts of Cape Breton, Nova Scotia, and New England, frequently landing men to report on "the state of those unknown regions." Most likely he continued down the coast, but the record is blank until he turned up in the West Indies.[4]

Late in the sixteenth century and early in the seventeenth century, the exploration of American waters was heightened by new incentives. Hopes for finding the Northwest Passage still remained strong, but now European courtiers and merchants were also interested in the fisheries, furs, and other resources of North America, and in establishing settlements there. Mariners in their employ penetrated coastal inlets and sailed far up many rivers from Cape Hatteras to northern Maine.

Simon Ferdinand and John Walker, sent by Sir Humphrey Gilbert in 1579 and 1580 to find a suitable site for a colony, examined Penobscot Bay and possibly also Narragansett Bay. In 1584 and 1585 Ferdinand, Philip Amadas, Arthur Barlowe, and Sir Richard Grenville, on similar assignments for Sir Walter Raleigh that resulted in the ill-fated Roanoke colony, found inlets through the Carolina Banks (the long series of narrow islands that Verrazano had assumed to be an isthmus between two oceans), nosed about in Pamlico and Albemarle sounds, and ascended several of the rivers that flowed into them.[5] In 1602 Bartholomew Gosnold explored for English merchants the coast of New England from southern Maine to Buzzards Bay. To him we owe the names Cape Cod, Martha's Vineyard, and the Elizabeth Islands. He temporarily established a small trading post on Cuttyhunk Island to barter with Indians and, apparently only incidentally, kept an eye open for "finding a passage . . . to the South Sea and China."[6] The next year Martin Pring, on a purely trading expedition, followed the same course as Gosnold, but entered several waterways that Gosnold had overshot, including Massachusetts and Cape Cod bays. For some five weeks Pring made a summer trading camp at a deep and protected anchorage that for many years was identified as Plymouth Harbor but is now thought to be Provincetown Bay. In 1605 George Waymouth, who three years before had searched Canadian waters for the Northwest Passage,

sailed along the coast of Maine to find a colonial refuge for English papists and fishing grounds for his merchant backers. He discovered Monhegan Island, put into an excellent anchorage that he named St. George's Harbor, as it is sti11 called today, and sailed up the broad St. George River estuary.[7]

The year before Waymouth sailed into Maine waters, Samuel de Champlain had taken the first of three voyages between 1604 and 1606 on which he systematically explored and charted the coast from Cape Breton Island to southern Massachusetts. While searching for a favorable site for a French colony, he was always on the lookout-for "a passage which should lead near to the great lake . . . where the water is salt: [a boon] as well for the navigation of ships . . . as for the shortening of the way more than three hundred leagues." The great lake was Lake Huron, which from Indian reports Champlain came to believe could "be nothing else than the South Sea. "[8] In the course of his three voyages Champlain navigated the Penobscot River and the lower reaches of the Kennebec River. He entered Eastport, Machias, Gloucester, Boston, Plymouth, Barnstable, Nauset, and Chatham harbors and sailed through Vineyard Sound as far as Woods Hole. Like many later mariners, he grounded on a reef off Cohasset or Brant Rock and experienced difficulties among the shoals around Monomoy Island. He sighted Portsmouth Harbor and stopped at the mouth of Saco River, but sailing across Casco Bay he missed[9] the fine harbor of Portland, as had other explorers before him. Champlain's report of his voyages was the only fruit of his New England venture. Sieur de Monts, who sponsored the colonial project, lost the king's support, no French settlement was made, and the history of New England became quite different from what it might have been.

Chesapeake Bay, with its many inlets and feeding rivers, was like deeply indented New England a magnet for European navigators. From 1560 the Spanish had an interest in the bay as a site for a naval base to protect their treasure galleons from pirates and privateers as they sailed from Havana northeasterly with the Gulf Stream along the North American coast before turning eastward for home. As this would be an expensive undertaking, however, nothing was immediately done. The first known English ship into the bay was a vessel of the first Roanoke expedition of 1584 piloted by Simon Ferdinand, who claimed to have been there previously with Spanish mariners. The next year the colonists of Roanoke worked their way in a small boat around Cape Henry and explored the southern shore of the bay, Hampton Roads, and the lower estuary of York River. Now that the English had a position on the American coast, the alarmed Spanish, intent on destroying it and replacing it with a Spanish settlement, sent Vicente Gonzalez in 1588 to make a

reconnaissance. But not knowing the colony's location, Gonzalez sailed past the small inlets through the Banks leading to Roanoke Island and took his ship into Chesapeake Bay. There he searched up the western shore and down the eastern, and departed without finding a trace of the English.[10]

After that, exploration and settlement in the great bay was left solely to the English, for the defeat of Spain's great Armada in 1588 destroyed Spanish power to contest it. Christopher Newport, who transported the first colonists to Jamestown, on instructions from King James worked his way up the James River to the falls at present Richmond. More importantly, Captain John Smith, who assumed leadership of the colony, spent much of his first two years at Jamestown exploring the bays and estuaries of the neighboring coast. Smith was under orders from the Virginia Company to find a way to the Pacific and was determined in any event to test Indian statements regarding such a passage. In 1607 he went up the James and the tributary Chickahominy River, looking for a lake at its source--the lake that Englishmen at home continued to believe lay just beyond the Blue Ridge Mountains and fed rivers flowing to the Pacific. The next year he poked into numerous bays and creeks in Chesapeake Bay, searching for good harbors and sites for settlement as well as for the passage. He went up the Potomac, Patapsco, Sassafras, Patuxent, and Rappahannock rivers, but the route to the "big sea water" that supposedly lay somewhere to the northeast of Chesapeake Bay always eluded him.[11]

The Captain, still having hope, sent to his friend Henry Hudson maps that indicated a passage to the western ocean might be found north of the Virginia colony, somewhere about the 40th latitude. Hudson, after having failed twice in the employ of the English Muscovy Company to find a Northeast passage to China through the arctic seas north of Europe, had entered the service of the Dutch East India Company, which assigned him to try once again. Before leaving Holland in 1609, he received Smith's letter, which inclined him to disobey instructions and look to the west. Therefore, failing again to pass Novaya Zemlya, the long barrier island north of Russia, he doubled back to North America. He coasted south to Chesapeake Bay, then reversing his course and examining the coast more carefully, discovered Delaware Bay, but could find no deep and open channel. Working past the confusing sand dunes and keys off the New Jersey shore, he entered New York Harbor, close to the 40th latitude, early in September, probably the first white man to do so since Verrazzano almost a century before. The low screen made by the shores of Long Island, Staten Island, and Sandy Hook had hidden well the only river of the Atlantic coast that provided an entry into the interior at all comparable to that of the St. Lawrence. Hudson

was able to navigate his vessel up the river that bears his name for 150 miles before he had to use small boats to explore farther.[12]

The Hudson River was not the passage to the Orient, but rather to the richest fur country south of the St. Lawrence. Hudson's employers were not interested in the fur trade, but other Dutchmen were. They returned to the river the next year to pursue the exceedingly lucrative trade, and within a few years expanded their operations. In 1614 Adriaen Block navigated the treacherous Hell Gate, pushed eastward through Long Island Sound, visited Narragansett Bay, rounded Cape Cod, and sailed into Massachusetts Bay. In the course of this exploration he discovered another long north-and-south river. Crossing the awkward bar at the mouth of the Connecticut River in Long Island Sound, he sailed upstream for 50 miles nearly to present Hartford. Later the Dutch set up a depot there to tap the fur supply of the long, rich valley. Meanwhile Cornelis Jacobsen Mey sailed south to chart Delaware Bay, bestowing his names, Cornelis and Mey, on the Delaware capes. In 1616 Captain Cornelis Hendrickson sailed up the Delaware River as far north as the Schuylkill, and in this region, too, the Dutch set up trading posts and established a settlement.[13]

In the same year, 1614, that Block and Mey were exploring southern New England and Delaware Bay, Captain John Smith spent 11 weeks working southward from Penobscot Bay to Cape Cod, carefully investigating the shores and waterways of the region, which to him owes its name, New England. By this time several navigators had made their way along the New England coast, but Smith was the first to put into many of its harbors, and his meticulous record of physical features was of enormous value to later mariners. In his Description of New England, a remarkably accurate depiction published in 1616, he comments that he had "sounded about 25 excellent good Harbours: in many whereof there is anchorage for 500 sayle of ships of any burden; in some of them for 5000. *'[14] On his return to England he presented Prince Charles with a map that for accuracy of detail and clarity of presentation far surpassed the charts made by Champlain and other navigators. Speaking of it, Smith explains:

> I have drawn a Map from Point to Point, Ile to Ile, and Harbour to Harbour, with the Soundings, Sands, Rocks and Land-marks as I passed close aboard the Shore in a little Boat; although there be many things to be observed which the haste of other affairs did cause me omit. For set in in being sent more to get present commodities than knowledge by discoveries for any future good, I had not power to search as I would; yet it will serve to direct any that should goe that waies, to safe Harbours and the Salvages habitations.[15]

THE LINES OF SETTLEMENT

The search for the Northwest Passage never shortened passage to the East, but it added vastly to European knowledge of North American geography and helped open the way for colonization. American waterways now took on a more vital purpose. No longer merely imagined avenues to riches beyond, they became the essential highways for the new settlements. The Atlantic coast is a "drowned'* coast, its land and rivers having been submerged by the prehistoric sinking of the continent's edge. This produced an indented coastline with innumerable bays and estuaries, into each of which flows one or more rivers providing access for varying distances to the interior. Majestic rivers like the Hudson, the Delaware, the Potomac, and the Savannah, and many smaller streams such as the Piscataqua, the Charles, the Patapsco, and the Cooper, linked the coastal plain with seaports and through them with Europe. At a time when travel and transportation by waters was easier and more economical than by land, and often the only means of communication in the new colonies, the rivers and their tributaries largely determined the lines of settlement and the course of trade.

In early Virginia, farms and plantations lined the James, York, Rappahannock, and Potomac rivers up to the fall line. Almost every farmer kept a boat on a nearby creek or river, and the larger plantations had wharves for handling their own tobacco at points which seagoing vessels of the day could reach. The first settlers of Maryland established themselves on the St. Mary's River, a small tributary of the lower Potomac, where supplies could be brought in from neighboring Virginia and from New England. From there the colony developed up the north bank of the Potomac and around the great water road of Chesapeake Bay. William Penn instructed his colonists to select on the western side of the Delaware River a spot "most navigable, high, dry and healthy, . . . where most ships may best ride, of deepest draught of water, if possible to load and unload at the bank . . . without boating."[16] On the site chosen, where the Schuylkill joins the Delaware, the city of Philadelphia was laid out. The smaller nearby colonies of Delaware and New Jersey grew from settlements hugging close to Delaware River and Bay and to the east shore of the lower Hudson.

New Netherland, later New York, owed its beginnings to the Hudson passage to Iroquois fur country. The colony's Dutch promoters, hoping to add permanence to their trading-post enterprises, encouraged immigration, and thinly scattered settlements developed along the river to Albany. South Carolina grew from a nucleus at Charleston, which had a good harbor at the point where, as South Carolinians later boasted, "the Ashley and Cooper rivers join to form the Atlantic Ocean.'* North Carolina settle-

ments grew up on the Cape Fear River and on Albemarle and Pamlico sounds. Georgia, founded on the southern border of English America as a military barrier against the Spanish in Florida, began as a fortified town at the mouth of the Savannah River. The Spanish, to protect their treasure fleets from French and English marauders, had founded St. Augustine on Florida's Atlantic coast in 1566. Few settlers, however, came to the colony, and Florida during three centuries of Spanish rule remained little more than a military outpost of Mexico and Cuba.

New England's heavily indented coastline encouraged more scattered early settlement than elsewhere. Within a decade after the Pilgrims of the Mayflower fronted their colony on a good harbor within the shelter of Plymouth Bay, a dozen or more fishing and trading posts dotted the New England coast at inlets from Penobscot Bay to Massachusetts Bay. The Pilgrims established posts on the Penobscot River, on the Kennebec River at the site of modern Augusta, and, shortly after the Dutch opened their post at Hartford on the Connecticut River in 1633, set up another at nearby Windsor. The Massachusetts Bay colony started with the founding of Boston at an excellent harbor and the establishment at the same time of six or seven other towns close by on good water connections. The other New England colonies similarly had their beginnings in groups of towns dispersed on rivers and bays. Rhode Island developed from the communities of Providence, Portsmouth, Newport, and Warwick, which ring Narragansett Bay. Connecticut was formed by the amalgamation of the Connecticut River settlements of Hartford, Windsor, and Wethersfield with New Haven, Branford, Guilford, Stamford, and a half-dozen other port towns on Long Island Sound. New Hampshire got its start with Portsmouth on the Piscataqua River, Dover and Exeter on tributaries of the Piscataqua, and Hampton on the Hampton River, ten miles to the south. Maine originated from Kittery, York, Wells, Saco, New Harbor, and other isolated towns strung along its coast from the Piscataqua River to Pemaquid Point.[17]

THE COURSE OF TRADE

During the colonial era settlement extended up the river valleys as far as the fall line, and there generally stopped. Some outlying communities existed above the line, and a few hardy souls penetrated into and even beyond the Appalachian Mountain chain stretching from Maine to Georgia, but not until after the Revolution was population movement very strong beyond the reach of navigable waterways. Throughout the whole period land travel remained both difficult and costly and roads appallingly bad. It was not until 1722, a century after New England was settled, that a team was driven for the first time from Connecticut to Rhode Island. And as late as 1818 the Niles

Weekly Register reported that two-thirds of the market crops of the Piedmont were raised within 5 miles of some river and the remainder not more than 10 miles from water that could be rendered navigable. The value of the rivers was easy to appreciate: in New York, where-the Hudson was the highway, the average cost of carrying a bushel of wheat 100 miles was only two pence, whereas the cost was a shilling, or six times as much, in Pennsylvania, where 40 wagons, 160 horses, and 80 men were required to transport the same amount of freight handled by two or three men on a scow in New York.[18]

Waterways connected the colonies with the world and with each other. Down the rivers and from the ports went the tobacco of Virginia, Maryland, and North Carolina; the rice and indigo of South Carolina; the grain, flour, cattle, and meats of the middle colonies; the fish, saltmeats, lumber products, ground vegetables, livestock, and simple manufactures of New England; and the furs, hides, ship timber, and naval stores of New England, New York, Pennsylvania, the Carolinas, and Georgia. Into the waterways and up to the towns and farms came tools, hardware, utensils, luxury articles, and other commodities from England and the continent; sugar, rum, molasses, diewoods, ginger, and other exotic products from the islands of West Indies; and fruits and wines from Spain, Portugal, the Mediterranean, and the Wine Islands. A busy coastal traffic also developed, through which the products of each region were exchanged. In New England and the middle colonies the water connections along the coast were also integral links in overseas commerce. Boston, New York, and Philadelphia each served as an entrepot to which small vessels carried the products of the surrounding area for export in ocean-going ships and from which foreign goods were transported by the coasters to the dozens of smaller ports in each trading network.[19]

THE ATLANTIC HARBORS

The colonial settlements had the good fortune to be abundantly provided with natural harbors having the rare combination of considerable shelter and sufficient depth of water. Unlike many foreign ports, where extensive and expensive breakwaters or moles were required for protection against the violence of ocean waves and storms, early American ports could develop on sheltered estuaries and bays. Some ports, like Baltimore, Philadelphia, Norfolk, and Savannah, lay from 30 to 152 miles inland from the sea. Others, like Portland, Boston, and New York, opened more directly on the ocean, but were nevertheless relatively well protected by natural breakwaters of islands and headlands.

Although nature cut some East Coast harbors deeper than others, and at the entrances to many of them had the annoying habit of forming bars from river silt or from shifting shore sands, their depths were generally adequate to the demands of the time. Vessels throughout the colonial period and for more than a half-century after were of diminutive size compared to the cargo carriers of today. Much of the coastal trade between Atlantic ports was carried by shallow-draft sloops and schooners that could enter harbors with shoal entrances. The sloops, rigged fore-and-aft with a single mast, were often under 25 tons and rarely more than 100. Sometimes they were equipped with centerboards instead of fixed keels, which could be drawn up when traversing shoal waters. Schooners, rigged fore-and-aft like sloops but with two masts, usually ranged in size from 50 to 150 tons. Originating in Gloucester, Massachusetts, in 1713 or 1714, the schooner was destined to stand for a century and a half as the favorite and distinctive rig of American waters. It was peculiarly adapted to the requirements of New World navigation, where on many rivers and estuaries the wind tended to draw up or down the channel, and passage involved a great amount of beating to the windward in short tacks. For such service the fore-and-aft rigged schooner, which could sail closer to the wind, was superior to square-rigged vessels of similar size.

While schooners, and even large sloops, were employed in off-shore trade, square-rigged brigs and ships were more common on the longer sea voyages. The two-roasted brigs usually displaced from 150 to 250 tons, and the three-roasted ships seldom more than 300. A vessel over 200 tons was considered large, and a 400-ton ship was looked upon both in Europe and the colonies as being too large for successful operation. Small vessels best met the needs of the highly dispersed trade that prevailed both here and abroad before railroads, good highways, or developed canals and river works could concentrate export shipments in a few major ports. Because each port and waterway was the focal point of its own small hinterland, and there was comparatively little concentration of export shipments prior to loading, cargoes were loaded and discharged in many places. Small vessels could enter and easily maneuver in the several hundred small ports on the Atlantic coast and the many small ports of foreign countries. They could quickly find sufficient cargo and depart, whereas larger vessels might have to wait for some time or sail with partly filled holds. Moreover, as trade was dispersed, spasmodic, and speculative, and all merchant ships were tramps with no fixed routes or schedules, merchant shipowners preferred to spread their risks by employing two or three small vessels rather than a single large one.

With full-rigged ships seldom exceeding 300 tons, and with shipmasters content to wait for 5- to 9-foot tides to carry them over harbor entrance bars, the numerous Atlantic harbors generally had sufficient depth of water just as the colonists found them. Newburyport at the mouth of the Merrimack River, and Salem on Massachusetts Bay, with mean low-water depths diminishing to 7 or 8 feet, became maritime metropolises and leading shipbuilding centers turning out large full-rigged ships as well as smaller craft. Charleston, with some 12 feet at low water and 17 feet at high, and Savannah, with a channel 7 feet deep at low water and about double that at high tide, became the major ports of the South. Even a place like Kennebunkport in Maine, a small hamlet located on an exceedingly small river, with water at low tide as little as 4 feet in places, could develop into a thriving mercantile port building everything from sloops to full-rigged ships.[21]

Some harbor improvement was no doubt attempted in the colonial period, but evidence is sketchy. In three studies of the port of New York, for example, the only references to colonial port improvement, except for the construction of commercial facilities such as docks, wharves, and weighthouses, are the brief comments of one study that in 1662 the Dutch built a small breakwater to protect ships against floating ice from the Hudson, and that when the English took over the colony their improvements included the construction of bulkheads along the waterfront.[22] Dredging appears to have been performed for the first time in America in 1729 at the mouth of the Mississippi River, but evidence indicates that probably the only attempt made on the East Coast during the colonial period was in 1774, when Philadelphians employed a horse-powered grab dredge to clear out ship slips. Dredging was not likely to be tried much in any event, for prior to the application of steam power to dredging equipment, doing the job by man or animal power was slow, laborious, and at best minimally effective.

Whatever the harbor depth, the channel had to be found and followed. Local authorities as a matter of course adopted the age-old device of marking channels with buoys, and at some major harbors pilots were necessary for all vessels except the smaller coasters. Portland Harbor, with a straight, deep channel and a run of only 3.5 miles from open sea to docks, was easy to enter. Norfolk, though 30 miles from the sea, had the same advantage of a deep and clear entrance. Boston Harbor, 17 miles from the ocean, had sufficiently deep water, but its channel threaded through rocky islands hazardous to the mariner in darkness, storm, or fog. The entrance to New York Harbor appeared to the uninitiated to be a 6-mile breadth of good water between Sandy Hook and Coney Island, but a broad sandbar stretched between the two shores, and the main ship channel was only a few hundred

yards wide. Small craft could use three lesser channels, but close to each lay dangerous sandbanks. Philadelphia, just over 100 miles from the sea, Baltimore, 152 miles, and Savannah, 30 miles, all had long winding channel approaches that invited grounding. 24 Illustrative of the measures taken was the action of the colonial assembly of New York in 1763 empowering the governor to appoint one master and three or more wardens for the port of New York. Their duties included examining and commissioning all pilots, keeping buoys in repair, and maintaining lighthouses. At Boston Harbor, piloting was one of the functions of its early lighthouse keepers, who were also the collectors of impost fees.[25]

The lighthouse was another ancient aid to navigation that the colonists began to employ to a limited extent. The first American lighthouse was Boston Light, located on Great Brewster Island (then called Beacon Island) at the entrance to the harbor, which was kindled on 14 September 1716. The enterprise was set in motion by Boston merchants led by one John George, who petitioned the General Court for this protection to the '*Lives and Estates of His Majesty's subjects." The cone-shaped tower was made of rough-cut stone and was at first illuminated by tallow candles. These were later replaced by lamps burning whale or fish oil. New York's lighthouse resulted from a lottery organized in 1762 to raise the money for a tower 85 feet high at Sandy Hook. Newspapers described it as the best light on the continent, an easy boast as at the time only three others existed. Local authorities administered lighthouses until 1789 when the Treasury Department of the federal government assumed control of the 12 stations then operating along the seaboard. Eight were located on the busy but troublesome waters of New England. The northernmost lay at Portsmouth, New Hampshire; five warned of Massachusetts coastal dangers at Newburyport, Cape Ann, Boston, Gurnet at the entrance to Plymouth Bay, and Great Point on Nantucket Island; and two blinked out from New England's southern coast at New Haven, Connecticut, and at Beaver Tail at the entrance to Narragansett Bay. The four lights to the south were at Sandy Hook; Brant Point, New Jersey; Cape Henlopen at the mouth of Delaware Bay; and Charleston, South Carolina.[26]

THE COASTAL RIVERS

Rivers during the colonial period, like harbors, generally provided satisfactory navigation in their natural condition. Most major rivers were not seriously obstructed below the fall line, and the head of sloop navigation was often a considerable distance inland. The Hudson was a splendidly navigable waterway for some 150 miles above New York to Troy. The head of tidewater and sloop navigation on the Delaware was at Trenton, about 140 miles from the sea. In Virginia the three great river ports of

Alexandria, Fredericksburg, and Richmond developed on the Potomac, Rappahannock, and James rivers, each approximately 100 miles from Chesapeake Bay. Even on New England's comparatively shorter streams, vessels could sail 30 miles up the Penobscot to Bangor, 45 miles up the Kennebec to Augusta, and 52 miles up the Connecticut to Hartford. Smaller but important rivers up and down the coast permitted sloop navigation at different tide stages a dozen or more miles inland to busy commercial towns such as Haverhill, Massachusetts, on the Merrimack; Norwich, Connecticut, on the Thames; and New Brunswick, New Jersey, on the Raritan. Many streams that today are little more than winding brooks were also once commercial arteries of some significance. Observers in the nineteenth century noticed a diminution in the size of rivers compared to that in the eighteenth, a phenomenon possibly resulting from deforestation. Bound Creek in New Jersey, for example, now only a brook between Elizabeth and Newark, once had wharves and landings for the accommodation of sloops . And the town of Exeter, New Hampshire, on a small branch of the Piscataqua River now used only by small recreational craft, was in the seventeenth and eighteenth centuries a shipbuilding community ranking in importance with Portsmouth.[27]

Above the head of sloop navigation, flatboats, skiffs, bateaux, wherries, and other shallow-draft vessels plied the rivers. The Durham boat, developed on the Delaware River to fill the need for a sizable carrier that could go against the current, was a favorite craft on many streams. Box-like, with straight and parallel sides extending to about 12 feet from the ends where they curved to the stem and stern posts, the Durham boat was usually about 60 feet long, 8 feet wide, and 42 inches deep from gunwale to keel plank. It drew from 3 to 5-1/2 inches of water when light, and about 28 inches loaded, and could easily carry 150 barrels of flour or 600 bushels of corn. Going downstream it floated with the current, helped along at times by long oars or by a sail attached to a removable mast. The sail was sometimes used going upstream, but more often the boat was poled. The crew, using 12- to 18-foot poles shod with iron, set the pointed tip in the riverbed and, pushing as they went, walked back the length of the boat on planks about a foot wide, called ‘*walking boards,” laid on the thwarts on each side. Sometimes it was possible to draw the boat along by grasping overhanging branches, or “pulling the brush” as it was called, At particularly difficult rapids iron rings were attached to rocks and the boat was pulled upstream by boathooks or ropes.

Local authorities occasionally improved river navigation. Adjoining towns on the lower Connecticut River sometimes deepened the channel lying between them, as did Hartford and Wethersfield in 1686. From time to time the legislature of colonial Virginia authorized associations of gentlemen to raise

subscriptions for clearing rivers of logs, sandbanks, or other obstructions. In South Carolina the assembly assumed occasional responsibility on sections of streams by appointing commissioners authorized to make assessments of labor and money on local residents who would benefit from improvements. In 1770 citizens of Pennsylvania and New Jersey, wanting to make commercial travel on the Delaware above Philadelphia less hazardous, appointed commissioners to remove obstructions in the river and generally improve navigation. Collecting subscriptions to cover the expense, the commissioners surveyed the river between Trenton and Easton and hired men and boats to remove the worst of the rocks. At Trenton Falls, where the river dropped ten feet in a distance of about 1,200 yards, the channel was changed and buoys were placed to mark it. The next year the legislatures of Pennsylvania and New Jersey sanctioned these efforts by declaring the Delaware a common highway and by empowering the commissioners to continue; but, as before, individual donations provided the necessary funds. In 1773 a group of New Jersey residents took it upon themselves to organize a lottery to raise 3,000 pounds to clear and deepen the channel of Elizabeth-Town Creek so that boats might be brought to a landing in the center of town.[29] River improvement in the colonial period, however, like harbor improvement, was obviously not a very extensive practice.

Chapter II

THE CANAL ERA

TRANSPORTATION REQUIREMENTS

From the first days of the Republic Americans recognized that the transportation facilities of the colonial era no longer sufficed. The Revolution disclosed the isolation of the colonies from one another and the difficulties of moving men, military supplies, and goods up and down the seaboard. Roads were few and poor, all but the smallest rivers had to be ferried, and British warships menaced the customary traffic of coastal sailers. Thoughts turned inevitably to inland water connections. During and after the Revolution an unprecedented number of Americans surged westward. New settlements sprang up beyond the fall line, creating incentives to extend navigability farther inland by constructing passages around the falls. The growth in inland population also promoted the establishment of cities near the head of tidewater to provide transfer facilities for the trade on the upper rivers. Royal edicts such as the Proclamation of 1763 no longer restricted the flow of settlers into the more distant regions beyond the Appalachians. The number of people living west of the divide increased from a few thousand when the war began to 120,000 by 1790, laying the foundation for the states of Tennessee and Kentucky. These new westerners also needed access to markets.

Wars in Europe, which lasted almost without respite from 1793 to 1815, intensified the need for better transportation. The wars forced the belligerents to remove mercantilist restrictions on foreign trade with their colonies, threw the commerce of the world largely into American bottoms, and created an enormous demand for American foodstuffs and other supplies. Flour nearly doubled in price, sending a tide of migration into new grain-growing regions of western New York, western Pennsylvania, and still more remote areas along the Ohio River and the shores of Lake Erie. The cost of long overland hauls, however, placed many newly settled regions beyond the range of profitable use. Western Virginia, Tennessee, Kentucky, and Ohio could reach markets by way of the Mississippi River, but with New Orleans for some years in Spanish hands this was a politically uncertain avenue. For even more years the distances involved, time consumed, primitiveness of transport, and chance availability of ships at New Orleans--made this route an economically marginal one. In the lower South the cotton industry arose at this same time, stimulated by an increasing demand for the fiber in Europe and Whitney’s invention of the cotton gin in 1792, which cheapened production to a fifth of its

former cost. Populations spread westward into upland sections suitable for cotton culture, adding to the pressures for better connections with the ocean highway.

A NATIONAL SYSTEM

The pressures for improved transportation facilities were not only economic and military, but also political. Improved communications would help tie together a still fragile new union, especially if they ended the isolation of the West. How to keep regions without an outlet for their produce except by way of New Orleans or the St. Lawrence loyal to the United States was for some years a matter of serious national concern. In 1808 considerations of commerce, defense, and political integrity led Secretary of the Treasury Albert Gallatin to prepare at the request of the Senate a comprehensive plan for tying the new nation together with government-sponsored roads and canals. Gallatin's great achievement was not to offer much that was new in the way of specific plans, but to combine many local improvement schemes then being urged or already undertaken into a coherent national system to be constructed under the aegis of the federal government.

To improve communications between the northern and southern states, Gallatin proposed the construction of canals across four *"necks" of land between Boston Bay and Albemarle Sound, North Carolina, which would open an almost continuous natural "tide water inland navigation'" from Massachusetts to Georgia. To this should be added "a great turnpike extending from Maine to Georgia passing through all the principal seaports." To bring the settlers beyond the mountains into easy communication with the East, the Secretary recommended the construction of roads over the Appalachian divide to connect the Susquehanna or the Juniata River to the Allegheny, the Potomac to the Monongahela, the James to the Kanawha, and the Santee or the Savannah to the Tennessee. He further recommended that the navigation of the eastern rivers of these four great land and water routes be improved, principally by constructing canals around falls. To open communication between the East and the Great Lakes, where advantage could be taken of a natural gateway through the mountains, Gallatin advised the construction of canals to connect the Hudson River with Lake Champlain, the Hudson River with Lake Ontario, and Lake Ontario with Lake Erie around Niagara Falls.

Because such "internal improvements" would unite the nation, improve its defense, and advance the economy, Gallatin proposed that the federal government either do the work itself or subsidize private companies. He considered the projects of such obvious value that the state involved would readily consent.

President Jefferson, however, always cautious about federal authority intruding upon the states, proposed an amendment to the Constitution that would "remove every impediment" to the great national plan.[1] But events interfered. Foreign difficulties leading to the War of 1812 gripped the nation's attention, and Gallatin's superb. "Report on Roads and Canals'* was shelved.

Belligerent interference with American shipping, American retaliatory restrictions on trade, and then the war itself served to accentuate the need for internal improvements. The embargo and the war diverted much of the capital employed in shipbuilding and commerce to manufacturing, and better roads and waterways were essential for the larger home markets desired. The British blockade reduced coastal shipping to a trickle, forcing American goods to move over inland routes. Coastal roads clogged with traffic, wagons backed up for miles at river ferries, and teams took weeks and even months to go from Boston, New York, or Philadelphia to Charleston. In some localities serious shortages of goods normally carried by sea pushed prices to new heights. Rice cost three times as much in New York as in Charleston; flour cost three times as much in Boston as in Richmond. The absence of good roads and dependable water communications also helped to frustrate American military campaigns on the northern and western frontiers.[2]

With these experiences in mind, President Madison in 1815 urged upon Congress "the great importance of establishing throughout our country the roads and canals which can best be executed under national authority.'" As had Jefferson, Madison suggested that any defect of that authority could be remedied by constitutional amendment.[3] Representative John C. Calhoun of South Carolina promptly sponsored the so-called **Bonus Bill," which provided for a national system of internal improvements funded by monies due the government from the newly chartered second Bank of the United States. A strong nationalist at this point, Calhoun viewed internal improvements as a broad national question. But the debate and vote in Congress revealed that many of his colleagues were more concerned with state and sectional self-interest. New England, whose roads were relatively good, was almost solidly opposed. The measure, she feared, would increase an already serious drain of her people to the West and would promote the commerce of New York, Philadelphia, or Baltimore to the disadvantage of Boston. The South, which was well supplied with navigable rivers but had the poorest roads in the country, was largely opposed because she believed that other sections would benefit more than herself. The middle states of Delaware, Maryland, and New Jersey, apparently with similar thoughts, voted two to one against the measure. The West, badly needing internal improvements,

strongly approved, but local jealousies nevertheless produced some opposition. Only New York and Pennsylvania gave almost unanimous support. Both had promising routes to the West through their territories, New York hoped for federal aid in building the Erie Canal, and Pennsylvania hoped to reach the South by way of a Chesapeake and Delaware Canal and to see Pittsburgh profit immeasurably by the opening of the Falls of the Ohio to navigation. Ultimately Calhoun's bill squeaked by, but President Madison, firm in his belief that a constitutional amendment was necessary, vetoed it.[4]

Internal improvements at federal expense nevertheless seemed assured. In 1819 Calhoun, now Secretary of War, elaborated at the request of the House of Representatives a program much like that put together by Gallatin. Ignoring the constitutional question, Calhoun stressed the defensive value of a "judicious" system of roads and canals. He also advocated the extensive use of Army Engineers in making surveys and plans. Army Engineers were already involved in the work of improving internal communications and were to become even more so in the next several years. In 1816 the War Department, acting on the assumption that England would have to be fought again at some future date, had created a Board of Engineers for Fortifications. Initially consisting of Colonel William McRee, Major Joseph G. Totten, Captain J.D. Elliot of the Navy, and Brigadier General Simon Bernard, a French military engineer employed under congressional authorization by President Madison to assist the Corps of Engineers, the board sought to create a comprehensive defensive system based on the armed services, fortifications, and interior land and water communications.

On essentially military assignments, Army Engineers identified transportation routes while making western explorations. They made navigational surveys of the nation's great inland lakes and rivers and of rivers and harbors along the Atlantic coast. They laid out military roads and occasionally other highways. State governments and private corporations, faced with a critical shortage of civil engineers, called on the War Department for engineering assistance in making canal surveys. The Engineer Department within the War Department ordered the Board of Engineers to formulate plans for breakwaters at the mouth of Delaware Bay, as called for by an act of Congress, and Congress directly turned to the Army Engineers to determine the most practicable means of improving the navigability of stretches of the Ohio and Mississippi rivers and to provide a plan for improving the entrance to the harbor of Presque Isle, Pennsylvania, on Lake Erie.[5]

President Monroe, while at first taking the strict constructionist attitude of his predecessors toward internal improvements, was by 1823 satisfying his constitutional scruples by holding that Congress could make appropriations for improvements of national benefit if control of the improvement companies remained within the states. He also recommended that the Corps of Engineers survey the route of a canal to be built by private enterprise connecting Chesapeake Bay with the Ohio River and the routes of several proposed canals to connect the Ohio with Lake Erie.[6]

With federal encouragement of internal improvements conspicuously on the increase, Congress on 30 April 1824 passed a General Survey Act authorizing the President to employ Army and civil engineers to make surveys, plans, and estimates of roads and canals of national importance. Its evident purpose was to lay the foundations for a program of appropriations for internal improvements, with federal subscription to the stocks of companies undertaking them. To implement the act President Monroe appointed a Board of Engineers for Internal Improvements consisting of General Bernard, Colonel Totten, and John L. Sullivan, a prominent civil engineer. Under the direction of the board, Army Engineers examined all the major land and water routes proposed by Gallatin and Calhoun, and many other routes as well. The board began formulating plans for great national arteries of transportation. But the scheme of Gallatin and Calhoun for a rational, integrated system of internal communications developed under federal leadership was never realized.

The vote on the General Survey Act had again ominously revealed that particularist interests were far stronger than nationalist concerns. Successive Congresses and chief executives approved federal grants to help build specific roads and canals, and the average annual appropriation for internal improvements increased with each administration through that of Andrew Jackson. But bitter state and sectional jealousies, constitutional arguments that often seemed forced and unreal, and extremes of partisan politics all served to thwart plans that looked to the broad national interest. Increasingly, the General Survey Act became merely a vehicle for providing engineering assistance to state and private agencies. Complaints against this practice and the pressure of other duties on Army Engineers finally resulted, in 1838, in repeal of the act. The tremendous task of developing transportation in America was thus left largely to the conflicting ambitions of state and private enterprise.[7]

EARLY CANAL CONSTRUCTION

Artificial waterways were the most favored mode of transportation. The construction of turnpikes beginning in the 1780s had by the 1820s greatly improved overland transportation. But roads were not economically feasible for hauling anything except the most compact and valuable goods. Bulky products like wheat and corn could not be transported at a profit beyond 100 miles at the most. Contemporaries calculated that four horses could pull a wagon weight of one ton 12 miles a day over an ordinary road and one-and-a-half tons 18 miles a day over a turnpike. Comparatively, four horses could draw a boatload of 100 tons 24 miles a day on a canal.

From the late eighteenth century, when canals began to prove their worth in England, forward-looking Americans like George Washington, Robert Morris, and Albert Gallatin had visualized major waterways penetrating deep into the American hinterland. It was easier to conceive great waterways, however, than to construct them. America's eastern terrain was not, like England's, one of gentle contours. The science of civil engineering in America was in its infancy, and would-be engineers learning as they went often committed costly errors. Excavating machinery still belonged to the future, and canals were formidable challenges in an age of hand tools, gun powder, wheelbarrows, and horse-drawn carts. Canals also required heavy expenditures, and large pools of venture capital did not yet exist in the United States. Even when a few early enterprises overcame these obstacles, they *were* such financial failures as to discourage further investments. It was not until construction on the epic Erie Canal was under way several years and seemingly conquering all difficulties that the Canal Era in the United States really began.

Prior to that time many canal companies were organized. Before the year 1793 eight states had incorporated a total of 30 companies, and between 1776 and 1823 New Hampshire alone chartered 20. Some companies intended to construct lengthy overland canals, but most planned to improve river navigation by building short canals around falls and rapids. Many soon abandoned their efforts. Before work began on the Erie, only about 100 miles of canal had been constructed, and few canals were more than 2 miles long.[9]

The Riverine Canals

Although the canals bypassing river falls were not long, they were often impressive engineering achievements. Some required more than a half-dozen locks to make their descents, and almost all needed one or more dams or wing dams to divert water into their locks and ditches.

Canal construction in New England began in 1792 on the Connecticut River at South Hadley, Massachusetts. Dropping 50 feet in two-and-a-quarter miles, the river at this point was impassable even for canoes. Undertaking a difficult task for the time, the canal company, the “Proprietors of the Locks and Canals on Connecticut River,” in one place cut a gorge 300 feet long and 40 feet deep through solid rock. For about a decade the company used an "inclined plane” to raise and lower boats from one river level to the other. Employed here for the first time in America, this device was perhaps suggested by Dutch stockholders. It was a 230-foot-long stone and timber ramp upon which the boats rode on a carriage that was hauled up or eased down by chains connected to water wheels. In 1805 the company replaced the inclined plane with five locks.

Meantime, other companies constructed locks and dams at four falls farther up the river, making the Connecticut navigable for flatboats for more than 200 miles above its mouth. A difficult passage, however, still remained at Enfield Rapids about 11 miles above the head of sloop navigation at Hartford. A long canal was required, and the high estimated cost deterred investors. Shippers got through inconveniently by transferring their goods to smaller boats or by passing the rapids at times of high water. It was not until a threat to Hartford arose from a plan to divert the Connecticut Valley trade to New Haven by a canal from that city to a point on the river above the rapids that a company formed in 1824 succeeded in digging a canal around them. The company went to work in earnest in 1827, and the Enfield Canal, six miles long with three locks, opened in 1829.[10]

The Merrimack River, rising at the same height as the Connecticut but reaching the sea by a course only half as long, saw even more construction. In 1796, Newburyport interests built a canal around Pawtucket Falls at present Lowell, Massachusetts, to permit lumber to pass downriver to the shipyards at Newburyport and other towns on the lower Merrimack. Farther up the river, subsidiaries of the Middlesex Canal Company had by 1814 constructed, as part of the company’s extensive navigation system, six more sets of locks and canals to bypass more than a dozen falls and rapids. The largest work was the Amoskeag Canal at present Manchester, New Hampshire. A mile long and equipped with several dams and nine locks, it overcame a descent in the river of 45 feet.[11]

In Maine, the Kennebec River was navigable for 65 miles to Waterville, but no seaport lay at its mouth about 30 miles up the coast from Portland. In 1795 a short canal constructed between the Kennebec and Casco Bay along the line of the Stevens River allowed a more direct connection to that city’s wharves .[12]

Canal construction improved navigation on other rivers down the Atlantic seaboard. The Susquehanna River and its tributaries provided water transportation for a huge area of interior Pennsylvania and southwestern New York, but for more than 40 miles above its entrance into Chesapeake Bay it was choked by rapids and falls. Between 1792 and 1798 a stock company dug a l-mile canal around Conewago Falls, the worst obstacle, just below Columbia, Pennsylvania, and improved the river by sluices for some 17 miles farther down.[13] Flatboats and arks could now come down the river more easily, but to get back up was still difficult and often impossible.

The Potomac Canal Company, organized in 1785 with George Washington as president, set out to open the Potomac River to Cumberland, Maryland, over 200 miles above tidewater and 300 miles from Chesapeake Bay, and to connect it by road to the Ohio River. By 1818 the company had constructed crude chutes without locks around the three upper falls of the Potomac, locked canals around the Great and Little falls above Georgetown, and locked canals to pass five falls on the branch Shenandoah River, bankrupting itself in the process. The work on the falls above Georgetown was both a remarkable piece of engineering and extremely expensive. At Great Falls, where the river descends 76 feet in little more than a half-mile, the eastern end of the canal and the last two of five locks were be cut from solid rock. The 37-foot descent of Little Falls required four locks in a canal 2 miles long.

The James River Company, chartered in 1785 and reorganized as a state corporation in 1820, had a comparable plan of improving navigation on the James River and linking it by turnpike to the Kanawha River, a tributary of the Ohio. This project also owed its conception to Washington, who was the company's honorary president for a decade. The company constructed and later enlarged a canal around the falls above Richmond and built another canal where the river breaks through the Blue Ridge. It also completed the turnpike connecting the James and Kanawha rivers and sporadically made river navigation improvements. But it was still far from its goal of providing adequate transportation through to the West when, under the influence of Erie fever, it was again reorganized as a private company in 1835.[15]

The state of South Carolina also participated directly in improving river transportation, and for several years after establishing a Board of Public Works in 1819 invested heavily in building locks and canals at falls. By 1825 small boats could make a trip of more than 300 miles from Cambridge to Charleston by passing through three state-built canals on the Saluda River and another on the Congaree and then through the Santee and

Cooper Canal constructed earlier by private enterprise. South Carolina also constructed canals at two places on the Wateree River, a large tributary of the Santee flowing down from the north, opening the river to navigation for about 200 miles from Charleston.

In North Carolina, the Roanoke Navigation Company, chartered in 1812 to improve navigation on the Roanoke River, had by 1823 constructed nearly nine miles of canal around the falls near Weldon, where, within a few miles, the river drops 100 feet. The canal terminated at its lower end, however, at a basin at Weldon, 1,800 feet from the river. As the extension to the river entailed the construction of six more locks at considerable expense, nothing more was done for several years and goods on reaching this point had to be drayed and transshipped. Upon insistence by the state that the company accept its stock subscription--which the directors considered inadequate--and complete the waterway, the company resumed work in 1828 and the canal opened to through traffic in 1834. Shortly afterward the Roanoke River flooded, breaking the sides of the lower locks. Refusing to rebuild them, the company argued, as it had before, that produce could be carried from the basin to the river by land as easily as it could pass through the locks. Within a few years railroads drew away a large part of the trade that had formerly gone down the lower Roanoke, and the canal was no longer considered of importance to the commerce of the region.

Early Overland Canals

Only three major canals were constructed before the Erie Canal was pushed across New York State, but compared to that ditch, they, too, were small undertakings. The longest was the Middlesex Canal in Massachusetts. Started in 1793 and completed in 1803, it ran 27 miles from the Merrimack River above Pawtucket Falls to the Charles River near Boston Harbor. Initiating a competition between ports that was to be a prominent feature of the Canal Era, its proprietors planned to divert the traffic of the Merrimack, which carried much of the trade of New Hamphsire, from Newburyport to their own city of Boston. Upon completion of the Merrimack River canals in 1814, canal boats with capacities of 30 tons could travel from Boston to Concord, New Hampshire. Smaller boats could continue farther up the river and up the tributary Pemigewasset River to Plymouth, 113 miles from the sea. Despite the canal's value to the territory it served, it was a financial failure from its first day of business to its last, 50 years later. Local conditions permitted competition from teamsters in carrying general goods, and when the growth of manufacturing created a demand for raw materials that

was favorable to the canal, railroads reached out to gamer this trade and eventually diverted to their cars every ton of traffic formerly moving by water.[17]

The Santee and Cooper Canal of South Carolina, constructed between 1792 and 1800, was a 22-mile waterway cut between the two rivers to give the agricultural products of central South Carolina a better outlet to Charleston. The Santee and its tributaries drained the whole South Carolina uplands, but its entrance to the sea, some 50 miles northeast of Charleston, was choked by a swampy delta and a shallow bay. From there boats had to pass to Charleston inside a broken string of sea islands, by turn risking shoal water and open ocean. The first boat to make the less hazardous passage through the Santee and Cooper Canal, in July 1800, carried a cargo of salt from Charleston up the Cooper, Santee, and Congaree rivers some 200 miles to Columbia. Although it opened the interior of South Carolina to water transportation, the Santee and the Cooper Canal} like the Middlesex Canal, never made money. Construction was more costly than had been expected. Then the rise of the cotton industry in the uplands in place of cereal production soon ended all shipment of grain to the coast. Cotton, far lighter in weight and more precious in value, could better bear the cost of transportation by land, especially since transport on the rivers was plagued by frequent mishaps, low water, and delays. Railroads also began to compete for the upland traffic in the 1840s, and the canal was finally abandoned in 1858.[18]

The Dismal Swamp Canal, a 20-mile waterway between the Pasquotank River flowing into Albermarle Sound and the Elizabeth River of Virginia near Norfolk, was designed to give North Carolina a short and sheltered outlet to a deepwater port. Begun in 1793 it was the only segment of Gallatin's proposed intra-coastal waterway under construction when the Secretary wrote his report. For years, however, sporadic work produced little more than a muddy, shallow ditch which not even flatboats carrying shingles cut in the swamp could navigate until 1805. The first craft other than a shingle flat to travel its course was a 20-ton boat in 1814, and it was not until a year-and-a-half later that another such passage was recorded. The first vessel to make the trip completely loaded with North Carolina cotton, flour, tobacco, and hogs was a 35-ton schooner in 1823. In 1826 Congress directed the Army Engineers to make surveys and estimates for improving and enlarging the canal so that it might serve as part of a chain of canals contemplated along the Atlantic coast. To pay for the reconstruction Congress ultimately purchased $200,000 worth of Dismal Swamp Canal Company stock. In 1829 barges carrying up to 92 tons, as well as sloops, schooners, and rafts, began plying the enlarged waterway. Traffic steadily increased, and the canal at last became a paying enterprise and an important part of the transportation system of eastern North Carolina.

THE INSPIRATION OF THE ERIE

In view of the record of canal construction, the building of the Erie Canal was an act of faith. Authorized by the New York legislature in 1817 and completed in 1825, "Clinton's Big Ditch" stretched 363 miles from Buffalo on Lake Erie to Albany on the Hudson. It was the longest canal in the world and the greatest construction job that Americans had ever undertaken. Its high cost of $7 million was met, not by private investors, but by the state. Engineering problems were greater than any previously confronted in canal building, but the lack of professional engineers was overcome by the appointment of able, though untrained, people to Plan and supervise construction. They devised -ingenious arrangements of cables, pulleys, wheels, and gears for bringing down trees and uprooting stumps. Instead of the usual shovel and wheelbarrow, they used specially designed plows and scrapers for moving earth. Even before its completion, the Erie Canal was a phenomenal financial success as well as a transportation triumph. The middle section of the canal from Utica to Rome opened in 1819, and successive sections as they came into use quickly filled with traffic. Within seven years after the canal opened to through traffic, tolls brought in enough money to repay the whole cost of construction.[20]

The Erie funneled much of the commerce of the West to New York City. The area through which it passed, much of it formerly unsettled wilderness, boomed with prosperity. Boston, Philadelphia, and Baltimore--New York's commercial rivals--felt that they too must find ways of tapping the western market, and the idea took hold that almost any region reached by a canal would so prosper as to merit the investment. The Erie's success provided the stimulus that finally got the great canal-building boom under way. The huge sums necessary for construction were supplied to a large extent either directly or indirectly through public aid. Congress made substantial contributions by granting public domain to canal companies in the West and by purchasing stock in the Chesapeake and Ohio, Chesapeake and Delaware, Dismal Swamp, and Louisville and Portland canal companies. It was the states, however, that made the major capital contributions. In some cases, as in New York and Pennsylvania, they directly owned and operated extensive canal systems. More often states purchased or guaranteed the stock of private companies, the heaviest investments being made by Pennsylvania, Virginia, and Maryland. Sometimes states permitted newly organized banks to invest a portion of their capital endowment in the stock of a canal company, as did Maine, or they granted canal companies themselves banking privileges, as did Rhode Island and New Jersey. The Middle Atlantic states granted valuable monopoly rights rather than financial assistance to the promoters of the so-called "anthracite canals." Municipalities, such as New Haven, Connecticut, and various banks also invested in canal companies.

NEW ENGLAND CANALS

Of the major canals of the eastern seaboard, three were constructed in New England. The Cumberland and Oxford Canal in Maine, chartered in 1820 and completed in 1827, connected Sebago Lake with Casco Bay near Portland. Although only 20 miles long, it was supplemented by lake and river navigation that reached another 30 miles inland, and for many years it was an important outlet for products of the southeastern corner of the state. More successful than other New England canals, it did not succumb to railroad competition until the 1870s.[22]

The Blackstone Canal, constructed between 1824 and 1828, linked Worcester, Massachusetts, with Providence, Rhode Island, 45 miles away. Worcester was surrounded by good farming land, but the area had been slow in developing because of the heavy expense of hauling produce to the Boston market. Despite irregular service resulting from too much or too little water and from poor maintenance, the canal proved to be a considerable, if brief, boon to the area. Trade increased, villages sprang up, and mills and factories developed along its line. When a railroad from Worcester to Boston was completed in 1835, however, business declined rapidly, and when Worcester was connected by rail to Providence in 1847, traffic ceased entirely.[23]

The longest and most costly, and also the least successful, of New England canals was the New Haven and Northhampton, chartered in 1822 and after many difficulties opened in 1835. Connecting with the Connecticut River at Northhampton, Massachusetts, some 40 miles above Hartford, it was designed to capture for New Haven the trade of the river's rich upper valley, as Enfield Rapids, when the project began, still hindered navigation to Hartford. Poorly constructed though costing well over a million dollars for its 78-mile course, constantly short of capital, repeatedly damaged by floods, and always short of water in dry seasons, it seldom carried enough traffic to cover expenses. In 1847 it was abandoned.[24]

New England’s construction of canals fell considerable short of it vision and schemes. An old plan of Boston merchants dating back to 1791 for a canal from the Charles River to the Connecticut River, “to take the trade from Hartford,” was revived on grander lines. One proposed route would run the canal through Worcester, stopping the drainage of trade by the Blackstone Canal, connect with the Connecticut, taking that river’s trade from both Hartford and New Haven, and continue across the Berkshire Mountains to the Hudson River near Albany, where it would divert to Boston much of the Erie trade going to New York. In 1825 the Massachusetts legislature ordered surveys,

and canal commissioners reported eloquently on the benefits of the enterprise. But the legislature, recognizing that costs would be huge and engineering difficulties almost insurmountable, turned its attention to railroads.[25]

Canal promoters in Maine contemplated several large projects, which would direct state trade to the St. Lawrence River or to Boston, that never reached the survey stage. Ambitious canal schemes in New Hampshire and Vermont, however, progressed to the point where Army Engineers surveyed several routes under the authority of the General Survey Act. One route connected Rutland, Vermont, with the Champlain Canal, which the state of New York had built in conjunction with the Erie Canal to connect Lake Champlain to the Hudson River. The other routes, while consisting of numerous sections, each with its own state or private sponsor, would together have formed three great lines of navigation reaching across New England from Lake Champlain to the Atlantic, one terminating at Portland, another at Portsmouth, and the third at Concord on the Merrimack. Intersecting the principal rivers of the region--the Connecticut, the Merrimack, the Androscoggin, and the Kennebec, which the Army Engineers also surveyed with a view to improving navigation--the canals would have formed with the rivers a huge transportation grid serving five states. Railroads, however , quashed the projects even before the Engineers had time to complete their reports and designs.[27]

One other canal proposed for New England was to have a future, though it had to wait nearly a century. This was a waterway that would eliminate the dangerous passage around Cape Cod and shorten the sailing distance to New York. In his “Report on Roads and Canals," Gallatin had proposed a route from Boston Harbor to Narragansett Bay along a course surveyed by the state of Massachusetts in 1806. In 1824-1825 the Army Engineers made another survey of this route, but they were more interested in a shorter one that cut across the base of the cape between Barnstable Bay and Buzzards Bay. Less than eight miles long, the route was traversed most of the way by rivers flowing north and south, with the ridge between them rising only about 30 feet above sea level and at one point only three-quarters of a mile wide. The Plymouth colonists had crossed here by boat and foot as early as 1623 to trade with the Narragansett Indians and later with the Dutch at New Amsterdam. By 1676 people were talking of cutting “a passage from the South Sea to the North.” In 1697 and again in 1776 the General Court of Massachusetts appointed committees to investigate the feasibility of such a canal, but with no result. In 1791 the legislature ordered a third survey, and in 1818 a Boston company chartered that year made yet another. Plans and estimates for a canal, however, were not forthcoming until the Corps survey. Although there seemed to be

no doubt about the canal's practicability, no serious obstacles to construction, and no great costs involved, neither Congress, nor Massachusetts, nor private enterprise took any further action. The project languished until 1860, and then it was another 54 years-before the canal was finally built.[28]

MIDDLE ATLANTIC CANALS

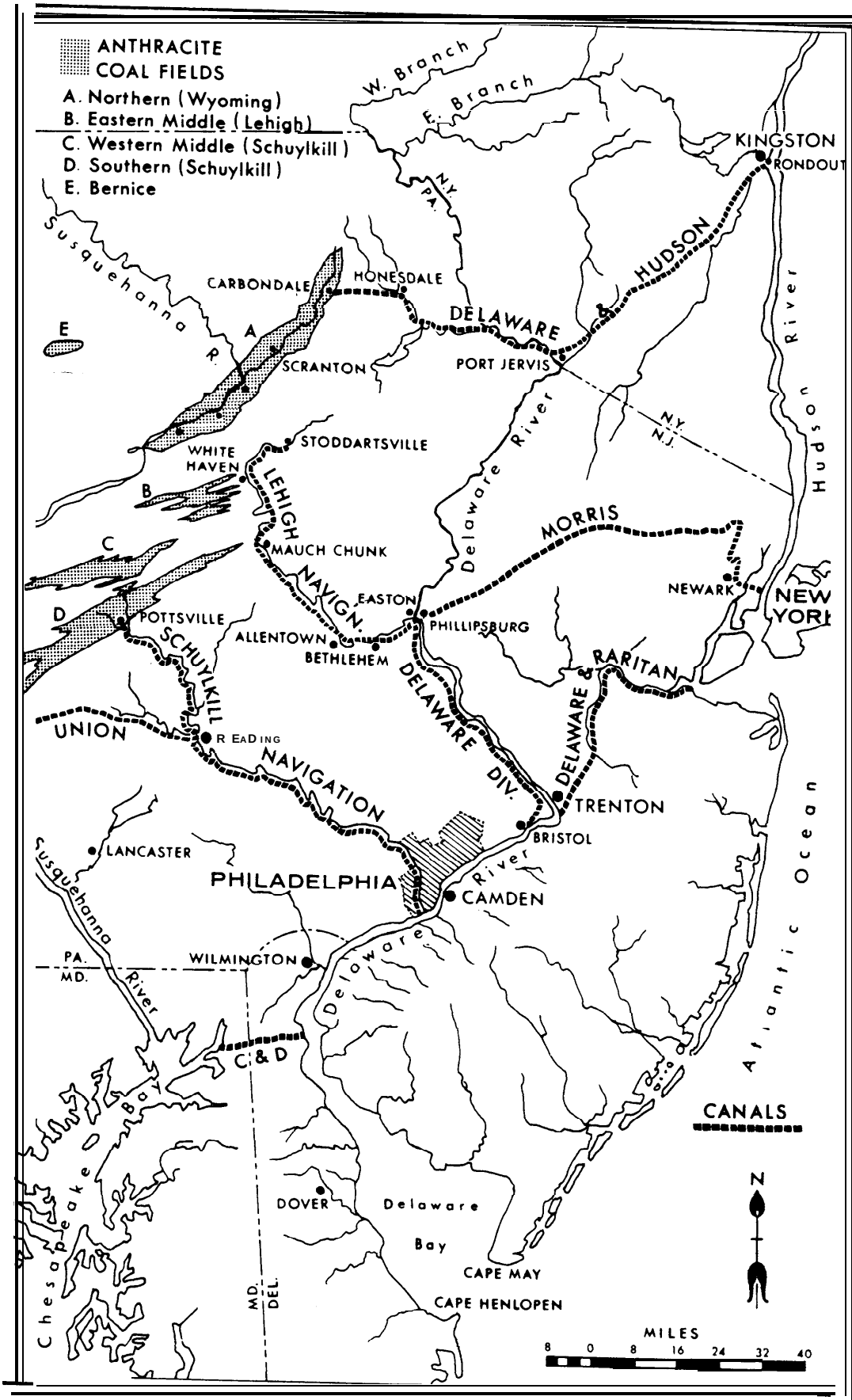
The Anthracite Canals

The Middle Atlantic states saw the greatest activity in canal building, with three distinguishable groups of waterways constructed. One complex, known as the "anthracite canals" was constructed to carry this new fuel from eastern Pennsylvania to New York and Philadelphia markets. The northernmost canal, the Delaware and Hudson, ran from Honesdale in northeastern Pennsylvania to the Delaware River, which it crossed by means of a dam and slackwater and later by a suspension aqueduct. The canal continued northeasterly across New York for a total of 108 miles to Rondout on the Hudson near Kingston. Started in 1825 and completed in 1828, the canal did a tremendous business making an increasingly popular fuel available to New York and New England cities. Originally a small waterway that could accommodate boats carrying only 25 or 30 tons, it was enlarged several times until boats of 140 tons capacity could be used. Enormously profitable, the canal company paid its investors good dividends for many years with the peak of its traffic not being reached until 1872.[29]

The Lehigh Canal, completed in 1829 to provide another outlet for Pennsylvania anthracite, ran nearly 72 miles from White Haven through Mauch Chunk to Easton on the Delaware River. Replacing an inadequate system of transporting coal on the Lehigh River, the Lehigh Canal, although still depending in small part on slackwater navigation on the river, was a large, well-constructed waterway capable of floating boats of 100 tons. In its peak year, 1860, 2,000 barges ran its course, carrying more than a million-and-one-third tons of traffic.[30]

At Easton, the Lehigh Canal fed into two other canals, one supplying anthracite to Philadelphia, the other to New York. The Delaware Division Canal, opened over its full length in 1832, paralleled the Delaware River for 60 miles south to Bristol, from where boats could navigate the river to Philadelphia. Built by the state of Pennsylvania, it was the only anthracite canal not under private management. In a mistaken effort to save money, it was constructed on a smaller scale than the Lehigh, with the result that cargoes of the larger Lehigh boats had to be transshipped at Easton to small craft. Nevertheless, the Delaware Division Canal did a large business and yielded good return on construction costs.

The Anthracite Canals



U.S. Army Corps of Engineers

The Morris Canal, also connecting with the Lehigh at Easton, was intended not only to supply New York with coal, but to stimulate agriculture and manufacturing and revive the iron industry of northern New Jersey, which had flourished in colonial times. Winding through the hills of northern New Jersey to Newark Bay, the canal had to overcome an elevation of 914 feet. With the limited lift of locks in those days, the 200 to 300 locks required made the project prohibitively expensive. The canal's promoters, considered using inclined planes, but wanting reliable professional advice, called on Secretary of War Calhoun for assistance. General Bernard and Colonel Totten of the Army's Board of Engineers for Fortifications surveyed the route in 1823. They agreed that the idea was financially and technically practicable. The inclined planes, constructed wherever a long, steep hill had to be surmounted, were steam-powered cable railways on which the barges ascended or descended about 10 feet for every 100 feet of track. Twenty-three inclines took care of the greater part of the elevation, and only 23 locks were needed to cover the rest.

Construction on the canal began in 1825, and in 1831 the 90-mile connection between the Delaware River and Newark was completed. In 1836 the canal was extended another 12 miles across the Bayonne neck to Jersey City. Although a considerable engineering achievement, the Morris Canal, like the Delaware Division, was the victim of shortsighted planning. No doubt due in large degree to lack of funds, its locks could not accommodate boats of more than 25 tons, thus excluding the larger Lehigh barges. Hurting the profitability of the canal even more were the scandalous financial manipulations of its directors, who had been granted banking privileges. When bankruptcy hit in 1841, a new company took over the canal, enlarged it, and managed to keep it out of the red until after the Civil War. Despite its shortcomings, the canal carried a considerable tonnage of anthracite and contributed materially, as had been intended, to the economic development of northern New Jersey.[32]

A fifth anthracite canal, the Delaware and Raritan, cut 44 miles across central New Jersey from Bordentown on the Delaware River to New Brunswick on the Raritan, which connected it to Perth Amboy. The location was one of the four "necks*' of land across which Gallatin had recommended the construction of canals in 1808. Completed in 1838, the canal was a large and well-constructed waterway that not only carried considerable Pennsylvania coal, but also much commerce of a more general nature. Despite handicaps of railroad ownership and irresponsible management, the canal was one of the most important in the country before the Civil War, and for a few years actually carried greater tonnage than did the Erie.[33]

Canals of Broader Commercial Purpose

Three other Middle Atlantic canals built by private enterprise, while also important to the coal trade, were primarily carriers of general merchandise. One, the Chesapeake and Delaware Canal, provided an inland shortcut for shipping between the two great bays. At their heads the land distance between the bays narrows to less than 20 miles. Cutting a canal across this isthmus had been discussed since the Delaware Colony was in the hands of the Dutch. A route was surveyed as early as 1764, and construction repeatedly urged. Like the Delaware and Raritan, the proposed canal was a link in Gallatin's projected intracoastal waterway, and like the Morris Canal, it was surveyed in 1823 by Engineers Bernard and Totten, whose recommendations appear to have been decisive in determining the route that was adopted. When opened in 1829, the canal reduced the distance of water transportation between Philadelphia and Baltimore by more than 300 miles. Financial embarrassments plagued the canal in its early years, but by the 1840s it was carrying steadily increasing amounts of traffic that in 1872 reached a peak of a million-and-one-third tons. But the company never fully recovered from the financial disasters of its first decade, and until the federal government purchased its property and franchises in 1919, it was continually in debt. Ultimately the government transformed the waterway from a small barge canal into a ship canal as part of the Atlantic Intracoastal Waterway.[34]

The Schuylkill Navigation and the Union Canal was a combined waterway designed to bring to Philadelphia the trade of interior Pennsylvania and southwestern New York reached by the Susquehanna River and its tributaries. The Schuylkill Navigation, which opened in 1825, consisted of 45 miles of slackwater and 63 miles of canals that extended the navigation of the Schuylkill River from Philadelphia to Port Carbon. The Union Canal, completed two years later, united the Schuylkill at Reading with the Susquehanna at Middletown, just south of Harrisburg. The 77-mile Union Canal, however, proved to be a bottleneck in the extensive system. Because of topographical difficulties and a shortage of water, the canal's dimensions limited traffic to boats of 25 tons, thereby excluding the larger barges of the Schuylkill and those of the Pennsylvania state canals soon built to the west. Enlarged in the early 1850s to give it the capacity of the state canals, the Union for a few years doubled its traffic, but the excessive costs of reconstruction together with increasing railroad competition led to declining profits by the end of the decade.[35]

The Susquehanna and Tidewater Canal represented Baltimore's bid to garner the rich trade of the Susquehanna watershed. This could be done only if the navigability of the lower Susquehanna, with its 40-odd-miles of rapids and falls, were improved. In 1823 Army Engineer Captain Hartman Bathe, at the request of Maryland, surveyed a route along the river to circumvent these obstacles. It was not until 1840, however, that the Susquehanna and Tidewater Canal, reaching from Havre de Grace on Chesapeake Bay 45 miles up the river to clear navigation at Wrightsville, opened to traffic. It was a costly canal, about $80,000 a mile, but its large locks were soon heavy with traffic, justifying the expense. Ironically, in view of the intentions of the canal's original-promoters, Susquehanna trade flowed not only to Baltimore but also, by taking advantage of the Chesapeake and Delaware Canal, to rival Philadelphia.[36]

The Pennsylvania State Canals

The third group of canals in the Middle Atlantic region, and the most ambitious of all the artificial waterway projects, were the Pennsylvania state canals. As the Erie Canal neared completion, merchants of Philadelphia, fearing a heavy loss of western trade to New York, began to push for a waterway of their own to Pittsburgh on the Ohio. Opposition was not wanting. It came from wagoners and innkeepers on the turnpikes, from farsighted people who said that the still unproven railroad would be the better answer, from Pennsylvanians who would share in the canal's costs but not in its benefits, and from critics who insisted that the canal would cross such rugged and difficult terrain it could never compete successfully with the Erie. But canal fever carried the day. In 1826 Pennsylvania began the Main Line Canal.

But the state had to settle for a compromise between waterway and rail. The Union Canal, which already connected Philadelphia with the Susquehanna River, was too small to carry all the expected traffic. Moreover, Major John Wilson of the Army Engineers, who made a preliminary examination of the route at the request of the canal's promoters, advised that the area between Philadelphia and the Susquehanna was much more appropriate for a railroad than for a canal. Therefore the first section of the Main Line from Philadelphia to Columbia on the Susquehanna was a railroad, which for its first few years, was horse drawn. From Columbia a series of canals along the Susquehanna and Juniata rivers brought the Main Line to the backbone of the Allegheny Mountains near Hollidaysburg. The famous 36-mile Allegheny Portage Railroad surmounted the crest. On a series of ten inclined planes, the canal boats, which could be dismantled into sections, rode on cable cars up one side of the divide and down the other. Canals following the Conemaugh and Allegheny river valleys brought the Main Line the rest of the way to Pittsburgh.

Opened over its entire length in 1834, the Main Line was 30 miles longer than the Erie Canal and cost in excess of $4 million more to build. The Erie took the Appalachians in flank, rising at its highest point only 650 feet above sea level. The Main Line had to take the mountains head on, crossing at an altitude of 2,322 feet. The Erie could travel its course with 84 locks; the Main Line needed 174. The Main Line did attract considerable business, but it never became a serious challenge to the Erie. The Portage Railroad bottlenecked traffic and the excessive lockage slowed passage further. Then at Columbia cargoes had to be transshipped to railroad cars or to boats small enough to slip through the Union Canal. In 1840 the last disadvantage was partially overcome with the completion of the Susquehanna and Tidewater Canal, which permitted large barges to continue on to Chesapeake Bay and to Philadelphia or to rival Baltimore. But traffic on the Main Line continued to be more costly and more time consuming than on the Erie.

Because of political pressures from sections of the state that wanted their own waterways, Pennsylvania built not only the Main Line but also a whole system of branch canals, whose total mileage by 1834 was almost double that of the through route to Pittsburgh. Sections of the state not yet satisfied, however, continued to force construction, until by 1842 Pennsylvania had 772 miles of canal built and another 162 miles building. Then the bubble of confidence burst. Most of the canals, suffering from high initial costs, slow movement of traffic, and strong railroad competition, were losing money; and the state was virtually bankrupt. In the 1850s Pennsylvania sold most of her canals to railroads and other private corporations.[37]

SOUTHERN CANALS

The success of the Erie also gave new life to the South's schemes to share in the rich trade of the West. The dream of the old Potomac Company to connect the Potomac River with the Ohio was revived by the Chesapeake and Ohio Canal Company, organized in 1828. Taking a lesson as well as enthusiasm from the Erie, the company abandoned the system of short canals and river improvements constructed by the old company and substituted a permanent artificial waterway extending up the Potomac Valley. Receiving generous stock subscriptions from Virginia, Maryland, and the federal government, the company began work on the Potomac River section from Georgetown to Cumberland, 184 miles away at the base of the mountains. This barrier, even higher here than in Pennsylvania, was not to be crossed by tracks like the Main Line, or by road as the Potomac Company had planned, but would be surmounted by 246 locks and a 4-mile tunnel piercing, the divide at 1,900 feet. This engineering challenge was never met. The waterway did not open to Cumberland until 1850, and

its $11 million cost exceeded that of the Erie and Champlain canals combined. Disputes over rights of way, a cholera epidemic, political obstructionism> and continual labor, financial, and engineering problems had delayed construction and increased costs beyond the $8 million estimate of the Corps of Engineers in 1826 that canal supporters had deemed preposterous. The canal's dimensions, however, were generous. Therefore despite competition from the Baltimore and Ohio Railroad, whose tracks paralleled most of its route, the waterway accommodated large barges and attracted considerable business, mostly transporting coal from around Cumberland. The canal continued in use into the twentieth century, but it never became a major transportation agency or a paying enterprise.

The plan to connect the James River with the Kanawha was also revived. In 1835 the assets of the old James River Company were taken over by a private corporation under the name of the James River and Kanawha Company, with the state of Virginia holding three-fifths of the stock. Making the last attempt to unite the Atlantic with the West by water, the company displayed enormous optimism, for not only were the engineering problems substantial, but by 1835 the faith placed in waterways was already being transferred to railroads. Like the Chesapeake and Ohio Company, the James River and Kanawha Company made little use of the old river-improvement works and relied on slackwater navigation for only a small part of the route. And it too planned to pierce the mountains with a tunnel. Surveys made by Major William G. McNeill of the Army Engineers between 1826 and 1828 had found that it would be practicable to do so with a tunnel 2.6 miles long at an elevation of about 1,900 feet. Subsequent surveys did not change these plans. By 1840 the canal was completed 146 miles from Richmond to Lynchburg. From that date to 1856, as funds became available, it was extended about another 50 miles toward Covington. Then work was suspended for want of means to carry it further. As with the Chesapeake and Ohio, difficulties of construction were great and the cost, over $10 million, exceeded expectations. Although the company never turned debts into profits, the canal traveled through relatively rich country and did a substantial business. In 1860, despite railroad competition, it was by far the largest freight carrier in Virginia.[39]

Following the Civil War, the James River and Kanawha Company turned to Washington for succor, propagandizing the idea of a great central waterway from the Atlantic to the Mississippi. The moment was opportune, for there was growing resentment in the West over alleged exploitation by railroads. The National Board of Trade; national commercial conventions; and the states of Ohio, Iowa, and Kansas, claiming that railroads were not meeting the demands of the West for the cheap and abundant

transportation of bulky produce to the seaboard, petitioned Congress to construct the great "central water line." In 1870 Congress authorized the Corps of Engineers to make a new survey to the Ohio. Major William P. Craighill, who directed the survey, reported, as had Major McNeill over 40 years before, that a water route through the mountains was entirely practicable. In 1868 the canal company had surveyed a route through them at a lower elevation than originally planned, which would pierce the crest with a tunnel 9 miles long. Craighill found that the job could be done with a tunnel 7.8 miles long. He estimated the cost of constructing the uncompleted parts of the line and of enlarging the rest to admit boats carrying 280 tons at around $50 million, an expense that he argued was warranted by the needs of the West for a cheap and certain commercial outlet to the Atlantic coast. "It has been supposed by some that the day of canals is past," he also commented. "Facts do not sustain this view . . . . When the circumstances are such that slowness of movement is permissible and the quantities to be moved large, the cheapness of the canal becomes obvious to everyone who chooses to consider the statistics of the case." Chambers of Commerce and other commercial organizations now fell in behind the idea, and in 1872 President Grant urged Congress to insure that the West and South had adequate transportation for their increasing products. In 1874 the Corps submitted to Congress further estimates and details of surveys, which did not differ materially from Craighill's. But if the proposal ever had a chance with Congress, the Panic of 1873, which turned the great postwar economic boom into despairing depression, ended any such possibility. By the end of the decade the James River and Kanawha Canal became another abandoned enterprise.

THE END OF THE CANAL-BUILDING ERA

By 1840 the great period of canal construction was over. Work continued on the Chesapeake and Ohio and on the James River and Kanawha canals; and the Union, Morris, and Delaware and Hudson canals were enlarged and improved. But no new construction on canals of major size was started, and by the 1850s abandonment of canal mileage exceeded new building. High construction costs, heavy fixed charges, and less than expected revenues contributed to the collapse of the canal-building boom, but they do not appear to have been vital causes. Railroads, whose construction costs seem to have averaged higher than those for canals, also had their share of financial difficulties, yet investment in them continued, and for a time most canals were profitable ventures. Pennsylvania in the East and Indiana in the West became disastrously involved in the enthusiasm for canal building, but their experiences were not typical. The financial crises of 1837 and 1839 perhaps retarded construction.

But canal building came to an end primarily because by 1840 most of the practicable routes for long-distance artificial waterways had been developed and by that year the enormous potential of the railroad could no longer be doubted.[41]

In September 1825, one month before the Erie Canal opened to through traffic, George Stephenson ran his pioneer locomotive over the Stockton and Darlington Railroad line in England. The steam engine promised a future for railroads that early horse-drawn systems, which were little more than turnpikes with tracks, could never have achieved. Interest in railroads immediately spread to the United States. Numerous corporations, starting with the Baltimore and Ohio Railroad Company in 1827, began constructing roads on the eastern seaboard. The first trial of an American-made steam locomotive took place in August 1830. The early railroads were crude affairs, but they were rapidly improved, and they completed the transportation revolution in the United States that had begun with the construction of turnpikes. Less obliged than canals to conform to the lay of the land, not freezing up for part of the year, unaffected by droughts and seldom by floods, easier to connect with the point of origin and the ultimate destination of goods, and carrying freight at the prodigious speed of 20 miles an hour, railroads possessed advantages that few canals of the time, even those capable of handling heavy traffic, could hope to overcome. Many canals, especially those that carried coal, continued to be relatively prosperous well into the second half of the nineteenth century. Some did not reach their peak traffic until after the Civil War, but eventually railroad competition forced their abandonment.

Though the Canal Era was brief, it greatly furthered the transportation revolution in the United States that permitted a huge expansion of agriculture and industry in the decades before the Civil War. The waterways opened new areas to profitable use and stimulated economic development everywhere they serviced. Even those that failed to pay a fair return on investment were almost always useful to the public, even if not profitable to their owners.

Chapter III

RIVER AND HARBOR IMPROVEMENT

For a half-century after Independence, river and harbor improvement remained a local responsibility. Federal activity, of any significance, began in the 1820s, motivated by the same economic and military considerations that led to the General Survey Act of 1824 relating to roads and canals. But just as the intention of that measure was frustrated within a decade and a half, so was the program of navigation improvement. Occasional federal projects continued to be carried out, but it was not until after the Civil War, when a new economic, technological, and political climate prevailed in the nation, that the federal government initiated a vigorous and continuing program of river and harbor improvements.

EARLY LOCAL EFFORTS ON RIVERS

As shallow sloops and often larger vessels generally had little difficulty navigating the tidal reaches of rivers, state agencies and private companies directed their attention mostly toward improving small boat navigation on upstream stretches. They made some rivers considerably more usable, but more often their success was limited.

On the Merrimack River the series of canals constructed by subsidiaries of the Middlesex Canal Company provided a workable system of navigation. All the locks were large enough to pass the 75-foot boats employed on the canal. Towed along that ditch by horse or oxen, and propelled on the river by oars, poles, and under favorable conditions by sail, the boats could travel uninterrupted to Concord.

In 1812 steamboats, used for the first time as tugs on an American waterway, began towing barges on the canal and river. But they proved of little advantage. At speeds greater than three-and-a-half miles an hour on the canal they badly washed its banks, and whatever time they saved was usually more than offset by delays at the locks. On the river, traffic was not sufficiently regular, nor were the reaches between the canals sufficiently long, to use tugs profitably. Towing by steam was abandoned in 1820 and never resumed.[1]

Navigation on the Connecticut River above the head of sloop navigation at Hartford, while much improved by canals, was less satisfactory. Flatboats carrying 15 to 18 tons of cargo could use the river during high water in spring and fall, but during the summer months navigation was restricted to lighter boats with draft of only 12 to 15 inches. Other conditions were even

more disadvantageous. Although flatboats operated with some regularity between Hartford and the Massachusetts towns upriver, and for a time small steamboats towed barges on stretches of the river, inhabitants of the upper valley often found it cheaper to send wagons overland to Boston, to Portland, or to Lake Champlain, from where products could be sent down the Champlain Canal to the Hudson River. As separate companies operated the canals, tolls were not uniform and locks varied in size. Boats that could pass the locks in the lower river could not squeeze through those in Vermont. Nor was there satisfactory slack-water navigation, as the dam of one company did not back water to the foot of the next. At ten places on the upper river the help of extra men or oxen, and sometimes the toilsome expedient of lightening the cargo, was required to get boats through rapids.

Below Hartford the major obstacles to navigation were river bars scattered downstream from the city for about ten miles. The Connecticut at this point flows through an alluvial region and its banks are easily eroded, causing constant changes of its bed and the formation of shoals at every flood stage. In 1800 the Connecticut legislature entrusted improvement to the Union Company, which, like the canal companies, could recover its expenditures by collecting tolls. Dredging sandbars, reveting banks with stone and planting them with willows, and extending wing dams into the river to scour shoals by concentrated currents, the company secured a channel of seven-and-a-half feet over the bars. The toll system, which opponents said should not be applied on "navigable tide waters*' of the state, aroused intermittent hostility throughout the six decades of the company's chartered life. But the improvements enabled larger vessels to reach Hartford and relieved all trade of many interruptions, especially in periods of low water.[2]

In Pennsylvania the major efforts to improve river navigation were the Schuylkill Canal and slackwater system, discussed in the previous chapter, and works on the Lehigh River. Beginning in 1791 the state legislature enacted provisions for improving the Lehigh, but little was accomplished until 1818, when Pennsylvania allowed the Lehigh Coal Mine Company to take measures to move coal down the river to market. In some places the company scoured out shoals with wing dams, and in others it made rapids navigable by the unique device of "artificial freshets." This consisted of constructing V-shaped dams across the river at the heads of rapids, thus forming pools above them. Sluice gates opened in the dams created artificial floods that floated coal-carrying arks over the rapids. The arks were merely large boxes 16 to 18 feet wide and 20 to 25 feet long, steered with oars like a raft. For economy of operation two arks were joined together, fastened by hinges to allow them to bend up and down in passing

over rapids. As men became accustomed to handling the arks and the channel of the river was improved, more sections were added until their whole length reached 180 feet. From the mouth of the Lehigh the arks floated down the Delaware River to Philadelphia. There they were broken up for lumber, as the system of artificial freshets did not permit upstream navigation. It was this disadvantage, combined with rapidly increasing business, that soon led to the construction of the Lehigh Canal. On the Delaware River, the state carried out minor improvements. In 1817 it spent $10,000 to improve navigation from Trenton to Foul Rift, 12 miles above Easton, most of the money being used to blast rocks and build wing dams at Rocky Falls and Wells Falls. Two years later the state constructed wing dams at Scudders Falls.[3]

The southern states, with their plentiful, lengthy, but shallow rivers, saw the greatest efforts at improvement. The James River Company that set out in 1785 to create a trans-Appalachian transportation system was essentially a river improvement concern, and during its half-century of existence it not only built two canals but cleared obstructions from the river and constructed wing dams and sluices. Sluicing consisted of cutting channels through shoals, confining them by stone walls on each side, and directing stream flow through them with wing dams at their approaches. The company also improved navigation on the Rivianna, Willis, and North river branches of the James. But its operations were so limited and ineffective that inhabitants along the James persistently complained. In dry seasons the river was not everywhere navigable by boats drawing a mere foot of water, as required by the company's charter.[4]

The Potomac Canal Company, which also began operations in 1785, was, like the James River Company, primarily intent on river improvement, and it undertook canal construction only at falls. The canals, however, absorbed so much of its limited resources that it made only minor excavations in the main river and its larger branches. In the upper course of the Potomac it never attained more than a foot of permanent water. Thus it failed to achieve its modest charter objective, which was to provide a safe channel in all seasons for vessels carrying 50 barrels of flours

The state of Virginia, which controlled the James River Company after 1820, also financed other river improvements. In 1816 the legislature created a Fund for Internal Improvement, to be administered by a Board of Public Works. The system remained in effect until the Civil War, by which time the state held an interest in 12 canal and navigation projects, several still unfinished, as well as in roads, bridges, and railroads.[6]

North Carolina enacted river improvement measures as early as 1784. It chartered a number of companies to carry out the projects, but decades passed with little being accomplished. In 1819 the state established a Board for Internal Improvements to solve its transportation problems. North Carolina produce was finding its markets largely in neighboring states. Most of the trade of the Roanoke Valley made its way to Norfolk, and much of the trade of the central part of the state flowed southward into South Carolina. North Carolinians hoped that if these leakages were checked a commercial city would grow up on their own coast equal in importance to Philadelphia, Baltimore, or Charleston. To this end the state subscribed to stock in companies chartered to improve navigation on six rivers, build a canal between the Yadkin and Cape Fear rivers, and cut a short intracoastal waterway.

But results continued to fall far short of objectives. The construction of sluices on the Roanoke River and its Staunton and Dan tributaries, for which Virginia's subscriptions were larger than North Carolina's, secured small boat passage on the Staunton through the Blue Ridge Mountains to Salem, Virginia, and on the Dan to the foot of the Saura Town Mountains in North Carolina. Otherwise little progress was made, and most of the companies abandoned their efforts. The Board for Internal Improvements attributed the failure partly to blunders made “before the aid of science and skill had been enlisted to direct the operations” and partly to diffusion of effort among so many projects. Indeed, too much had been attempted with too little. Private investment had been meager, and total state expenditures to 1833 were less than $300,000.[7]

South Carolina expended much more money but fared little better. Beginning in 1799 a number of companies tried to make various rivers more navigable with slim finances and even slimmer results. Traffic in the state was still too light to create effective demands for expensive improvements, and cotton growers managed to get their crops to market profitably with rivers and roads as they were. Not until competition arose from western cotton producers after 1815 were South Carolina planters spurred to lower the cost of marketing their crops through improved transportation facilities. The effort began in 1817 when South Carolina appointed a “Civil and Military Engineer," purchased a company that had attempted improvements on the Catawba and Wateree rivers, and subscribed heavily to the stock of the Winyaw and Wando Canal Company. The next year it appropriated $1 million for an ambitious program, to be spent at the rate of $250,000 a year.

In 1819 the state placed the work under the direction of a Board of Public Works but because of squabbles over the board’s management transferred authority to a Superintendent of Public

Works in 1822. By 1834 South Carolina had spent nearly $2 million, more than half of which went into costly canals bypassing falls in the center of the state; had improved to some extent nearly 2,000 miles of rivers, the most important work being done on the Wateree and the Great Peedee; and had constructed nearly 150 miles of roads. Yet the results were on the whole disappointing. Individual improvements had been selected on a highly political basis, thus frustrating the development of a coherent transportation system. Improvements above the fall line, including most of the canals, locks, and sluices, were not navigable by steamboats, and almost all were ultimately abandoned. Below the fall line, periodic flooding choked the channels with debris and sandbars, yet maintenance was neglected as disappointment over the failure of the system to meet expectations created a reluctance to spend more money on waterways. Finally, as with many inland navigation projects along the East Coast, by the time the system was completed the practicability of railroads was being demonstrated. As in North Carolina, the poor results were attributed in part to too much diffusion of effort. There was hardly a public work in the state, except the State Road and the Columbia Canal, declared a disillusioned governor, that "would find a purchaser . . . at a public auction."[8]

In Georgia reaction to the spread of the cotton culture westward after the War of 1812 paralleled that in South Carolina. Upland sections of the state demanded better means of transportation, and in 1817 Georgia made its first appropriations for river improvement. It allocated funds for each of the important streams in the state, to be expended by local commissioners, and established a fund of $250,000, later increased to $500,000, to earn interest for financing projects. Improvements came so slowly and were so disappointing when they did come that in 1825 the state established a Board of Public Works to inaugurate a more centralized and effective program. The next year, however, it abolished the board and went back to a policy of appropriations expended by local commissioners. By 1829, when efforts petered out, river navigation had been little improved.

The Savannah River, flowing to the state's principal port, was of special interest to many Georgians. Because it formed the state's boundary with South Carolina, improvement was considered a matter for joint action; but as Georgia was the most benefited, it put the most money into the river. In 1817 a steamboat company began running vessels on the Savannah to Augusta. Within a few years, however, despite work on the river's channel, traffic declined because of the inability of the boats to reach Augusta during long seasons of low water. At one time the legislature planned more extensive improvements to facilitate their passage but subsequently turned its attention

to a railroad line to Macon. Inhabitants of the Piedmont continued to demand improvements on the upper course of the Savannah, but rapid descents and frequent heavy freshets prohibited better navigability at reasonable cost. The farmers of the upper river had to wait for a railroad.[9]

EARLY HARBOR WORK

Harbor improvement in the early years of the Republic was minimal. Trade still remained highly dispersed among many small ports, and seagoing vessels, while adopting better hull designs and rigs, did not increase much in size from colonial times. Ships still rarely exceeded 400 tons displacement and 100 feet in length. As late as 1828 the largest ship in Salem's merchant fleet, which in the early nineteenth century experienced its golden age of world-wide commerce, was 404 tons.[10]

But not all ports had the depth of water or degree of protection shipping interests preferred. In 1784 the port wardens of Baltimore tried to deepen the harbor using a Dutch-type mud mill, a dredging machine that raised spoil with long-handled scoops operated by man-powered treadmills. Dredging is said to have been attempted on the Thames River channel to Norwich, Connecticut, in 1785, on the Hudson River shoals between Albany and Troy in 1799, and on the Delaware River mud at New Castle Harbor in 1803 and after. In 1804 Oliver Evans of Philadelphia built a steam-powered dredging machine equipped with wheels for travel on land and a paddle wheel for propulsion on water, but the extent of its use is uncertain. In 1785 Pennsylvania, in an early effort to furnish protection to shipping, constructed timber piers at Marcus Hook on the Delaware River to provide a harbor of refuge from drifting ice.[11]

Beginning in 1790 several states carried out harbor improvements under the authority of congressional enabling acts. Congress granted permission to levy tonnage duties on shipping to Georgia to pay for raising wrecks sunk during the Revolutionary War to block Savannah Harbor, to Maryland to support improvements by the port wardens of Baltimore, and to Rhode Island to subsidize work at Providence by a “River Machine Company" incorporated for that purpose. In 1798 Congress approved the incorporation of a company by Massachusetts to erect a pier at the mouth of the Kennebunk River in Maine to protect the channel. In 1806 it allowed Pennsylvania to levy tonnage duties at Philadelphia for “building piers in, and otherwise improving the navigation of the river Delaware, "[12] with which monies, apparently, the state constructed ice harbors of refuge at Chester and Fort Mifflin.

Harbor improvements by the federal government's own agencies developed slowly. The First Congress of the United States had provided that all expenses for the maintenance and repair of

lighthouses, beacons, buoys, and public piers should be defrayed out of the Treasury of the United States and that all contracts for work be made by the Secretary of the Treasury with the approval of the President.[13] Under this authority relating to navigation safety, the federal government undertook its first harbor projects. In 1802 a congressional directive to the Treasury resulted in the construction of cribwork piers at New Castle, Delaware, to provide vessels a harbor of refuge from the dangerous Delaware River ice. In 1820-1821 the Treasury built a pair of cribwork piers at the entrance of the Kennebunk River to confine the channel and obtain more water over the bar. In 1822 Congress authorized the Treasury to construct a breakwater to improve a harbor of refuge at the Isles of Shoals, about seven miles off Portsmouth, New Hampshire, and to erect two piers at Cape Henlopen, at the mouth of Delaware Bay, to create a refuge from the twin threats of storms and ice. Calling on other government agencies in 1823 for projects other than piers, Congress authorized a collector of customs to supervise the removal of a channel obstruction between the harbors of Gloucester and Annisquam on Cape Ann in Massachusetts and ordered a survey by an Army Engineer to determine how best to improve the entrance of the harbor of Presque Isle, Pennsylvania, on Lake Erie.[14]

FOUR DECADES OF SPORADIC FEDERAL ACTIVITY

Even before the Presque Isle assignment to plan harbor work, the Army Engineers had planned river improvements. Under military appropriations bills of 1819 and 1820 they had made surveys on the Ohio and Mississippi rivers and several tributaries to devise methods for making them more navigable. In June 1823 the Engineer Department ordered the Board of Engineers to design the piers at Cape Henlopen that Congress had authorized the Treasury to construct the year before.

Responsibility for carrying out navigation improvements soon followed. On 24 May 1824 Congress provided for the removal, by *'engineers in the public service," of snags and sandbars from the Ohio and Mississippi rivers, work which President Monroe assigned to the Corps of Engineers. Two days later Congress voted appropriations for improving the harbor of Presque Isle and for repairing Plymouth Beach, Massachusetts, which sheltered the town's harbor. Further appropriations in the next two years provided for breakwater construction at two Lake Erie ports, for breakwater surveys at the Massachusetts harbors of Marblehead and Holmes* (Woods) Hole and a canal route survey across Florida, and for clearing obstructions from the Savannah River.[15]

On 20 May 1826 Congress enacted its first omnibus rivers and harbors bill, a measure that provided for more than 20 works and surveys on the Atlantic and Gulf coasts and on the Great Lakes.

Annually thereafter through 1838 Congress passed similar bills authorizing new projects and surveys or appropriating additional funds for projects under construction. With the exception of the act of 1836, few new projects or surveys were authorized after 1830, and appropriations were mostly for completing or continuing works. Occasional--y Congress also made individual appropriations for projects.

Much of the work on the East Coast was to protect shipping from storms or ice at both commercial harbors and harbors of refuge. At Plymouth, Provincetown, and Duxbury, Massachusetts, the Army Engineers by various means firmed beaches that formed natural harbor breakwaters to arrest water and wind erosion. They constructed granite seawalls on islands and headlands at Boston Harbor and at Black Rock and Westport harbors in Connecticut to preserve these natural harbor screens. At Little Egg Harbor, New Jersey, they strung jetties out from the shore of Tuckers Island, which protected the harbor, to prevent abrasion of the island by surf. At harbors without sufficient natural cover, the Engineers constructed rubblestone breakwaters, thus providing protected anchorages at Belfast and Portland, Maine; Rockport, Bass River, and Hyannis, Massachusetts; Churchs Cove, Rhode Island; and Stonington, Connecticut. At Cape Henlopen they took over the construction of the artificial harbor of refuge originally assigned to the Treasury; and on the Delaware River they constructed ice-breaker piers at New Castle and repaired those at Chester, Port Penn, Marcus Hook, and Fort Mifflin. They also built an ice breaker at Staten Island, New York, to protect the public wharf and buildings of the harbor's quarantine station.

Deepening channels to coastal or river ports constituted the bulk of other projects. Bars obstructing harbor entrances were tackled with horse or steam-powered dredging machines at Nantucket, Massachusetts; Bridgeport, Connecticut; Wilmington, Delaware; Baltimore, Maryland; and Brunswick, Georgia. For the benefit of shipping to Philadelphia, the Delaware River ice harbors of New Castle, Chester, Marcus Hook, and Port Penn were dredged; and for the benefit of shipping to Hartford and other river towns, dredging was begun on Saybrook Bar at the mouth of the Connecticut River. In the shallow Pamlico Sound area of North Carolina, dredging was performed to clear a shoal in the Pamlico River below the town of Washington, to remove shoals near the Ocracoke Inlet to the sound, and to open a navigable passage through adjoining Core Sound to Beaufort Harbor. In the Savannah River wrecks sunk during the Revolutionary War were raised and the shoals formed by them dredged. Rocks and other obstructions were cleared from the Kennebec River of Maine to facilitate navigation to Bangor, from the Saugatuck River of Connecticut to improve the harbor of Westport, and from the

Raritan River of New Jersey to benefit New Brunswick. In work aimed at protecting channels, a breakwater and dike were constructed at Southport, Connecticut, to confine the channel and prevent sand from washing into it; and at Edgartown, Massachusetts, a pier supporting a lighthouse was extended, also to prevent sand from being carried by littoral current into the harbor.

Several attempts were made to deepen channels by constricting river currents to increase their natural scour. The jetties at the mouth of the Kennebunk River, erected earlier by the Treasury and soon wrecked by storms, were rebuilt and extended; and new jetties were constructed at the mouth of the Merrimack River, at the entrance of the Saco River of Maine, and in the Cape Fear River below Wilmington, North Carolina. To improve the channel of the Thames River to Norwich, Connecticut, a number of wing dams were extended into the stream, the scouring effect of which was supplemented by dredging. Wing dams, together with shore-protection dikes and revetments as well as dredging, were also employed in the Hudson River to control the shoals above and below Albany.

The focus of the early East Coast projects was on harbors accessible to seagoing ships. Work on inland waterways was negligible. Rocks and shoals were removed from the Cocheco and Berwick branches of the Piscataqua River to permit small boats to reach communities a few miles upstream, the inside navigation channel between St. Johns River in Florida and St. Marys Harbor in Georgia was improved, and shoals were dredged in Joyces Creek at the southern end of the Dismal Swamp Canal. [17]

Early navigation projects on western rivers and on the Great Lakes followed the advance of the steamboat on these waters. But the steamboat was of little significance to improvements on the Atlantic seaboard. By the 1820s steamboat routes had been established on a number of rivers, bays, and sounds, but the instances of correlation between these routes and the localities of the river and harbor improvements are few and it would be difficult to credit these to the steamboat.[19] Even more than the sailing vessel, the coastal steamer, with its flat-bottomed hull, only slightly protruding keel, and gingerly dipping paddle wheels, was suited to shallow waters. The eastern steamer was primarily a passenger vessel--its large engines and huge stores of firewood (anthracite did not come in to general use until the 1840s) left little room for freight. And oceangoing steam vessels scarcely existed. Because of various technical and economic obstacles much harder to overcome than those met on sheltered waterways, the application of steam to ocean transportation was slow to develop. Not until the 1850s did either the coastal or ocean steam vessel begin to compete with sailing ships in the carrying trade.[20]

Navigation improvements on the East Coast coincided with a marked increase in coastal shipping. Although for some years after the War of 1812 foreign trade made little progress beyond prewar levels, the American fleet engaged in the coastwise trade grew steadily from 475,666 gross tons in 1815 to 842,906 gross tons in 1828, an increase that reflected' the rise of manufacturing in the United States and the more extended division of labor resulting from it. The acquisition of Florida in 1821 and an ever-increasing volume of goods from the South and West moving down the Mississippi, a considerable part of which went to northeastern ports, further augmented the coastal trade.[21]

Most of the projects had beneficial results. Some, however, were left unfinished, and almost all subsequently suffered from lack of maintenance, for no further appropriations were forthcoming until 1852. Just as it had been politically impossible for the federal government to initiate a unified national system of roads and canals, it was unable to institute a coherent plan for rivers and harbors improvement. Local and sectional pressures supported by logrolling tactics had produced rivers and harbors bills that appropriated small amounts for numerous projects in uncoordinated piecemeal fashion. Criticism and opposition arose both within Congress and in the executive branch. Except for the briefly incumbent Whig Presidents Zachary Taylor and Millard Fillmore, all chief executives to the time of the Civil War took the constitutional position that Congress could appropriate for works of a national character but not for projects of a local nature, a distinction often difficult to determine. They generally refused to present estimates for work to Congress and several times vetoed rivers and harbors bills. This was a period of turbulent party politics, and party alignment on the issue was clearly evident. The Democrats, who generally believed that the government should let economic activities pretty much alone, tended to be hostile toward internal improvements, while the Whigs, who held a broader conception of the powers and duties of the federal government, usually supported them. The Depression opening in 1837 and increasing state and sectional tensions did nothing to ease the controversy.

Except for a measure in 1844 confined to projects in the interior, there was not another general rivers and harbors act until 1852. Congress continued to make a few appropriations through special acts or riders attached to other bills. Projects on the East Coast, however, were restricted to minor works justified by military requirements. The Corps of Engineers cut a small canal in Florida between Mosquito Lagoon and the Indian River at a portage called the Haulover to permit easier movement of Army supplies in campaigns against the Seminole Indians, and it constructed or repaired seawalls at Boston Harbor and St. Augustine, Florida, to preserve sites for fortifications.[23]

The Rivers and Harbors Act of 30 August 1852 was the product of election-year tactics. In the campaign of that year the Whig and Free Soil parties, both more attuned to the interests of eastern businessmen and western farmers than the southern-controlled Democratic party, proclaimed themselves in favor of internal improvements. Swaying with the political winds, Congress appropriated in excess of $2 million for more than 100 works and surveys, 46 of which, at a cost of about $640,000, were on the East Coast. With the Whig Millard Fillmore in the White House, the bill was assured of presidential approval.[24]

More than half of the East Coast projects consisted of repairing or continuing works left untouched for over a dozen years. Combating the depredations of storms and time, the Corps of Engineers repaired the breakwaters at Portland and Hyannis, the jetties at Kennebunk River, and the ice piers at Chester and New Castle; they patched up a seawall at Marblehead and a dike at Woods Hole built years before by other agencies; and they closed several large breaches in the beach at Plymouth opened by a gale in 1851. Continuing unfinished projects, the Corps worked on the Delaware Bay breakwaters and the Boston and St. Augustine seawalls, resumed beach protection measures at Provincetown, and again dredged and made other channel improvements at Bridgeport Harbor and in the Hudson, Pamlico, Savannah, and Cape Fear rivers.

Undertaking new projects, the Army Engineers constructed breakwaters at Owls Head and Richmond Island harbors in Maine and ice-breaker piers at Reedy Island in the Delaware River. They blasted out rocks at New Haven Harbor, Connecticut, at Cobscook Bay, Maine, and at Hell Gate in New York's East River. They dredged at Charleston and Providence harbors, in Newark Bay, in the Kennebec, James, Appomattox, and Patapsco rivers, and at the mouths of the Susquehanna and St. Johns rivers. They also made an unsuccessful attempt to reopen navigation between Albemarle Sound and the Atlantic Ocean at Nags Head on the Outer Banks of North Carolina.[25]

The act of 1852 failed to restore an ongoing program of navigation improvement. The Democrats won the election, and with the party opposed to internal improvements in power for the rest of the decade, Congress did not pass another general rivers and harbors bill until after the Civil War. Through special acts it authorized four works in the interior and three in the East, and passed five of these bills over the vetoes of President Pierce. The three eastern projects allowed the Corps to continue work on the Savannah and Cape Fear rivers and to deepen the Patapsco River to make Baltimore Harbor accessible to steam frigates and other vessels of the United States Navy.[26] When these appropriations and those of 1852 ran out, river and harbor improvement by the federal government again came to a halt, with many projects still uncompleted.

PRESSURES FOR NAVIGATION IMPROVEMENTS

At the close of the Civil War several forces converged to settle the long-debated issue of river and harbor improvement. Many Atlantic harbors were feeling the pinch of three decades of economic and technological development that had drastically changed long-existing patterns of maritime activity. Between 1830 and 1860 world shipping had expanded enormously as part of the complex development labeled the Industrial Revolution. Manufacturing had increased immensely and had tended to become geographically concentrated, necessitating the transportation of raw materials from remote places and the mass shipping of finished products to distant markets. The construction of railroads, canals, river works, and highways had greatly increased the hinterlands of seaports and provided cargoes for ships on a scale formerly unknown. The tonnage of United States ships engaged in all employments rose from 1.19 million tons in 1830 to 5.35 million in 1860. In this same period the annual tonnage of American vessels that entered and cleared from American ports increased nearly sixfold.

The growing volume of trade, the concentration of overseas commerce at major ports, the rise of packet lines operating on definite routes and regular schedules, and the increasing carriage of bulky products led to a demand for larger vessels. In 1830 a ship of more than 400 tons was considered a monster. In the early forties ships of 1,000 tons were regarded as very large. By the fifties ships of this size were the typical deep-sea freighters and many vessels registered 1,500 or more tons. These developments affected not only the rising primary transshipment centers of New York, Boston, Philadelphia, and Baltimore, but also smaller harbors all along the seaboard as schooners and an increasing number of steamers carried an expanding amount of commerce between the larger and smaller ports.[27]

During the same years that Atlantic harbors were experiencing unprecedented use, people of the interior were organizing great commercial conventions calling for the improvement of the Mississippi and Ohio rivers and their tributaries. Among the earliest was a meeting in Memphis in 1845. From then on powerful associational appeals for waterway projects came steadily from the South and West. Reinforcing the resolutions of these conventions was an outpouring of tracts on river improvement that by 1860 had become a considerable body of literature. Even the war did not retard the movement. In 1863 a call signed by 14 senators and 80 representatives in Congress brought 2,000 delegates to a waterway convention in Chicago to demand improvements on the Erie Canal and on canals in Illinois and Michigan. The next year another convention in Louisville urged improvement on the Ohio River.[28]

These developments and appeals elicited from the nation's capital a response very different from that of the prewar decades. The Civil War opened a period of amazing growth in transportation, trade, industry, and agriculture that dwarfed even the substantial advances of earlier years. Old political patterns dissolved before new dynamic forces, and new ruling groups emerged anxious to provide expanding enterprise with a federal helping hand. And this assistance included the development of the nation's navigable waterways. The Republican party had begun its national career with a declaration in its platform of 1856 that appropriations by Congress for the improvement of rivers and harbors were constitutional and justified by the obligation of the government to protect the lives and property of its citizens. The Democratic party, forsaking its earlier opposition to internal improvements, was no less eager to give river and harbor improvement steady and generous support.[25]

RIVER AND HARBOR PROJECTS EXPAND, 1866-1914

River and harbor work resumed in a small way even before the war ended. In June 1864 Congress authorized the Secretary of War to expend $350,000 to repair harbors on the seaboard and Great Lakes. Improvements on a broad scale began in June 1866 with a congressional appropriation of nearly $3.7 million for more than 50 works and nearly 40 examinations and surveys throughout the country. Thereafter river and harbor expenditures grew by large amounts. For the decade of the 1870s they totaled nearly $54 million; for the decade ending in 1914 they came to more than $325 million.[30]

This extensive program embraced more than 500 waterways on the Atlantic seaboard. The Corps of Engineers dredged harbors to provide deeper and wider channels, anchorages, and turning basins; improved channels through inlets, bays, sounds, and offshore thoroughfares; cleared rivers of obstructions to small craft navigation; and created sheltered passages along the coast by cutting inland waterways. Many projects included structural works: breakwaters to improve natural harbors and to build wholly artificial harbors of refuge; jetties to stabilize harbor and river channels, control tidal currents, form ice harbors, check shifting sands, and protect shores from erosion; and dikes, walls, revetments, and other structures to preserve harbor and river shorelines.

As the program of navigation improvement expanded, work at major harbors tried to keep pace with constantly increasing commerce and larger ships. Steam was replacing sail and iron was replacing wood. By using iron, vessels could be built of far greater size than previously had been possible. Trans-Atlantic express liners increased in size from less than 4,000 tons in the 1860s to 12,000 tons in the 1890s and to 48,000 or more tons by 1914.[31]

New York Harbor, with a controlling depth over its outer bar and several inner shoals of almost 24 feet at mean low water, had been the envy of other Atlantic ports. But by the 1880s large ships on trans-Atlantic runs could cross the bar only on flood tides. The first improvement project, begun in 1886 and completed in 1891, provided a passage 30 feet deep and 1,000 feet wide through the Main Ship and Gedney channels to deep water outside the bar. Within a few years the channel was again inadequate, and in 1899 Congress authorized the construction of a 40-foot-deep, 2,000-foot-wide channel. To avoid interrupting the busy traffic of the port, the outer bar was dredged at the East, renamed Ambrose, Channel, a hitherto shallow and little-used passage that now became the main entrance channel to the harbor. As the dredging equipment then existing in the United States was incapable of doing such deep work while exposed to the open sea, the contractor was allowed a year to build two dredges before beginning the project. Before the unprecedented job was completed in 1914, however, the Corps built four dredges of its own for the project and transferred a fifth from the Delaware River. Commenting on the commerce of the port, the New York Engineer District noted that the value of foreign exports and imports (the District did not provide statistics for coastwise commerce) for the year 1914 was $2.1 billion, an increase over the valuation for 1886 before improvement began of $1.3 billion. Costing less than two-thirds of 1 percent of the increase in the annual value of foreign commerce, the projects were excellent investments.[32]

At Boston Harbor the original improvement project, adopted in 1867, enlarged the main ship channel from 18 feet deep and 100 feet wide at its most restricted point to 23 feet deep and 600 feet wide. A project of 1892 extended the depth to 27 feet and the width to 1,000 feet, and a project of 1899 increased these dimensions to 30 and 1,200 feet. Three years later Congress authorized another enlargement of the channel to 35 feet deep and between 1,200 and 1,500 feet wide.[33]

Shipping to Philadelphia originally had to contend with ten or more bars scattered down the Delaware River between the city and Delaware Bay that restricted channel depths at mean low water to between 17 and 20 feet. Initial improvements consisted of sporadic dredging and rock removal under separate appropriations. The first systematic and permanent improvement began in 1885 when a special Corps of Engineers board studied navigation of the river as a whole and recommended the construction of a ship channel to Philadelphia at least 600 feet wide and 26 feet deep. This work was carried out at some bars and shoals by the federal government and at others by the city of Philadelphia. Hitherto, vessels of deep draft had been compelled to ride two high tides to ascend the river to Philadelphia; now they could make the whole trip on a single tide. Continued dependence on tides,

however, was not satisfactory for long, and in 1899 Congress authorized the construction of a 30-foot channel. Work was nearing completion in 1910 when a new project increased the channel depth to 35 feet and the width to between 800 and 1,200 feet. 34

The controlling depth of the Patapsco River channel to Baltimore Harbor was originally 17 feet at low tide and only slightly more than 18 feet at high tide. Vessels exceeding that draft were obliged to transfer portions of their cargoes to lighters about 14 miles from the city in order to ride high enough to reach the wharves. The improvement begun in 1853 aimed at a channel depth of 22 feet and a width of 150 feet. Post-Civil War projects adopted in 1871, 1881, and 1896 deepened the channel by stages to 30 feet and widened it to 600 feet. In 1905 Congress authorized a 35-foot channel between 600 and 1,000 feet wide.[35]

Norfolk Harbor had a deep-water entrance on Hampton Roads, but several shoals within the Elizabeth River restricted mean low-water depths of the main and branch channels to 21 feet or less. The original project adopted in 1876 provided for dredging the worst shoals only. Modified no less than eight times between 1885 and 1910, the project ultimately provided a main channel 35 feet deep and at least 400 feet wide from Hampton Roads to a point above the Norfolk Navy Yard on the South Branch of the Elizabeth River.[36]

Efforts at other harbors to keep abreast of commercial and technological developments were equally striking. At Wilmington, North Carolina, the pre-Civil War projects to increase the governing low-water depths of the entrance bar and the channel of shallow Cape Fear River beyond 7.5 feet had accomplished little. Between 1870 and 1890 five successive projects, which included closing inlets between islands at the mouth of the river as well as dredging, gradually increased the channel's dimensions to the city to 20 feet deep and 270 feet wide. The rivers and harbors acts of 1910 and 1911 provided for securing such depths in excess of 20 feet as the appropriations would allow. The act of 1912 authorized a 26-foot channel 300 feet wide to the sea and 400 feet wide across the bar. 37 At Savannah, three projects adopted between 1873 and 1902 deepened the river channel to 28 feet at mean high water. A project begun in 1910 established a channel depth of 26 feet at mean low water. At Charleston, the deepest channel across the entrance bar was originally about 12 feet. In 1878 Congress authorized the construction of two jetties and auxiliary dredging to obtain a channel of not less than 21 feet, A project of 1899, which was modified in 1910, provided for dredging the entrance channel to 26 feet and then to 28 feet.[38]

An exceptionally dogged race to accommodate increasing commerce and larger ships took place at Providence, Rhode Island. The Providence River, which stretches eight miles from the city to Narragansett Bay, was obstructed by several shoals that at one point opposite the city decreased the low-water depth of the channel to 4.5 feet. At mean low water the channel in the portion of the river forming the harbor ranged from 4.5 to 15 feet deep, but most of the river at this point was only 1 to 3 feet deep. Resuming after the Civil War work begun in 1852, the Corps of Engineers had by 1870, under three successive projects, cleared the channel to a controlling depth of 14 feet. In 1878 they began constructing a channel that was 23 feet deep and 150 wide in the center to accommodate large ocean steamers. At lesser depths it was more than 1,000 feet wide to give sailing coasters more room to maneuver. Four years later Congress modified the project to provide a 25-foot-deep, 300-foot-wide steamer channel to deep water in Narragansett Bay and a capacious anchorage basin at Providence. In 1896 Congress authorized a 25-foot-deep, 400-foot-wide channel that would follow a more direct route to the ocean through the West Passage of Narragansett Bay. Projects of 1902, 1907, and 1910 provided for enlarged anchorage areas. The project of 1910 also authorized increasing the dimensions of the channel to 30 feet deep and 600 feet wide.[39]

Far outnumbering the projects at major harbors were works at smaller rivers and harbors to establish channel depths ranging from 4 to 16 or more feet at mean low water. As railroads did not reach every locality and their unregulated rates in any event encouraged waterway competition, and as highway transport was still limited, small streams continued throughout the nineteenth century to offer a mode of transportation for many inland communities. Small harbors all along the coast were even more vital to the economy. As shelters for fishing fleets and processing points for catches, they were elements of a large and still-growing industry. As commercial ports they *were* more active than ever, for as the commercial life of the nation quickened it was still mainly coastal vessels that moved bulk trade along the Atlantic seaboard.

Trunk-line railroads, having in the main followed economic development westward across the continent, provided long-distance east-west connections with the major Atlantic ports. But through lines going north and south developed at a slower pace. Rivers and estuaries had to be crossed by immense bridges; the diverse gauges of southern railroads had to be changed to standard size; the provincial aims of short lines had to be harmonized with the objectives of longer hauls; long-haul commerce had to be stimulated by low rates and efficient service; and the consolidation of short lines had to take place to bring about these changes

and to form effective through routes. These changes came later than on east-west routes and were not fully apparent until the close of the century. Even then the railroads, afflicted by freight congestion and a car shortage that reached critical proportions within a few years, were far from able to meet transportation demands. Some roads would accept only the high-value freight that was more profitable to carry. Thus coastal trade continued to move many of the bulky commodities that had always been its mainstay.[40]

Fishery products, lumber, lime, building stone, ice, flour, grains, cotton, rice, tobacco, naval stores, manufactures, and many other goods found their way up or down the seaboard by water. Topping the list of bulk carriage was the coal trade out of Norfolk, Newport News, Baltimore, Perth Amboy, and New York. The use of coal for heating buildings in the North and for powering industry all along the seaboard increased tremendously in the last three decades of the nineteenth century. Small two-roasted schooners and brigs that entered all of the little ports of the coast at first monopolized this trade. Competition soon followed from a new breed of three- to six-roasted schooners of much greater tonnage that carried coal and other goods to the larger and deeper ports. But smaller vessels continued to service the lesser ports all along the coast, and every town and industrial enterprise located on waters navigable by the shallow-draft schooners had its coal wharf.

While sailing vessels continued to hold their own and something more in the coastal trade, steamships were by 1900 coming into increasing use, particularly in the coal and lumber business. After about 1880 tow barges were also frequently seen along the seaboard. The feasibility of regular towing over long distances had finally caught on, and tugs, no longer merely harbor and river auxiliaries, had become seagoing power plants. Tow barges had the flexibility of freight cars. They could be detached at ports along the route, unloaded, and then picked up on a later voyage. By 1900 barges and tugs, although bringing in less tonnage than ships, formed one-half of the arrivals in Boston Harbor.[41]

FLUCTUATIONS IN IMPROVEMENTS IN THE TWENTIETH CENTURY

By 1914 river and harbor improvement on the East Coast began to taper off as fewer projects were authorized. With the outbreak of war in Europe in 1914 a drive for governmental economy contributed further to the decline. Until 1919, when Congress authorized 27 new projects on the Atlantic seaboard, mostly of minor nature, rivers and harbors bills confined appropriations with only few exceptions to maintenance and to works already under way. 42 The downtrend was graphically illustrated in New

England, whose heavily indented coastline abounds in small harbors. In 1900 66 coastal navigation projects were under construction --as many as were under construction throughout all the United States and its territories in 1979. By 1917 projects had been completed on 95 rivers and harbors. On 68 of these waterways no further improvements have been made; on the other 27 nothing more was done until after World War 11. Improvements on 38 waterways were continued or renewed between the World Wars, but projects were begun at only seven new localities.[43]

As projects became fewer they became more restricted to localities of major commercial importance. Shipping at many small ports declined as trains and trucks took over business from coastal vessels. From 1920 through 1929 Congress authorized only 48 projects or modifications of existing projects for the Atlantic seaboard. Expenditures, including monies for maintenance as well as improvement, averaged $10.4 million a year. The total national outlay on rivers and harbors, excluding specialized expenditures such as those under the Mississippi River and California Debris commissions, averaged about $42.7 million a year, or about 6 percent more than expenditures for 1914.[44] Since prewar costs had inflated 105 percent by 1920, outlays for general navigation improvements were actually reduced by half.

The depression years of the 1930s restored for a decade an extensive program of navigation improvements. Expenditures for fiscal year 1930 were about 30 percent greater than for fiscal year 1929. The increase, the annual report of the Chief of Engineers explained, was “due to a speeding up of operations to meet the demands of expanding commerce, and in a considerable degree to carry out the purposeful plan of the administration to alleviate conditions of unemployment.” Not only had the greater ports benefited, the report noted, but also numerous lesser harbors and waterways had been improved and maintained. Between 1930 and 1938 larger regular appropriations together with public works and emergency relief programs increased general river and harbor expenditures nationwide to an annual average of more than $115 million. Expenditures on the Atlantic seaboard, while not increasing in proportion to the national average, nevertheless rose to more than $19 million a year, and four rivers and harbors acts between 1930 and 1938 authorized 265 works of improvement.[46]

World War II, burdening the Corps of Engineers with increased military responsibilities and creating a critical shortage of construction equipment, materials, and manpower, restricted river and harbor work to projects directly related to defense. On the Atlantic coast projects focused on improving facilities for naval and supply vessels. These works, several of which were already in progress, included clearing a 27-foot

channel in the Kennebec River to the Iron Works at Bath where warships were constructed for the Navy; dredging a 40-foot channel in the Delaware River to the Philadelphia Navy Yard; dredging to 35 feet the main channel of Charleston Harbor leading to the Navy Yard and the Army Terminals on Cooper River; deepening the Ambrose Channel to New York Harbor to 45 feet and dredging additional anchorage space within the harbor; improving the extensively used New York and New Jersey Channels, which pass through Raritan and Newark bays, for the benefit of large oil tankers; and removing from the main ship channel of Portland Harbor a rock ledge hindering the operation of deep-draft vessels. Submarine attacks off the Atlantic coast prompted additional emergency measures. The Corps stabilized bank sections on the recently completed Chesapeake and Delaware Ship Canal and with Navy Department funds constructed the three-mile Cape May Canal from Cape May Harbor to Delaware Bay.[47] Both improvements provided greater protection for shipments of freight and oil.

Congressional authorization between 1945 and 1950 of 198 projects on the Atlantic seaboard promised a strong revival of navigation improvements.[48] Only a fraction of the projects had been started, however, when hostilities erupted in Korea. Military requirements again took priority, a huge Cold War defense building program was quickly cranked into operation, and river and harbor work shrank once more to a handful of essential projects. Through fiscal year 1955 navigation works on the East Coast numbered fewer than a dozen.[49]

Although the Cold War construction program continued without letup for nearly a decade, river and harbor improvement resumed on a sizable scale in fiscal year 1956 when the number of projects under construction on the East Coast jumped from 6 to 38. The next year 37 projects were initiated. Thereafter the volume of work gradually diminished. From 1958 to 1967 between 7 and 14 projects were initiated each year; from 1968 to 1979 between 1 and 6 were initiated; and in fiscal year 1980 none was started. The number of projects under construction each year ranged from 39 in 1958 to 13 in 1980.[50]

During the post-World War II period more than 250 works of improvement were carried out at nearly as many localities. Small harbors and lesser ports necessarily accounted for most of the projects. Many are primarily fishing ports or seafood processing centers. Others are commercial ports handling a variety of bulky freight, including petroleum products, coal, fertilizers, chemicals, agriculture products, aggregates, pulpwood, metals, lumber, cement, limestone, machinery, and numerous other commodities including large quantities of fish and shellfish. Reflecting a new public interest, many small harbors are used heavily and

others almost exclusively by pleasure craft. Work on scores of these small waterways was carried out under Section 107 of the Rivers and Harbors Act of 1960, which permits the Corps to construct certain small projects not specifically authorized by Congress when they will result in substantial benefit to navigation.[51]

At major ports, the Corps of Engineers developed channels, anchorages, and turning basins to accommodate deep-draft oil tankers and other large vessels. They deepened the main channels at Portland, New York, Norfolk, and Newport News to 45 feet and those of 22 other ports to between 35 and 42 feet. In the past 25 years, commerce at these ports increased markedly. At New Haven, Norfolk, and Charleston the tonnage of freight moved in 1979 was approximately double that moved in 1954, and at Portsmouth, Fall River, New London, Wilmington (N.C.), Savannah, and Jacksonville it was approximately three times greater. At Port Everglades it was about five times greater, and at Morehead City it was seven times greater. The ports with the greatest tonnage in 1979 were New York (163.6 million), Philadelphia (54.8 million), Baltimore (51.4 million), Norfolk (48.6 million), and Boston (26.3 million).

In 1979 26 ports had freight traffic exceeding two million tons. Petroleum products or crude oil dominated the list of commodities handled at most of them. The exceptions were Baltimore, Norfolk, and Newport News, where the leading commodity was coal; Morehead City, where it was liquid sulphur; and Hempstead (N.Y.), where it was aggregates. Foreign traffic was present at all the ports except Hempstead, a small six-foot-deep harbor on Long Island Sound that is one of the nation's leading ports handling sand, gravel, and crushed rock. Foreign tonnage exceeded domestic tonnage at Portland, Portsmouth, Philadelphia, Wilmington (Del.), Baltimore, Norfolk, Newport News, Savannah, and Miami, but was concentrated in greatest quantity at New York (56.2 million), Baltimore (37.5 million), Norfolk (37.2 million), and Philadelphia (34.5 million).[52]

Chapter IV

THE INTRACOASTAL WATERWAY: ATLANTIC SECTION

The tidal streams, bays, and sounds that lie along and just within the shoreline of much of the Atlantic coast were indispensable arteries of communication and commerce for early settlers in America. Not many years passed before they began to speak of linking the waterways together with canals at one place or another to extend their usefulness. . Such enterprises were too formidable for seventeenth-century resources and knowledge, but by the final decades of the eighteenth century men were devoting themselves seriously to the idea, and at last in 1793 and 1796 attempts were made to link Albemarle Sound with "Chesapeake Bay and the Delaware River with New York Bay.[1]

In 1804 construction also began on the canal between Chesapeake Bay and Delaware Bay of which men had dreamed since at least 1654. A year-and-a-half later work came to a halt when the Chesapeake and Delaware Canal Company ran out of funds. Appealing unsuccessfully to the states of Maryland, Delaware, and Pennsylvania for financial assistance, the canal company then turned to Congress. Claiming that the canal was of national importance, the company's directors argued that it would free the coastal trade from the dangers of the sea, shorten water communications between Philadelphia and Baltimore by 319 miles, promote interstate commerce, lower freight and insurance rates, and facilitate the military defense of the country. Although Congress was not inspired to act immediately, the company's memorial sparked the Senate discussion of federal aid to internal improvements that led to the noted report of 1808 by Secretary of the Treasury Albert Gallatin on the transportation needs of the country.

The United States possessed, Gallatin noted, an inland navigation extending from Massachusetts to the southern extremity of Georgia (then the southernmost Atlantic seaboard state) that was '*principally, if not solely," interrupted by four necks of land: Cape Cod, New Jersey between the Raritan and Delaware rivers, the peninsula between the Delaware River and Chesapeake Bay, and the marshy tract between Chesapeake Bay and Albemarle Sound. With canals cut through them, the Secretary explained, a sea vessel could travel by rivers, bays, and sounds from Boston to Beaufort and Swansboro in North Carolina. From there a route through Stumpy and Toomers sounds and two cuts overland of less than three miles would extend the inland navigation with diminished draft to the Cape Fear River. Broken then by a short ocean run, the inland navigation continued again inside the chain of islands skirting the coasts of South Carolina and Georgia.[3]

Gallatin estimated that the cost of the four canals would be $3 million. His entire scheme for roads and canals would run to $20 million. By setting aside $2 million a year from the annual Treasury surplus, then in excess of $5 million, the whole undertaking could be accomplished in ten years. Gallatin's plan, delayed by foreign problems and then frustrated by domestic obstructions, was never fully implemented. His concept of an intracoastal waterway never died, but the waterway came into being through local projects rather than comprehensive planning. And instead of being completed in ten years, its construction took more than a century.

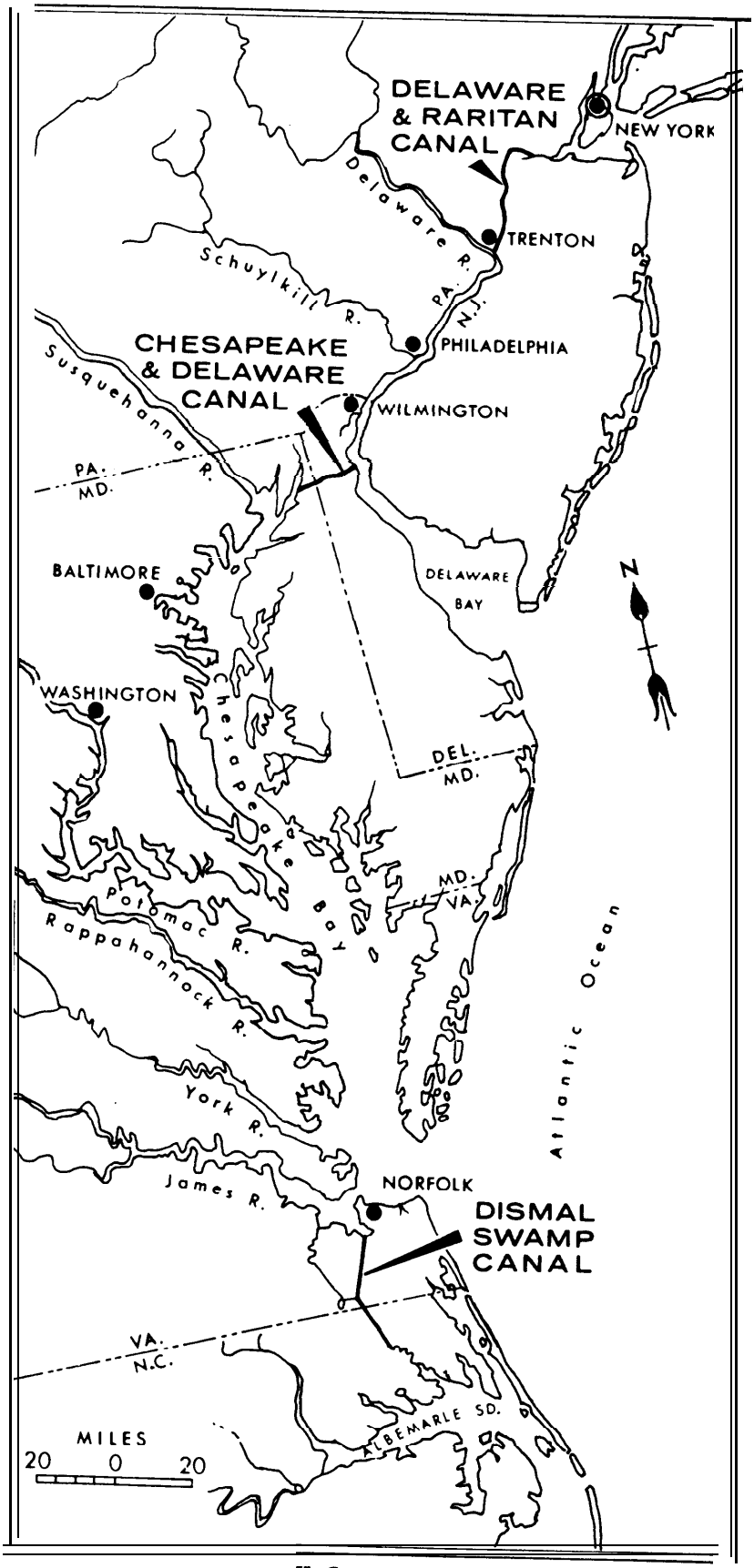
THE CONSTRUCTION OF THE CENTRAL CANAL LINKS

The Chesapeake and Delaware Canal

Until 1822 the Chesapeake and Delaware Canal Company did little else than make more futile appeals to Congress for assistance. Reorganized in that year by capable men, it obtained new stock subscriptions not only from private investors but from the hitherto reluctant states of Pennsylvania, Maryland, and Delaware. Before resuming construction the company had to settle an issue that had arisen over the best route for the canal, and it was on this matter that the federal government first lent a helping hand. An “upper” route, which had been selected in 1804, ran from the Elk River tributary of Chesapeake Bay toward Christian, then was to continue either directly to the Delaware River at New Castle or follow the Christina River to the Delaware at Wilmington. A recently proposed “lower’* route, more direct but more costly to construct, ran from the Back Creek branch of the Elk River into Broad Creek, through the ridge of the Delmarva Peninsula to St. Georges Creek, then on the Delaware at Newbold’s Landing, later renamed Delaware City. Upon the request of the company, Secretary of War Calhoun sent Brigadier General Simon Bernard and Lieutenant Colonel Joseph G. Totten of the Board of Engineers for fortifications to assist in making the decision. After examining the routes and reviewing all plans, estimates, and engineering data, the two Army Engineers conferred with two civil engineers in Philadelphia in January 1824. The unanimous decision of the board was for the lower route. Construction of the canal began the following April.

Continuing all the while to petition Congress for financial assistance, the company finally succeeded in March 1825, when President Monroe signed a bill authorizing a subscription of $300,000 for 1,500 shares of stock. Before construction was finished, unexpected costs in deep-cut and marshland areas forced the company to borrow $1 million and again appeal to Congress. An appropriation for $150,000 for 750 more shares of stock was quickly approved and became law in March 1829. Thus after

The Central Canal Links



U.S. Army Corps of Engineers

standing aloof for nearly 20 years, the federal government contributed $450,000 toward the canal's construction and, as the holder of nearly 38 percent of its stock, became the largest single proprietor.

Officially opened on 17 October 1829, the Chesapeake and Delaware Canal was 13.6 miles long, 10 feet deep, 66 feet wide at the top, and 36 feet wide at the bottom. Each of its four locks measured 100 by 22 feet. Although beset for a decade by crippling legal difficulties and costly engineering problems from which it never fully recovered, and almost immediately rivaled by a parallel railroad completed in 1831, the canal was by 1840 attracting increasing amounts of traffic and fulfilling its promoters' vision of becoming a major carrier of the nation's waterborne commerce.[4]

The Dismal Swamp Canal

The Dismal Swamp Canal connecting Chesapeake Bay with Albemarle Sound also owed its completion in large part to federal assistance. The construction of the canal, which extends from Deep Creek, a tributary of the South Branch of the Elizabeth River flowing to Norfolk, to the Pasquotank River draining into Albemarle Sound, began in 1793. Because of the Dismal Swamp Canal Company's inexperience, inefficiency, and constant lack of funds, work was still in progress when war broke out with Britain in 1812 and the canal was of little use in circumventing the British coastal blockade. Although the company stepped up its efforts to complete the waterway, when Major James Kearney examined the route in 1816 in response to an inquiry by a congressional committee, he reported that at the foot of the intermediate locks of the canal, '*if it may so be denominated," there had never been more than 18 or 20 inches of water. He thought that enlarging the canal was an absolute necessity for the country, but unfortunately the canal company was restricted by the difficulty of obtaining funds. The committee reported out a bill to buy stock in the company, but the measure fell by the wayside. Left on its own, the company could make only limited improvements.[5]

Federal interest in the Dismal Swamp Canal revived with the passage of the General Survey Act of 1824. In December 1825 in response to a query from the House of Representatives, General Bernard categorized the canal as "one link of the contemplated inland navigation . . . destined to connect . . . all our main streams emptying into the Atlantic." With larger dimensions, he advised, the canal would not only be of great military value but would "continue to a prompt, safe, and regular interchange of the manufactured produce of the North, with the raw materials of the South." A second report from the Engineer Department in

March 1826 stressed the military advantages of making the canal practicable for sloop navigation. Two months later, on 18 May 1826, Congress voted to buy 600 shares of Dismal Swamp Canal Company stock for $150,000, provided that the Board of Engineers determined that the improved canal would serve "as part of the chain of canals contemplated along the Atlantic Coast," and that the sum subscribed would be sufficient to complete the work.[6]

A survey carried out in July under the direction of Lieutenant Colonel Charles Gratiot, the Engineer in charge of defenses at Hampton Roads, produced plans to meet these conditions, and the canal company, fortified with the federal subscription and with loans totaling $137,000 from the state of Virginia, went to work. Reconstruction progressed so rapidly that by December 1828 an essentially new canal opened to traffic. Costs had evidently exceeded estimates, for in March 1829 Congress subscribed an additional $50,000 for 200 more shares in the waterway,[7] bringing its holdings in the company's stock to more than 40 percent.

The new canal was 22.5 miles long, averaged 40 feet wide, and could accommodate vessels drawing 5.5 feet of water. The elimination of two of seven locks made possible a speedier passage. A viable waterway at last, the canal rapidly attracted traffic. By 1833 the annual value of produce shipped through was nearly $2.5 million and by 1854 it was more than $3.5 million. Contrary to the prediction of General Bernard, however, trade was mostly local in character, coming from the sounds and rivers of North Carolina largely in schooners built especially for this traffic. Vessels occasionally sailed on to Richmond, Baltimore, or Washington, but most craft stopped at Norfolk.[8]

The Delaware and Raritan Canal

The Delaware and Raritan Canal, reaching 44 miles across central New Jersey from Bordentown on the Delaware River to New Brunswick on the Raritan, was the next link in Gallatin's chain to be constructed. Although the Army Engineers rated it, among canals being built or proposed in the 1820s, as first in importance for the defense of the country and third in importance for internal commerce,[9] the Delaware and Raritan received no federal engineering or financial assistance.

The idea for a Delaware and Raritan connection dated back to the seventeenth century, when William Penn and his associates are reputed to have commissioned an investigation of the possibility. In 1796 and again in 1804 short-lived attempts were made to connect the rivers, mainly by deepening existing streams rather than by digging a new channel. In 1816, with the lesson of the British blockade fresh in mind, the state of New Jersey

appointed a commission to explore the idea anew. Rejecting the earlier plan for a slackwater navigation as impracticable, the commission recommended the construction of a canal that in conformity with Gallatin's report would be large enough for seagoing vessels drawing eight feet of water.

During the next decade-and-a-half more than a dozen attempts to get construction of the canal under way by the state, by private enterprise, or by a mixed corporation were frustrated by inability to raise the necessary capital, local jealousies, or conflicting economic interests. Finally, in February 1830, the New Jersey legislature broke a deadlock between canal supporters and partisans of a Camden and Amboy railroad, who wanted to run a line roughly parallel to the canal, by chartering separate companies, one to construct the canal and the other the railroad. A year later the two companies united for their mutual benefit, and in return for guaranteed annual payments to the state, the legislature granted a monopoly of New York to Philadelphia rail transportation across New Jersey to the Joint Companies, as they came to be called.[10]

Opened in the spring of 1834, though not actually connected with the Delaware River at Bordentown until 1838, the Delaware and Raritan Carol was a large and well-constructed waterway. It measured 80 feet wide at the surface and had a depth of 7 to 8 feet. Its 14 locks were each 220 feet long, and the smallest was 24 feet wide. A navigable feeder canal 22 miles long, 60 feet wide, and 6 feet deep joining the main canal at Trenton brought an ample supply of water from higher up the Delaware. The canal quickly became one of the largest freight carriers in the country, with Pennsylvania coal dominating its tonnage.

The Inland Waterway Versus Sea Routes

With three links of Gallatin's projected intracoastal waterway completed by the late 1830s, a small vessel could travel from New London, Connecticut, at the eastern end of Long Island Sound, all the way to the large sounds of North Carolina without ever being exposed to the open sea. Long-distance shipments by this inside passage, however, were not often made. It was generally quicker and cheaper to make long transports by sea. Naval stores, red oak for ships, staves, shingles, and other forms of lumber from North Carolina, and flour and tobacco and other products from the Chesapeake region continued for the most part to reach New York and New England by coastwise vessels, while manufacturers from the northern states and from Europe furnished valuable return cargoes. Some long-distance shipments did come through the canals, particularly the two northern cuts. Barges filled with coal at Richmond, Virginia, arrived at New York via the inland waterway, while limited amounts of

merchandise moved back to Chesapeake ports the same way. And from far up the Susquehanna, barges descended to the Chesapeake and took the inside passage to New York, a journey of about 700 miles. But it was over the shorter distances, between the Carolina sounds and Norfolk, between Baltimore and Philadelphia, and between Philadelphia and New York, that the inland waterway carried the most traffic. On these transits it so successfully challenged the sea routes that only the bulkiest freight was left for coastal vessels.[12]

The Albemarle and Chesapeake Canal

At the southern end of this string of canals another potential waterway route existed between Norfolk and Albemarle Sound. Roughly paralleling the Dismal Swamp Canal on the east, it ran through low and level ground between Currituck Sound, an arm of Albemarle Sound, and the Elizabeth River. Requiring only short excavations, this route had such evident advantages that proposals for a canal had been presented to the Virginia Assembly as early as 1772. In 1807 Virginia and North Carolina granted charters to an aspiring canal company, but apparently because the Dismal Swamp Canal was already under construction, no stock was subscribed for the venture. Following the War of 1812 Major Kearney examined the route on the same assignment as his inspection of the Dismal Swamp Canal. With the interest of the government in mind, he concluded that the expense of improving the existing canal would be trifling compared to the cost of building a new one. Interest in the route persisted, however, and over the next decades several surveys were made by state and local agencies. Finally in 1856 the Albemarle and Chesapeake Canal Company began construction.

Designed for vessels of greater tonnage than the Dismal Swamp Canal could handle, the new canal was 8 feet deep, about 60 feet wide at the surface, and 40 feet wide at the bottom. Starting in the upper reach of the North River, a tributary of Albemarle Sound a few miles east of the Pasquotank River, it passed by a five-mile land cut through the Currituck Peninsula at Coinjock into the upper part of the Currituck Sound, thence by Currituck Sound and North Landing River to North Landing, Virginia, from where an excavation of nine miles brought it to the South Branch of the Elizabeth River at Great Bridge, five miles above the entrance to the Dismal Swamp Canal. Unlike earlier canals cut through more rugged terrain with primitive equipment, the Albemarle and Chesapeake was scooped through marshy soil by steam dredges working from deep water at both ends of the cuts. No lift locks were required, but because the Elizabeth River is a tidal stream, the company constructed a guard lock 220 feet long and 40 feet wide at Great Bridge to prevent currents from eroding the canal's banks.

In January 1859 the first vessel passed through the canal, a 75-ton schooner-rigged barge towed by a company side-wheel steamer. A steady stream of traffic followed. During the Civil War, when Union armies commandeered the canal, nearly 9,000 vessels made the transit. After the war, traffic continued to increase as the new waterway took over practically all of the trade passing between Albemarle Sound and Norfolk.[13]

THE UNITED STATES BUYS CANALS

Except for the now eclipsed Dismal Swamp Canal, the canals comprising the partially realized intracoastal waterway enjoyed increasing trade until about 1870. Forced from the outset, however, to meet competition from railroads, their financial returns were never sufficient to allow the expensive modifications necessary to keep pace with transportation requirements and, except for the enlarging of locks, their dimensions were not materially increased. After 1870, owing to the rapid improvement of railroad beds and locomotives and the lack of improvement of the canals, trade on the canals steadily declined. The traffic of the Chesapeake and Delaware Canal, which reached a maximum of 1.3 million tons in 1872, fell to 639,543 tons in 1890. In the same time span, traffic on the Delaware and Raritan Canal fell from 2.8 million to 623,751 tons. Without hope of revival through independent action, the canal companies turned to the federal government for relief.[14]

The Chesapeake and Delaware Canal

After 1871 the financial position of the Chesapeake and Delaware Canal Company steadily worsened. Growing competition from railroads and steamships using the outside route gradually forced tolls down more than 50 percent. Despite efforts to attract trade by giving larger rebates to towing companies, the important coal trade, which usually amounted to 40 to 50 percent of all traffic, declined by more than one-half between 1872 and 1879.

Adding to the troubles of the company was a movement, which took form at a National Commercial Convention in Baltimore in 1871, for the construction of a sea-level ship canal between the Chesapeake and Delaware bays. The supporters of this movement were not interested in an intracoastal waterway but in providing Baltimore with more direct access to the Atlantic in order to compete with New York as a great entrepot of overseas trade connecting with the West. In their view the Chesapeake and Delaware Canal, even if converted to a sea-level passage, was too far north to furnish the desired short outlet to the ocean. Looking primarily to the United States for the construction of the canal, its advocates succeeded in bringing about surveys by

the Corps of Engineers, between 1878 and 1883, of six probable routes across the Delmarva Peninsula. Upon submitting its findings to Congress, the Corps suggested the appointment of a special commission representing military, naval, and commercial interests to decide which route would best promote the defense and commerce of the country.[15]

When eventually appointed in 1894, the commission, chaired by Chief of Engineers Brigadier General Thomas L. Casey, rejected all of the surveyed routes and instead recommended development of the existing Chesapeake and Delaware Canal. Discounting the benefit of a ship canal to Baltimore's trans-Atlantic trade, the commission explained that for foreign traffic the gain in time from using any of the routes would be so small compared with the duration of the entire voyage it was unlikely vessels would risk the delays common in restricted channels. Thus a ship canal constructed on any of the routes would be used largely for interior navigation, and for this, the commission decided, the line of the present canal was the most advantageous. Though the Casey Commission report was unpopular in Baltimore, it was welcomed by the Chesapeake and Delaware Canal Company, which had already decided to do everything in its power to have its properties taken over by the government.[16]

Before Congress acted on the matter again, renewed interest in waterways began to be expressed in the nation. Despite the precipitous decline in canal traffic, belief in the relative cheapness of water transportation, especially for low-value bulk freight, remained strong. The competition of waterways was also seen as an effective means of regulating railroad rates. The most compelling cause for the renewed interest, however, was that the entire transportation system threatened to break down. Railroads, successful beyond their capabilities, had become clogged with more freight than their cars could carry and more traffic than their terminals could handle. Dozens of local and regional waterway associations sprang up for the purpose of pressing upon Congress the importance of waterway development.[17]

In 1906 Congress authorized a new special commission to determine the cost and advantage of converting the Chesapeake and Delaware Canal to a ship canal. By this time the advocates of a ship canal had significantly changed their tune. No longer urging a direct route to the ocean for Baltimore's foreign trade, they had for several years been touting the strategic and commercial benefits of the existing canal route as part of a great inland waterway. Reporting in January 1907, the commission, chaired by Felix Agnus of Baltimore, one of the first and most articulate of the ship canal advocates, declared that the canal was “the most important link in the proposed waterway from the Gulf to the City of Philadelphia . . . and its purchase and

improvement by the Government would be a benefit of extraordinary value." Bills to this end introduced in 1907 and 1909, however, failed to pass. Although the demand for the ship canal was growing, it still lacked sufficient strength.[18]

Adding to the political clout of the canal's supporters at this time, however, was the organization in 1907 at Philadelphia of the Atlantic Deeper Waterways Association. Its president was J. Hampton Moore, a congressman from Philadelphia, and chief among its other leaders was John H. Small, a congressman from North Carolina. The association persistently agitated for the systematic and gradual construction of a continuous inland water route from Boston to Key West. Because of the importance of the Chesapeake and Delaware Canal to its overall plan; "substantially the vital link," Moore maintained, the group became the canal's leading advocate.

In 1908 Congressmen Moore and Small introduced resolutions calling for surveys for an inland waterway from Boston to Beaufort, North Carolina, and from Beaufort to Key West. Approved in 1909, the surveys were the first to be made along the entire Atlantic coast. In 1910 Congress empowered the Secretary of War to negotiate the purchase of either the Albemarle and Chesapeake Canal or the Dismal Swamp Canal as part of the inland waterway if recommended in the survey report. The report on the Boston to Beaufort survey, submitted to Congress early in 1912, recommended two first steps in the development of the waterway: the construction of a 12-foot-deep waterway between Norfolk and Beaufort by way of the Albemarle and Chesapeake Canal and the purchase and gradual conversion, so as to interfere as little as possible with existing traffic, of the Chesapeake and Delaware Canal into a ship canal 25 feet deep. In the Rivers and Harbors Act of 1912 Congress accepted the first recommendation but not the second. According to Moore, "the desire to keep down the total appropriations and the pressure from the Mississippi Valley were too strong to be overcome."[20]

For several years repeated attempts to purchase the Chesapeake and Delaware Carol were frustrated by opposition from the West and Midwest, government economizing on waterway projects followed the outbreak of war in Europe, and failure to set a price acceptable to both the canal company and Congress. Finally, in 1917 Congress authorized condemnation proceedings. In March 1919 it made the necessary appropriation, and the next month the Wilmington District Court made a condemnation award of $2.5 million. This figure, which the company had agreed to accept prior to the award, had been set by the Agnus Commission as the value of the canal. It represented solely the bonded indebtedness of the company. As no dividends had been declared on the canal's stock since 1876, the commission had deemed it worthless. Formal transfer of the canal to the government occurred on 13 August 1919.[21]

By 1927 the first step recommended by the Corps--the conversion of the locked canal into a sea-level canal 12 feet deep and 90 feet wide at the bottom--was completed. To provide more ready access to deep water and to eliminate a sharp curve in the canal line, the Corps located a new eastern terminus at Reedy Point, two miles south of the old entrance at Delaware city. Reconstruction had proceeded with a minimum of hindrance to traffic, which increased while work was in progress from 481,000 tons in 1920 to more than 700,000 tons in 1928. Continuing to grow, tonnage exceeded one million tons in 1932 and remained well above the figure throughout the decade. New larger vessels were soon regularly navigating the canal, shallow-draft seagoing vessels occasionally used it, and in 1931 a new commodity—oil--began to pass through in tankers designed to the largest dimensions possible for use on the route.[22]

In 1935 Congress authorized the enlargement of the canal to 27 feet deep and 250 feet wide at bottom through the land cut and 400 feet wide down the Elk River and into Chesapeake Bay to deep water. Initiated with funds from the Emergency Relief Appropriation Act of 1935, the project was completed by 1938. Commerce through the canal increased dramatically from just over 1 million tons in 1935 to 3.8 million tons in 1940. World War II drove more freight to the protected passage, and in 1942, when German submarine activity along the Atlantic coast was at its peak, 10.8 million tons went through.[23]

Traffic on the canal dipped back to about 3.7 million tons by 1945, and then steadily increased until by the mid-1950s it amounted to nearly 10 million tons annually. In 1954 Congress again modified the canal project to provide for a channel 35 feet deep and 450 feet wide throughout, the reduction of curves in the channel, and the replacement of all movable-span bridges with high-level fixed structures (later changed to allow a vertical-lift railroad bridge). For several years meager funds allotted to the project permitted only minor works. But after new calculation of the project's cost-benefit ratio in 1932, which showed 30 percent greater benefits than costs, Congress provided for large-scale construction. Moving ahead at a steady pace, the project was by 1970 about 87 percent completed. Since then only minor work has been carried out. In 1979 vessels carrying 14.4 million tons of freight made 11,207 trips through the canal.[24]

The Dismal Swamp and Albemarle and Chesapeake Canals

The Dismal Swamp Canal, dealt a blow by competition from the Albemarle and Chesapeake Canal, was dealt another by the Civil War. Taken over to transport supplies first by Confederate troops and then by Union forces, neither of whom paid tolls or

provided maintenance, the canal deteriorated badly. In 1866 the canal company, reminding Congress that the United States still owned 800 of 1,944 shares in the waterway, asked for $200,000 for repairs. Congress responded by authorizing the Secretary of the Treasury to sell the stock, apparently intending that the company use the proceeds in lieu of an appropriation. At the same time Congress stipulated that the canal should be kept open as a navigable highway without any further expense to the government. This move died when the Attorney General advised that perpetual navigability of the canal was a matter the government could not control beyond its voice as a stockholder in the company and could not be insured by any guarantee a purchaser might be asked to give. 25 In 1867 the company floated a $200,000 bond issue, but the sum proved insufficient to rebuild a viable waterway. The company again petitioned Congress for aid in 1871 and 1874 without success. In 1878, in default on bond payments, it was forced by the bondholders to sell its properties, at which time the United States ceased to be a stockholder .[26]

Faring no better under new management, the company continued to lead a hand-to-mouth existence while the condition of the canal steadily worsened until only vessels whose draft did not exceed 2 feet had a reasonable chance of getting through without grounding. In 1892 came a turning point. The Lake Drummond Canal and Water Company of Baltimore purchased the canal and between 1896 and 1899 reconstructed it into substantially its present form. The new owners enlarged the canal to 10 feet deep, 60 feet wide at the surface, and 40 feet wide at the bottom; lowered the summit level so that only a single lock was required at each entrance; and dredged the canal approaches 10 feet deep and 40 feet wide. The Corps of Engineers, under a project authorized in 1899, widened the approaches to 100 feet.

The success of the reconstructed waterway in recapturing trade from its rival was remarkable. In 1880 the Dismal Swamp Canal had carried only 6,731 tons of freight, while the Albemarle and Chesapeake had carried 400,000 tons. In 1899, although reconstruction was not completed until August, it carried 78,211 tons compared to the Albemarle and Chesapeake's 316,793 tons. By 1906 the Dismal Swamp’s tonnage had increased to 340 135 tons, while its rival’s had dropped to 95,629 tons.[28] This advantage, however, was short lived.

The Corps of Engineers report on the survey of the intracoastal waterway from Boston to Beaufort, North Carolina, submitted to Congress in 1912, recommended the route of the Albemarle and Chesapeake Canal for the construction of the 12-foot-deep, sea-level waterway from Norfolk to Beaufort. The shorter land cut and lower elevation of this route brought

construction cost to less than half that of the Dismal Swamp route. Congress approved the project, and on 30 April 1913 the United States purchased the Albemarle and Chesapeake Canal for $500,000.29

The construction of the waterway, known officially as the "Inland Waterway from Norfolk, Vs., to Beaufort Inlet, N.C.," was completed in 1932. Congress modified the project in 1917 and 1918 to permit changes in the route and in 1930 to provide for the construction of a new tidal guard lock, measuring 600 feet long and 75 feet wide, at the Elizabeth River entrance to the Albemarle and Chesapeake Canal. Covering a distance of nearly 198 miles from Norfolk to Beaufort, the waterway varies in bottom width from 90 feet in land cuts to 300 feet in open waters. Upon leaving Albemarle Sound, it avoids broad Pamlico Sound and follows a succession of rivers, creeks, bays, and land cuts from the Alligator River, which flows into Albemarle Sound, to the Newport River, which leads to Beaufort Inlet. Prior to the adoption of the project the Corps had improved some of these water courses and, beginning in 1837, had made seven previous surveys for a through route. Now at last it had constructed a through waterway suitable for barge traffic as part of the larger scheme for an intracoastal waterway. Between 1970 and 1979 commerce on the waterway passing through the Albemarle and Chesapeake Canal averaged 1.36 million tons annually.[30]

Following federal purchase of the Chesapeake and Albemarle Canal, the Dismal Swamp Canal again lost trade to its now toll-free rival. For some years lumber shipped from landings on the canal's banks almost alone kept it in operation. Meanwhile its controlling depth gradually diminished to five feet. In time growing usage by pleasure boats helped keep the canal open. Yachtsmen taking this route found it a comfortable day's run from Norfolk to Elizabeth City on the Pasquotank River, where they could get supplies and lay over for the night. On the Albemarle and Chesapeake Canal route such accommodations are not readily available.

From the beginning of the Norfolk to Beaufort waterway project, the Lake Drummond Canal and Water Company tried to persuade the government to take over its canal as well as the Chesapeake and Albemarle. In 1925 Congress finally agreed to buy it as an adjunct to the inland waterway for $500,000. After several years' delay the transfer of title took place on 30 March 1929. Until recently the Corps of Engineers maintained the canal at project dimensions of 9 feet deep over a bottom width of 50 feet and, under the project of 1899, maintained its approaches at 10 feet deep and 80 to 100 feet wide. In 1940-1941 the Corps replaced the canal's old timber locks with steel and concrete chambers 300 feet long and 50 feet wide. Although yachts en

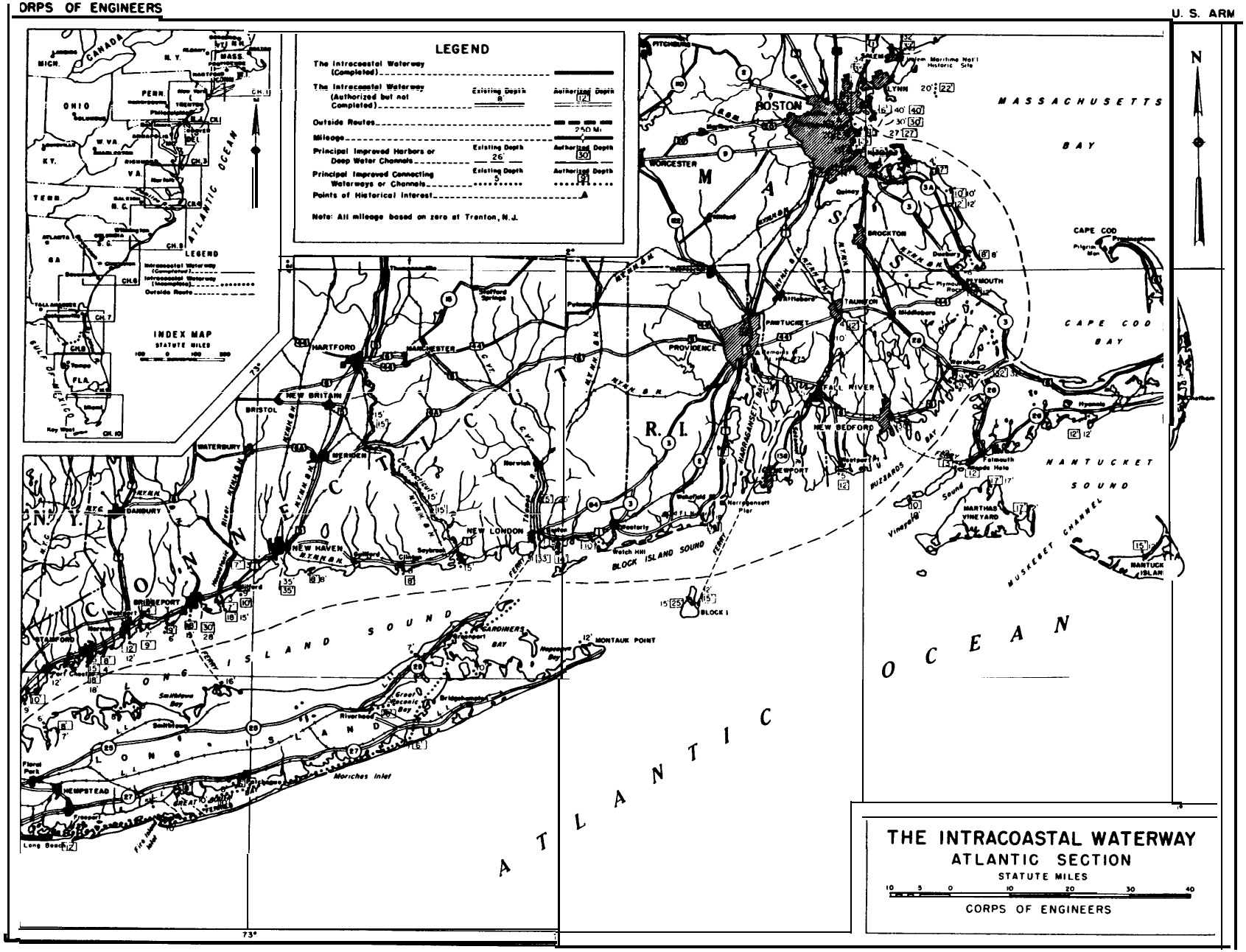
route to and from Florida continue to use the canal extensively, commercial traffic from 1974 to 1978 averaged only 173,504 tons annually. Finding this insufficient to justify maintaining the project depth, the Corps currently provides a 6-foot channel.[31]

The Cape Cod Canal

In 1860 the state of Massachusetts revived the idea, which had lain dormant since the 1820s, of cutting a canal through Cape Cod between Barnstable Bay and Buzzards Bay. It commissioned the drafting of new plans and in 1870 granted a construction charter to a newly organized Cape Cod Ship Canal Company. The state also asked the federal government to construct a breakwater to shelter the Barnstable Bay entrance, claiming that the work would be comparable to any other federal harbor project. Directed to look into the matter, Boston District Engineer Lieutenant Colonel John Foster suggested a much larger waterway than had been planned. A canal 23 feet deep, 300 feet wide at the surface, and 198 feet wide at the bottom, he advised, would permit the heaviest vessels of the Navy to pass through and allow vessels of all classes to pass each other. Because of considerable differences in the heights and times of tide at the two bays, previous plans had included locks at each end of the canal. Foster discarded this idea. He calculated that in a canal of the dimensions he proposed, the swiftest currents generated by tides, which would last only a few minutes anyway, would be no greater than in several other waterways navigated without difficulty.[32]

Foster's report established the concept of an open canal, but had no further effect as the canal company never started construction. For more than three decades new petitioners scrambled for charters to construct the canal. Several charters were granted, but little was accomplished. Almost everyone saw rosy prospects for the canal, but practically no one was willing to risk his own money. The string of false starts ended in 1907 when August Belmont, a New York investment banker and the builder of the city's first subway system, bought the rights and properties of a company chartered eight years before. Belmont formed a syndicate to underwrite the canal and in June 1909 started construction.[33]

Shortly afterward the Corps of Engineers made their intracoastal waterway surveys from Boston to Key West. They surveyed two inland routes from Boston to Narragansett Bay and also considered the advisability of purchasing the partly completed Cape Cod Canal, which would mean outside navigation for the waterway from Boston to Fishers Sound except for the several miles of the canal and Buzzards Bay. As existing commercial needs were insufficient to justify construction of a canal over either of the inland routes, the Corps recommended



Boston to New York City

postponing their further consideration until other sections of the proposed intracoastal waterway had been constructed and the benefit to commerce afforded by the Cape Cod Canal had been demonstrated. Accordingly, plans for purchasing the canal should also be delayed. Between Narragansett Bay and Long Island Sound the Corps surveyed a series of tidal streams, ponds, and lagoons that offered an inside route for a canal, but the Engineers doubted that it would be used sufficiently to warrant the large expense. The rest of the waterway to New York Bay, they noted, was by nature sheltered through Long Island Sound and of ample capacity for all the traffic that would ever use it except at its western end, where obstructions were already being removed.[34]

In July 1914 the Cape Cod Canal opened to traffic. It was a narrower waterway than Colonel Foster had proposed, Although its charter depth was 25 feet, its bottom width of only 100 feet and surface width of 200 feet precluded two-way traffic. The land cut of the canal was 7.68 miles long, a dredged approach in Buzzards Bay about 5 miles long, and the Barnstable Bay approach about one-half mile long, making the total length of the passage about 13 miles. For years it had been believed that the canal, by eliminating the hazardous passage around the cape, would aid shipping immensely. Yet it failed to attract the expected traffic. The current was a major deterrent. Underpowered vessels had to await slackwater or a favoring tide. Tugs towing barges could not proceed against the current, and on going with it had to take them through one at a time. Accidents occurred~ giving the canal a bad reputation. Mariners complained about delays in transit through the single-track route, the narrowness of the channel, shoals caused by bank erosion, the hazards of passing through narrow draw bridges, and the prevalence of ground fog.[35]

As early as 1915, Belmont, who formerly had been indifferent to government aid or purchase, thought that the national government “ought to really acquire the canal.” The first step in this direction was taken May 1917, five weeks after the United States declared war on Germany, when Senator John Weeks of Massachusetts introduced a bill for its purchase. Slightly amended, the bill became part of the Rivers and Harbors Act of August 1917. The government and the canal company, however, came to loggerheads on the question of price, an issue that was further complicated by claims for compensation due each side arising from the government’s takeover and repair of the canal in the last months of the war. In 1919 the government instituted condemnation proceedings that eventually led to an out-of-court settlement signed on 29 July 1921 under which the government agreed to pay the canal company $5.5 million in cash and assume its $6 million bond obligation. Until Congress approved the contract and appropriated the money, the company would operate the canal and the government would be responsible for the interest on the bonds.

In the next half-dozen years seven bills to carry out the contract were introduced in Congress, only to fail because of haggling over the terms, indifference, or opposition. In January 1927 a bill finally passed, but only with a Senate amendment providing that the government should pay interest on the bonds from the date of the title transfer rather than from the date of the contract, which meant a loss of nearly $2 million to the canal company. After more delay because of questions arising over the validity of company land titles, the United States took over ownership of the canal on 30 March 1928.[36]

The Corps of Engineers made extensive repairs on the canal and the government abolished tolls. Commerce seeking the waterway increased from 894,763 tons in 1927 to nearly 2.5 million tons in 1930. But it was obvious that without major improvements the canal could never attract the great bulk of shipping compassing the cape. Studies authorized in 1930 recommended deepening and widening the channel, installing a tidal lock midway in the land cut to eliminate the problems caused by currents, and replacing the hazardous bridges with more suitable structures.[37]

Reconstruction began in 1933 as an emergency relief measure. The Public Works Administration allocated funds to construct three bridges and widen the land cut to 205 feet. Before work had progressed very far, plans for the project went back to the drawing board. An initial widening of the land cut in one place to 170 feet had resulted in greater current velocities, yet tugboat operators found that most of the difficulties for one-way traffic had been removed. The trouble with the canal had not been the current, but the narrow width of the channel. A locked canal was no longer viewed as necessary, and the winter of 1933-1934 showed that it might be a nuisance. Buzzards Bay became so choked with ice that shipping was disrupted for weeks at a time. But the canal did not freeze. It was apparent that in the still waters of a locked canal there could be serious trouble with ice formations every few years.

Boston District Engineer Colonel John J. Kingman proposed modifying the project to provide for an open waterway 32 feet deep and 540 feet wide through the land cut. The 540-foot width would not only insure safe two-way navigation but also permit the excavation of a channel 40 feet deep and 500 feet wide at some future time without impairing revetments and other works on the banks of the canal. Other recommendations included widening the channel approach in Buzzards Bay to 500 and 700 feet, constructing mooring basins at each end of the land cut, and installing a new lighting system to combat the problem of ground fog. The reviewing authorities of the Corps concurred with Kingman's proposals, and Congress authorized the project in August 1935.38

By 1940 the project was essentially completed. The Corps cut the surface width of the canal to about 700 feet but reduced the bottom width to 480 feet. More gradually sloping banks, the Engineers reasoned, would reduce erosion and provide greater safety if a ship ran aground. In addition to the mooring basins for freighters, the Corps constructed harbors of refuge for small craft at each end of the waterway. With extended approach channels reaching to the new 32-foot depth, the total length of the canal became 17.5 miles. Even while work was in progress the improved canal attracted new shipping. In 1940 three times as many ships and more than eight times as much cargo tonnage went through as had gone through the old canal in 1927, the last year of private ownership.

During World War II cargo tonnage doubled as convoys bound for Greenland, Iceland, and the United Kingdom assembled in Buzzards Bay and all but the deepest ships sailed through the protected passage. Other merchant ships, whose peacetime routes passed wide of the cape, sought the safety of the canal, and naval vessels of the lighter classes used it extensively. At the height of submarine activity in the Atlantic, as many as 80 merchantmen and warships used the canal in a single day. Nearly 19 million cargo tons passed through in the year 1944.

After the war the canal continued to attract heavy traffic. Since 1970 freighters and tankers have carried through an average of about 12.5 million cargo tons annually. Thousands of recreational craft also pass through the canal each year. To accommodate this traffic the Corps, between 1957 and 1963, provided additional anchorage facilities at each end of the waterway .39

THE INTRACOASTAL WATERWAY FROM BEAUFORT, NORTH CAROLINA, TO KEY WEST, FLORIDA

In 1913 the Corps of Engineers submitted its report on the Beaufort, North Carolina, to Key West, Florida, section of the proposed intracoastal waterway. The Engineers were divided in opinion. The special board of officers making the survey recommended a ten-foot-deep waterway for the entire distance of 925 miles, to be completed in six years at an estimated cost of $31 million. Brigadier General William H. Bixby, the Chief of Engineers, concurred on the need for an intracoastal waterway but saw no urgency for one ten feet deep or, in view of the sparse population on Florida's east coast, for construction through to Key West. He recommended, for the present, a seven-foot channel as far as the St. Johns River, which the special board formed at his request estimated would cost about $14.4 million. The Board of Engineers for Rivers and Harbors declined to endorse either recommendation. Through traffic would be

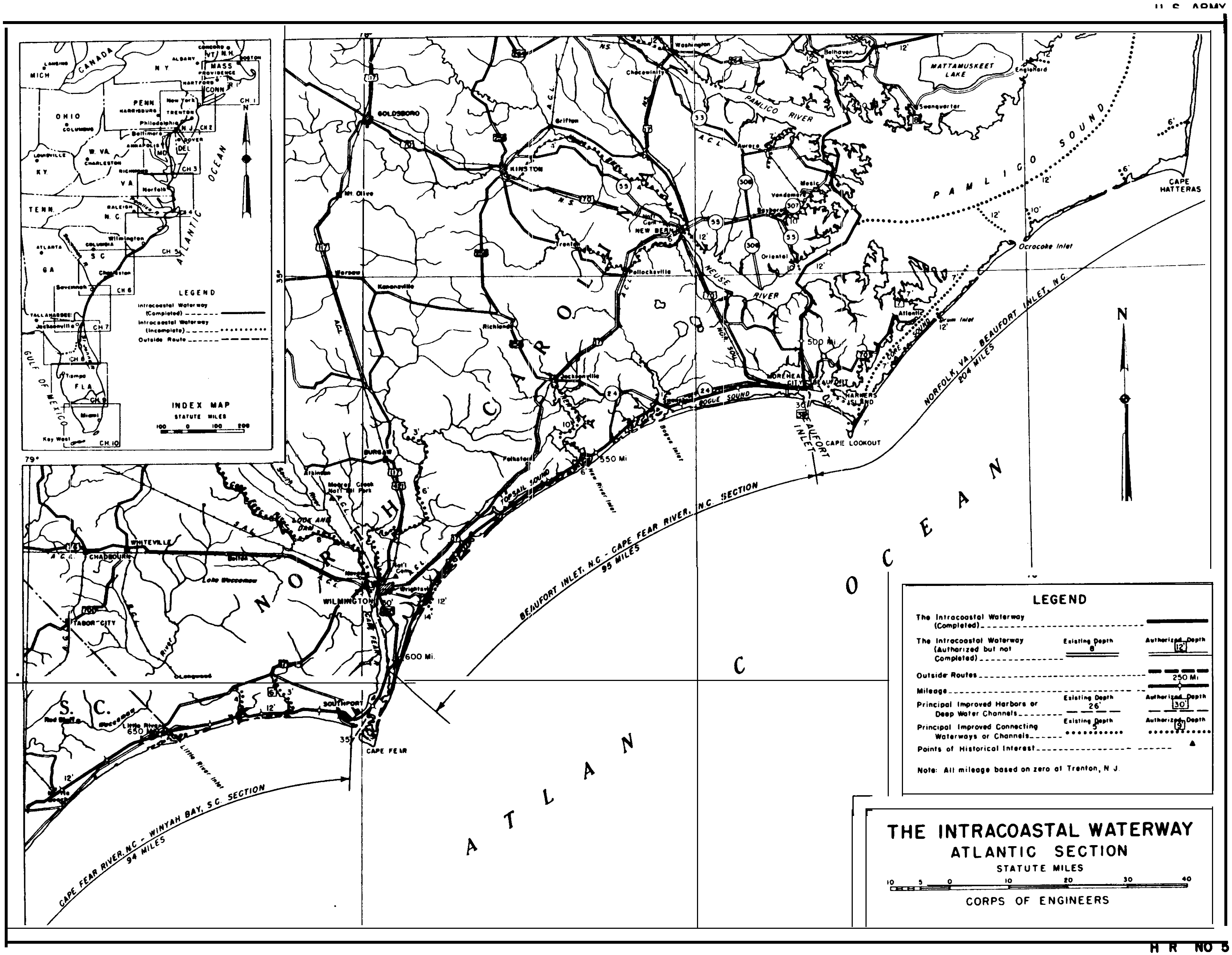
negligible, the board argued, as vessels suited to the waterway could not compete in capacity or speed with seagoing vessels. It agreed with the special board that most commerce would be local but saw no prospect of an increase sufficient to warrant the large expenditures involved. It noted that between Charleston and Jacksonville--in its view the most promising section of the intracoastal waterway--channels for small boat traffic already existed, for two of which improvement had already been recommended. Improvement of the remaining sections of the waterway, the board concluded, was not advisable at the present time.[40]

Congress took no action on the report. Ultimately the waterway between Beaufort, North Carolina, and Key West was developed, not as single project, but in several sections improved by stages in response to expectations of commercial benefit. The entire Intracoastal Waterway remained a string of variously named projects until 1947, when all but the last two of the southern reaches were collectively designated the *'Atlantic Intracoastal Waterway between Norfolk, Vs., and St. Johns River, Fla." The ship canals comprising the waterway in the north and the sections between the St. Johns River and Key West continue to remain separate projects.

Inland Waterway, Beaufort to Cape Fear River, North Carolina

The Intracoastal Waterway from Beaufort, North Carolina, to the Cape Fear River passes from Beaufort through Bogue Sound to Swansboro, thence through the sounds and marshes to the south to the lower end of Myrtle Sound where, near Carolina Beach, a land cut of 1.6 miles brings it into the Cape Fear River about 16 miles below Wilmington. Covering a distance of 93.5 miles, the channel is 12 feet deep at mean low water with bottom widths varying from 90 feet in land cuts to 300 feet in open waters.

Contrary to the assumption made by Secretary Gallatin when writing his report on roads and canals, inland navigation along this stretch of the coast even for vessels of light draft was not practicable. Between Beaufort and Swansboro the governing low-water depth through Bogue Sound was 18 inches; between Swansboro and the New River the depth of channels winding through marine marshes sometimes diminished to 6 inches; and between the New River and the southern end of Myrtle Sound the shallow channels and marshes were not navigable by rowboats at low water. Small boats sailing between Beaufort and the Cape Fear River had to make the trip by ocean and pass around the dangerous Cape Fear Shoals with no safe inlets to put into if caught in bad weather and without enough good daylight to make a safe through run.[41]



The Intracoastal Waterway: North Carolina

Navigation improvement along this reach of the inland waterway began in 1836 with a small appropriation for dredging in the New River, which today carries a side channel of the Intracoastal Waterway 21 miles to the town of Jacksonville. Several more minor appropriations through 1910 further improved the river. Navigation improvement between Beaufort and Swansboro began in 1886 and between Swansboro and the New River in 1890. In 1917 Congress consolidated the three works under the project, "Inland Waterway, Beaufort to Jacksonville, N.C.," which provided for a channel 100 feet wide and 3 feet deep at mean low water between Beaufort and Swansboro, thence 40 feet wide and 3 to 4 feet deep at mean high water to New River, thence 40 feet wide and 3 feet deep at mean low water to Jacksonville.[42]

Congress authorized the 12-foot channel through to the Cape Fear River in 1927, and the Corps completed the work five years later. Since then the Corps has increased the usefulness of the waterway for both commercial and pleasure craft by constructing ten channels, several with boat turning basins, to connect with ocean inlets or nearby communities.[43]

Intracoastal Waterway from Cape Fear River, North Carolina, to Winyah Bay, South Carolina

Passing down the Cape Fear River to Southport, near the river's mouth, the Intracoastal Waterway then follows the Elizabeth River to its headwaters, cuts 2.6 miles through high ground to the head of Davis Creek, descends the creek, and continues through coastal sounds and marshes to the Little River. Ascending the Little River to its headwaters, it cuts nearly 22 miles through land to the head of Socastee Creek, thence follows the creek and Waccamaw River to Winyah Bay to complete a distance of 94.5 miles.

Before construction began in 1930 inland navigation between the Cape Fear River and Winyah Bay had been totally impossible. The depth of water in the Elizabeth and Little rivers and in Socastee Creek diminished to nothing at their heads, and in other places shallow channels and marshes could not be traveled by rowboats at low water. Where the land cuts were made, elevations reached 30 and 32 feet. The only navigation work along the route had been dredging in the Waccamaw River, authorized in 1880, to clear shoals as far as the town of Conway.

The project initiated in 1930 provided for a waterway 8 feet deep and 75 feet wide, which was completed in 1936. The next year Congress approved a channel 12 feet deep with a bottom width of not less than 90 feet. Applying to the Intracoastal Waterway from the Cape Fear River to Savannah, this legislation was in accordance with a Corps review report that recommended

enlarging that portion of the waterway to the same dimensions as already existed north to Norfolk. In 1938 provision was made for the construction of a yacht basin at Southport. Both project modifications were completed in 1940.[44]

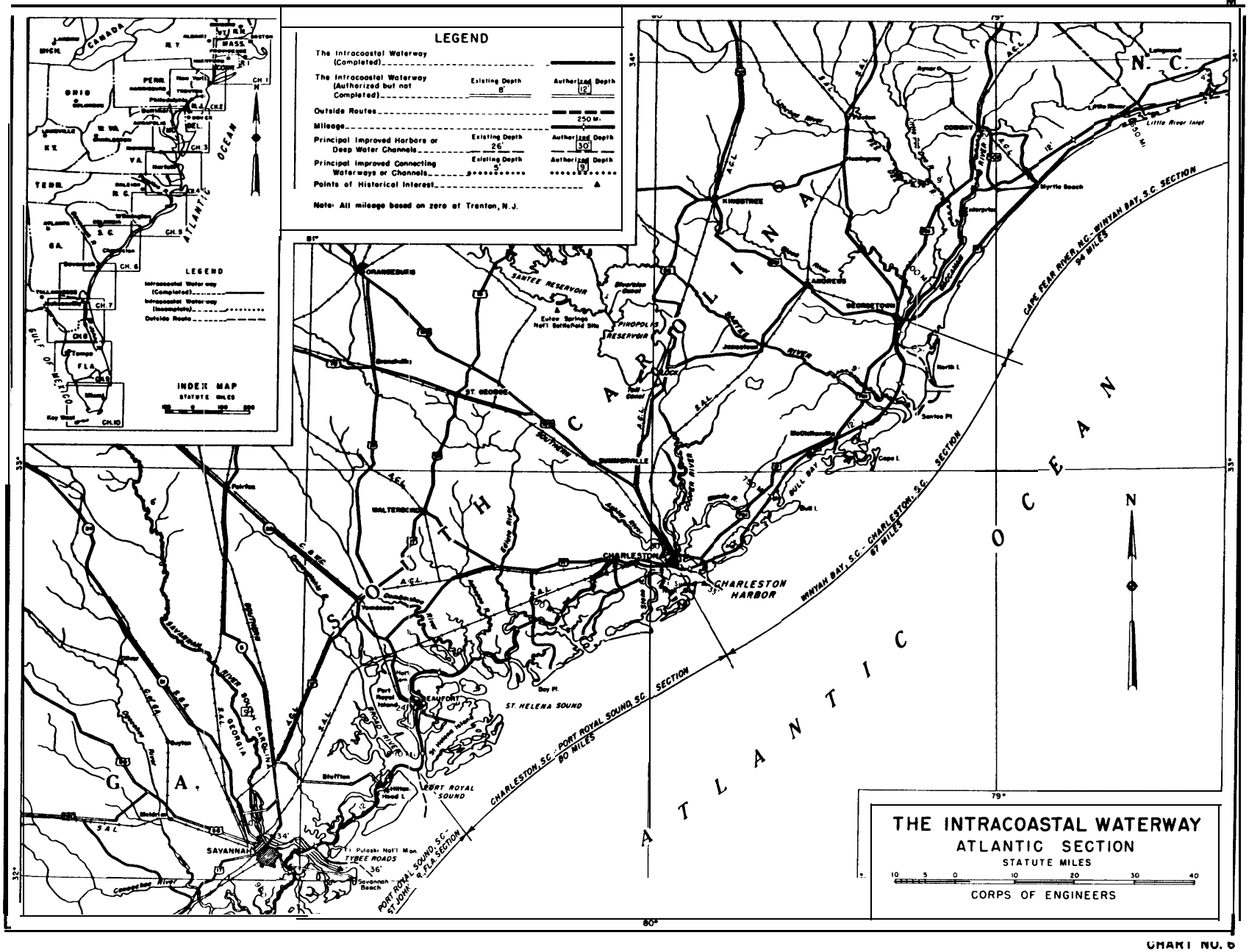
Waterway from Winyah Bay to Charleston, South Carolina

Leaving Winyah Bay 8 miles below the port of Georgetown, the Intracoastal Waterway passes through the Estherville-Minim Creek Canal to the North Santee River, cuts through Four Mile Creek to the South Santee River, and then threads through low coastal islands to Charleston Harbor, 63.5 miles away. For much of this course it follows a natural waterway, originally 86 miles long, that had allowed the passage of small vessels but was in many places obstructed by crooked channels and shallow reaches where low-water depths sometimes did not exceed a foot. More dangerous were stretches across Bulls Bay and near Cape Remain that were exposed to the sea.

Improvements on the waterway began in 1900 with the construction of the Estherville-Minim Creek Canal--6 feet deep, 70 feet wide, and 5 miles long--for the passage of Santee River steamers to Winyah Bay. A second project initiated in 1902 enlarged the channel from Charleston to the village of McClellanville, about two-thirds of the way to Winyah Bay, to 4 feet deep and 60 feet wide and rerouted it to eliminate the open stretch across Bulls Bay. 45 Nothing more was done until 1919, when the Corps extended these channel dimensions through to the Estherville-Minim Creek Carol along a course that avoided the exposed run near Cape Remain. In 1925 Congress authorized the cut across the Santee Delta at Four Mile Creek, which shortened the waterway by 10 miles. In 1932 the Corps recommended constructing a channel 10 feet deep and 90 feet wide, generally following the existing route. This project was included in the Public Works Program launched in 1933 to stimulate the economy, was adopted by Congress in 1935, and was completed the next year. In 1937 the legislation establishing uniform dimensions for the Intracoastal Waterway from the Cape Fear River to Savannah increased the project depth to 12 feet. Three years later this work was completed.[46]

Waterway from Charleston to Beaufort, South Carolina

At Charleston Harbor the Intracoastal Waterway passes from the Ashley River through the Wappoo Cut and continues along a sinuous string of tidal streams and land cuts 66.5 miles to the Beaufort River at Beaufort, South Carolina. Better endowed than the inland water course to the north, the original natural waterway between Charleston and Beaufort had a minimum depth of 6 feet interrupted at only four places and, except for a 6-mile passage across St. Helena Sound, was well protected from the sea.



The Intracoastal Waterway: South Carolina

Early work on the waterway tackled its most bothersome stretches. The first undertaking was at Wappoo Cut, a crooked and shallow creek joining the Ashley and Steno rivers. By dredging and by a cutoff bypassing some of the worst bends, a project authorized in 1881 created a channel through the cut 6 feet deep and 60 feet wide. At the other end of the waterway, a project adopted in 1890 improved Brickyard Creek. A continuation of the Beaufort River, Brickyard Creek had a fairly good 7-foot channel except near its juncture with the Coosaw River, where the channel practically disappeared among shoals. Work completed in 1905 provided the creek with a through 7-foot channel of '"convenient width." A third improvement, made in 1905-1906, was the construction of Fenwicks Island Cut in the central portion of the waterway. Replacing a narrow, tortuous, and shallow passage through Mosquito Creek, the cut, 7 feet deep and 90 feet wide, connected the South Edisto River with the Ashepoo River.

In 1925 Congress consolidated these improvements into a single project for a waterway from Charleston to Beaufort 7 feet deep and not less than 75 feet wide. Completed in 1929, the Corps ' work consisted mainly of widening and deepening the channel in Steno River, where in places the low-water depth had been 4 feet; constructing another cutoff at Wappoo Cut to eliminate a sharp curve; and cutting a new channel between the Dawho and South Edisto rivers to avoid more sharp bends and shorten the waterway by 9 miles. In 1931 a Corps report recommended eliminating the exposed passage across St. Helena Sound by excavating two short cuts through the marshes between the Ashepoo and Coosaw Rivers. This work, authorized under the Emergency Relief Appropriation Act of 1935 and included in a rivers and harbors act later in the year, was completed in 1936. In 1937 the Corps resumed construction on the entire waterway between Charleston and Beaufort to bring the channel to the 12-foot-deep, 90-foot-wide dimensions authorized that year for the Intracoastal Waterway from the Cape Fear River to Savannah. The Engineers completed this alteration in 1940.[47]

Waterway between Beaufort, South Carolina, and St. Johns River. Florida

Between Beaufort, South Carolina, and the St. Johns River the Intracoastal Waterway consists mostly of natural water courses through sounds and tidal marshes. Several artificial cuts help shorten the route and avoid exposed localities. Two hundred and seven miles long, this section offers intermediate connections with Port Royal, South Carolina; Savannah, Darien, and Brunswick> Georgia; and Fernandina, Florida. Even before improvement of the waterway, light-draft boats had carried considerable commerce between Beaufort and Savannah. Between Savannah and Fernandina, where the controlling depth of water was three feet, traffic had

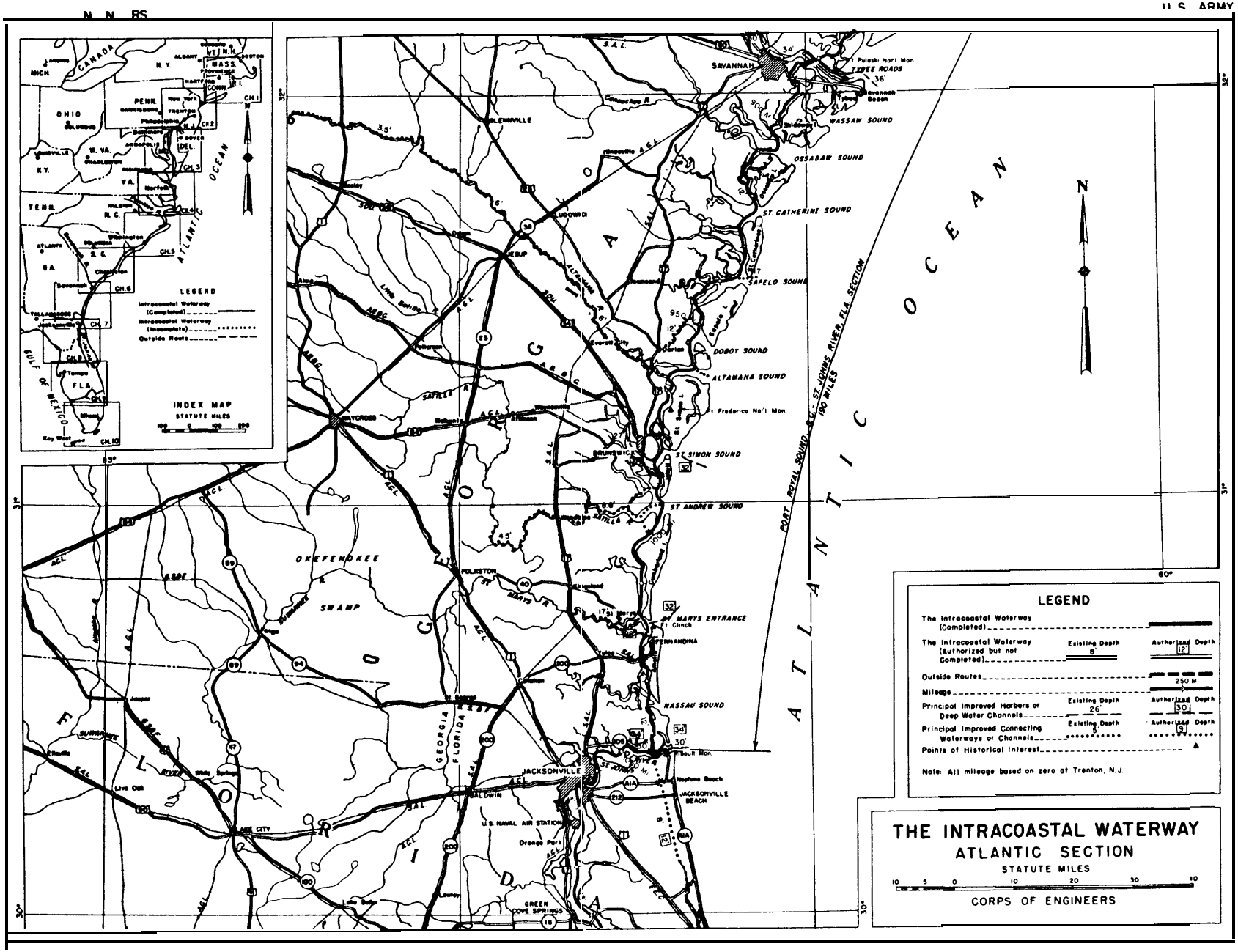
been lighter. Between Fernandina and the St. Johns River, which the waterway enters a few miles from its mouth, nature had neglected to provide a through channel, but private interests opened a shallow passage early in the nineteenth century by making cuts to connect streams paralleling the coast.

Until 1917 the Corps improved these three reaches of the waterway under separate authorizations. Work began on the section between Fernandina and the St. Johns River. Between 1828 and 1839 the Army Engineers dredged shoals at several places, chiefly in the cuts. Nothing more was done until 1874 when Congress called for dredging between the St. Johns River and Nassau Inlet in order to provide a better outlet for the commerce of the St. Johns than across the treacherous bar blocking the river's mouth. Six years later, however, upon the adoption of plans for improving the entrance of the St. Johns, the project was abandoned. The channel soon shoaled to 2.5 feet and remained in this condition until 1913. That year Congress authorized a new project, completed in 1915, to open a waterway between Fernandina and the St. Johns River 7 feet deep and 100 feet wide.[48]

Between Savannah and Fernandina the first navigation improvements deepened passages at Romerly Marsh in 1882 and at Jekyl Creek in 1888. In 1892 work began on a through 7-foot-deep channel. A separate project of 1905 improved Skidaway Narrows, a twisting and shallow passage near Savannah that was much used in preference to the regular route because it was safer in bad weather and shorter. In 1912 Congress incorporated the Narrows and four other water courses used as alternate routes or auxiliary channels into the Savannah to Fernandina Waterway.[49]

Work between Beaufort and Savannah began in 1896 with a project to deepen the natural waterway between the two communities to 7 feet throughout its course. Because current plans for improving Savannah Harbor included closing old entrances of the waterway, a new entrance was to be cut into the Savannah River near its mouth. Three years later, however, the waterway was re-routed to move the entrance upriver to a less exposed locality. In 1912 a similar change of route was made where the waterway entered Beaufort River to bring it into the shelter of Parris Island. Twenty-five years later this passage was abandoned in favor of the deeper water of Port Royal Sound.[50]

The Rivers and Harbors Act of 1917 consolidated the projects on the three reaches into the "Waterway between Beaufort, S.C., and St. Johns River, Fla." All work under the new authorization, which included several cuts that considerably shortened the



The Intracoastal Waterway: Savannah to Jacksonville

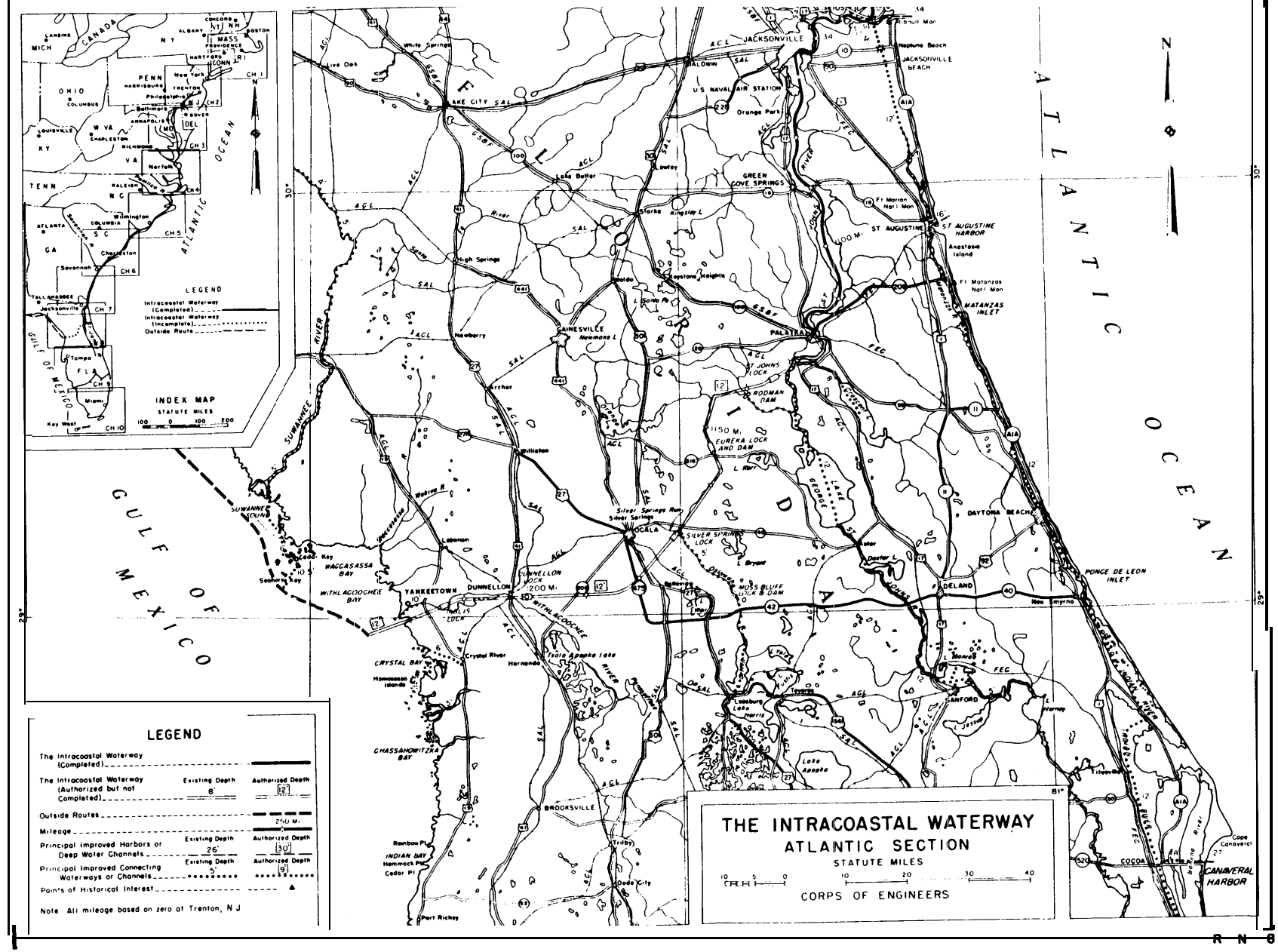
length of the waterway, was completed in 1932. In 1937 the waterway as far as Savannah came under the provision of that year for establishing a 12-foot-deep, 90-foot-wide channel from the Cape Fear River. The next year, upon the request of carriers, Congress authorized the extension of the 12-foot channel to the St. Johns River, work which the Corps completed in 1941. Between 1919 and 1945 Congress also provided for the construction of an anchorage basin at Thunderbolt, Georgia, and for the incorporation into the project of five more ancillary channels connecting with intermediate points or offering more protected passages.[51]

Intracoastal Waterway, Jacksonville to Miami, Florida

The Intracoastal Waterway from Jacksonville to Miami extends down the St. Johns River from Jacksonville to the entrance of Pablo Creek, a few miles from the river's mouth, and then follows an almost continuous series of protected waterways just inside the coast to Miami on Biscayne Bay for a total of 370 miles.

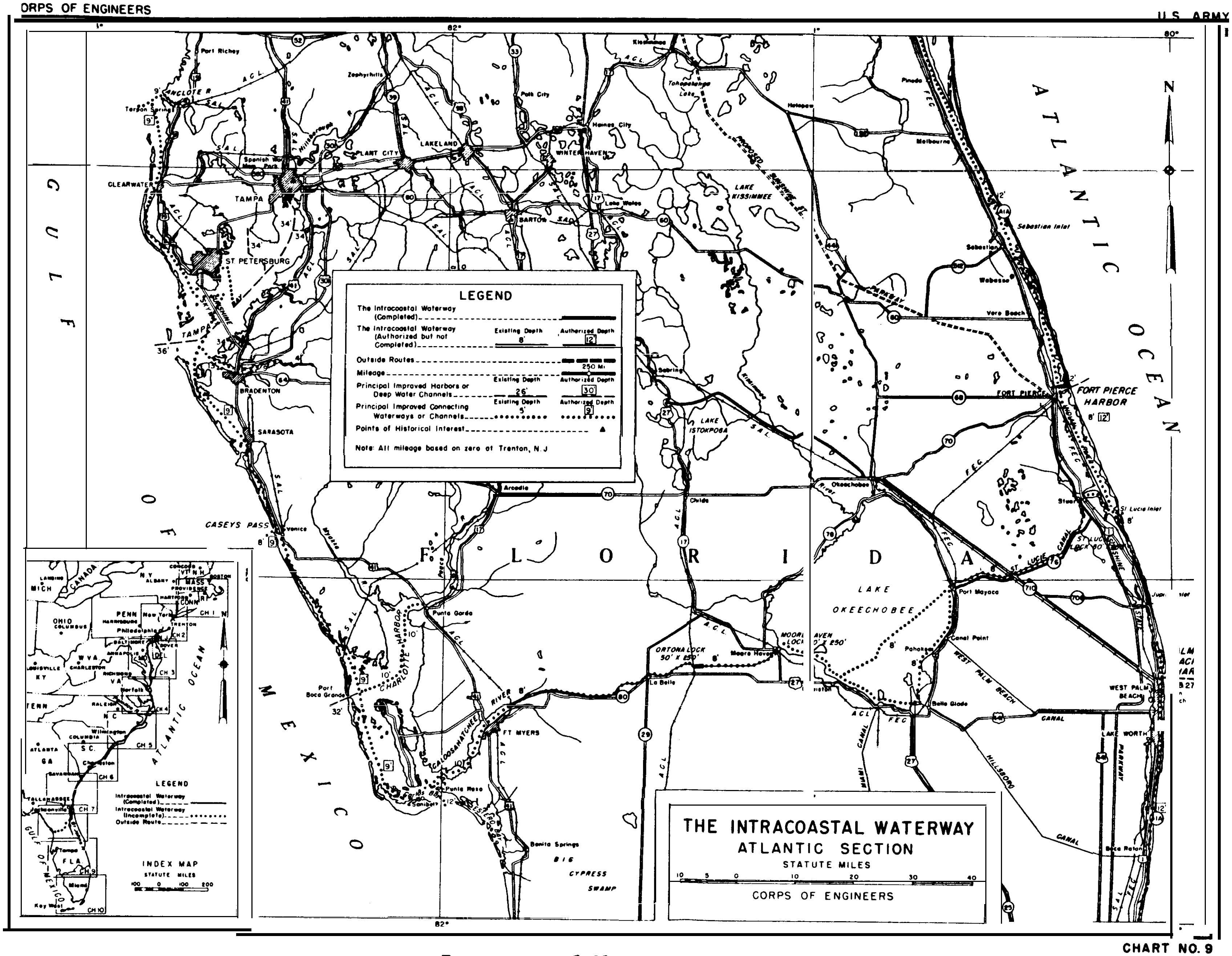
Early federal projects on this lengthy course were restricted to Indian River, a 128-mile-long lagoon lying between the mainland and barrier islands midway along the waterway. The first, prompted by logistic problems during the Second Seminole War of 1835-1842, was the construction in 1853-1854 of a small canal 8 feet wide, 2 feet deep, and less then half a mile long at a portage called the Haulover between Mosquito Lagoon and Indian River to permit the Army to transport supplies by flatboats down the waterways without having to lug them across an intervening sand barrier. With little permanent population in the region, the small passage soon fell into disrepair. By 1892, however, settlements along the Indian River had developed to the extent that a project was initiated for clearing a 5-foot-deep, 75-foot-wide channel for steamers through the river's most obstructed section between Goat Creek and Jupiter Inlet. Small dredging projects authorized in 1894 and 1896 opened Indian River Inlet and Jupiter Inlet for passage of small vessels to the sea.

The development of a continuous waterway along Florida's east coast was left to private enterprise. In 1883 the Florida Coast Line Canal & Transportation Company began construction from the St. Johns River to Biscayne Bay that continued until 1912, when the last section of the Florida East Coast Canal was completed. By charter requirements the company was to provide a channel 5 feet deep and 50 feet wide, but whether because of inadequate toll receipts or greater interest in profiting from the sale of lands granted by the state to subsidize construction, it failed to maintain these dimensions.

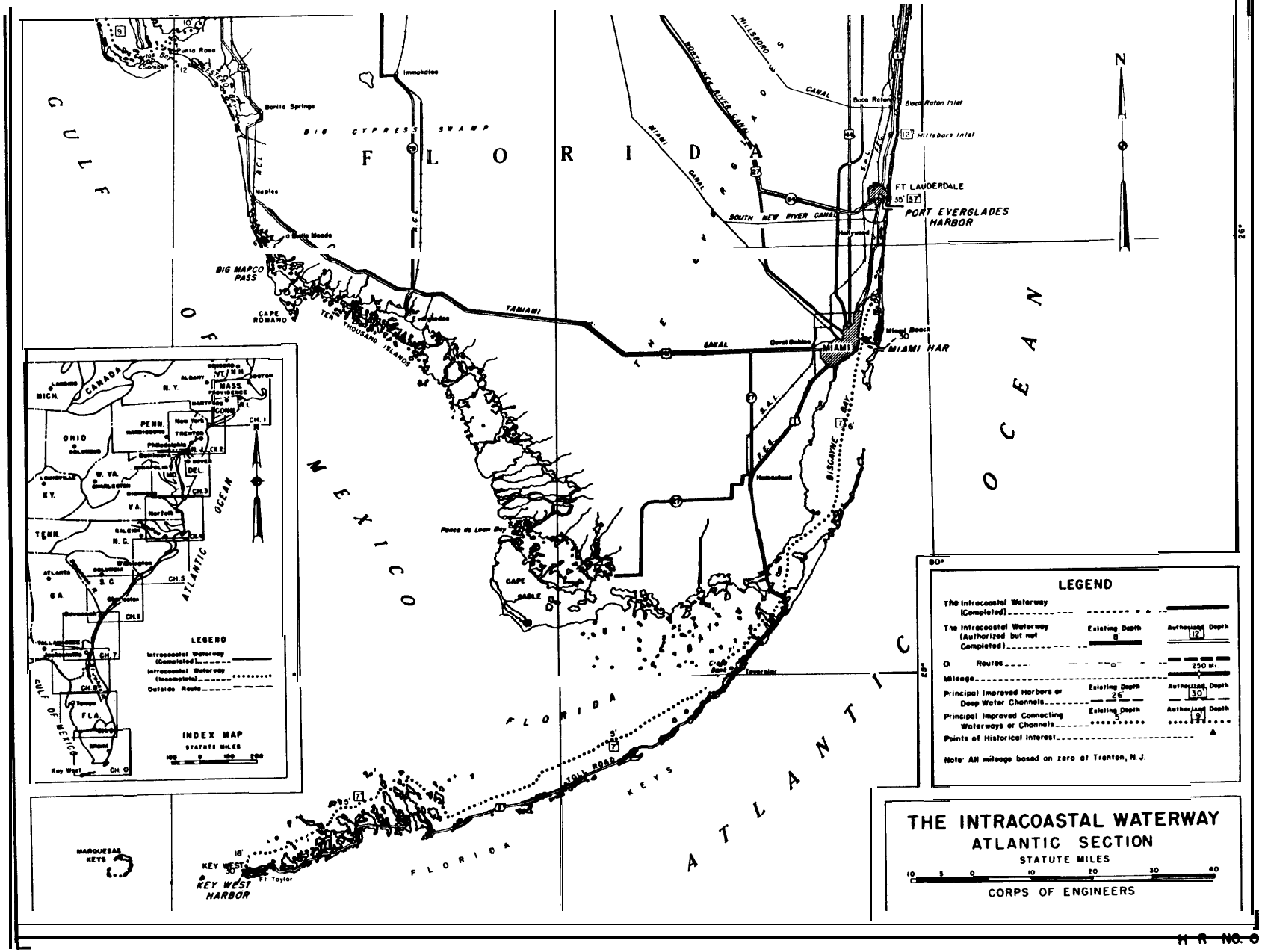


R N 8

Intracoastal Waterway: Florida



Intracoastal Waterway: Florida



H R NO. 6

Intracoastal Waterway: Florida

In 1915 Congress directed the Corps of Engineers to examine the advisability of purchasing the canal and converting it into a more usable waterway. The canal company was willing to sell its rights for $2 million, but the survey board advised against the purchase. Taking the same position as had the Chief of Engineers in relation to the intracoastal waterway surveys made a few years before, the board did not believe that commerce along Florida's still sparsely populated east coast would develop sufficiently within a reasonable period to justify the large expense. In 1920 Congress ordered a second survey. Not reporting until 1926, the Corps found a markedly changed situation. Noting that between 1920 and 1925 the population of Florida's east coast counties had increased more than 70 percent and that the Florida East Coast Railway could not provide adequately for the movement of perishable crops, the Corps now advised that the development of the waterway was warranted. It recommended the construction of an 8-foot-deep, 75-foot-wide channel (modified in 1930 to 100 feet wide) from Jacksonville to Miami, provided that local interests acquired the Florida East Coast Canal and the necessary rights of way and transferred them free of cost to the United States.[53]

Congress approved the project in 1927, and in 1929 a Florida Inland Navigation District created by the state purchased the canal properties and conveyed them to the United States. Financed in large part by Public Works funds, the construction of the waterway was completed in 1935. Ten years later, in response to objections by local interests that common carriers found it unprofitable to operate on regular schedules in an 8-foot channel, Congress authorized a channel 12 feet deep and 125 feet wide. In 1960, however, an economic study report led to a reduction of the project depth to 10 feet for the portion of the waterway between Fort Pierce and Miami. These channel modifications were completed in 1965. Extending through a now populous and recreationally popular coastal strip, the waterway from Jacksonville to Miami is dotted with private and municipal wharves and piers for freight and recreational craft, makes intermediate connection with the deep-water ports of Fort Pierce, Palm Beach, and Port Everglades, and connects with ten yacht basins open to the public.[54]

Intracoastal Waterway, Miami to Key West, Florida

In 1935 Congress authorized the continuation of the Intracoastal Waterway, with a channel 7 feet deep and 75 feet wide, from Biscayne Bay through Card, Barnes, and Backwater sounds into Florida Bay as far as Cross Bank at the southern end of Key Large, 63 miles from Miami and 94 miles short of Key West. A Corps survey report of 1932 justified the extension only to that point, where it would connect with Key Largo and

neighboring Plantation Key, the largest of the Florida Keys and the most important in fish and agricultural production. The survey found that the depth of water in Biscayne Bay and the sounds to the south was generally 10 to 12 feet and in the eastern end of Florida Bay 7 feet, but scattered shoals interrupted through navigation. Dredging through the shoals to construct a 7-foot channel to Cross Bank would cost relatively little. But the cost would be too great and the benefits too uncertain to justify extending the channel to Key West. For 53 miles from Cross Bank to Bahia Honda the controlling depth of water was 5 feet and for 41 miles from Bahia Honda to Key West only 2.5 feet, conditions that would require almost continuous dredging. The dredging to Cross Bank was accomplished in 1938-1939, with the width of the channel increased to 90 feet at no additional cost.

In 1945 Congress authorized the extension of the 7-foot channel to Key West. A Corps review report, completed in 1942, had advised that the channel would not only be of commercial benefit but would facilitate the activities of the federal military and civil agencies located at Key West. Funds for the work, however, never materialized. In 1963 an economic study report concluded that the extension was not economically justified, and this last stretch of the Intracoastal Waterway was placed in the inactive category. [55]

THE "MISSING LINK"

With the completion of the channel from Miami to Cross Bank in Florida Bay in 1939, the Intracoastal Waterway along the Atlantic coast reached its present length. But there is a "Missing Link," as it has been labeled by the Atlantic Deeper Waterways Association. The through navigation envisioned by Gallatin is interrupted between New York Bay and the Delaware River, where once the Delaware and Raritan Canal had carried more traffic than the famous Erie.

After 1872 the volume of coal entering the Delaware and Raritan Canal, which had comprised more than 80 percent of its tonnage, steadily declined. The Philadelphia and Reading Railroad, which now controlled many of the Schuylkill mines, preferred to ship anthracite to New York by rail or by barges towed along the outside route. The Pennsylvania Railroad, which in 1871 leased the canal to acquire affiliated railway rights across New Jersey, favored shipments by rail rather than canal and was apparently indifferent to the decline of traffic on its waterway. Despite criticism of the railroads by waterways advocates, the canal could in fact no longer accommodate barges of the size necessary for the economical transportation of freight by water. Freight revenues in the twentieth century

fell below those from pleasure craft. In 1933 the canal ceased operations, and the next year the railroad gave its rights to the waterway to the state.[56]

The failure of the Delaware and Raritan Canal to meet the requirements of modern water transportation caused the city of Philadelphia, in 1894, to commission an investigation of feasible ship canal routes across New Jersey. Reporting the next year, the commission favored a route from Bordentown to Sayreville near the mouth of the Raritan River, located to the south of the existing canal and following a more direct course across the state. Because of land elevations on the route ranging from 75 to 100 feet, it did not propose a sea-level canal, but one equipped with three locks at each end.

Philadelphia took no further action, and the scheme for a ship canal remained in abeyance until the Corps intracoastal waterway surveys initiated in 1909. Like the Philadelphia commission, the special board conducting the surveys ruled out the purchase of the Delaware and Raritan Canal. Topographical and geological conditions, the existence of numerous bridge crossings, and its route through the business center of Trenton were all too unfavorable for its conversion to a ship canal. The board recommended the construction of a 25-foot-deep sea-level canal close to the route proposed by the Philadelphia commission. It estimated the cost at $45 million and advised that construction should be deferred until the two sections of the waterway to the south were completed. Chief of Engineers Bixby, unconvinced of benefits to the general public sufficient to warrant that great an expense, recommended a 12-foot-deep locked canal at a cost of $20 million. It should be constructed to permit future enlargement, but as the benefits accruing from the use of heavy-draft boats would be mainly local, this cost should be met through provisions of local cooperation. The Board of Engineers for Rivers and Harbors advised against constructing either canal, but suggested that if one were built, the United States should foot only half the bill.[57]

Four more Corps reports on the New Jersey ship canal between 1920 and 1936 failed to produce a favorable recommendation. Prospective commercial benefits never caught up with escalating costs. By 1920 the estimated cost of a 12-foot-deep locked canal had risen to $40 million and that of a 25-foot-deep sea-level canal to $86 million. By 1930 the cost of a sea-level canal only 12 feet deep was $100 million. In 1934 a congressional request for data on a waterway with a minimum depth of 25 feet resulted in plans that discarded the concept of an open sea-level waterway and recommended a canal with a summit level of 10 feet reached by locks and dams in the Delaware and Raritan rivers. Studies had developed the essential requirement that the canal

must be designed to prevent an intolerable intrusion of salt water into the Delaware River, upon which Philadelphia and other communities were dependent for water supplies. The estimated cost of the waterway was $210 million.[58]

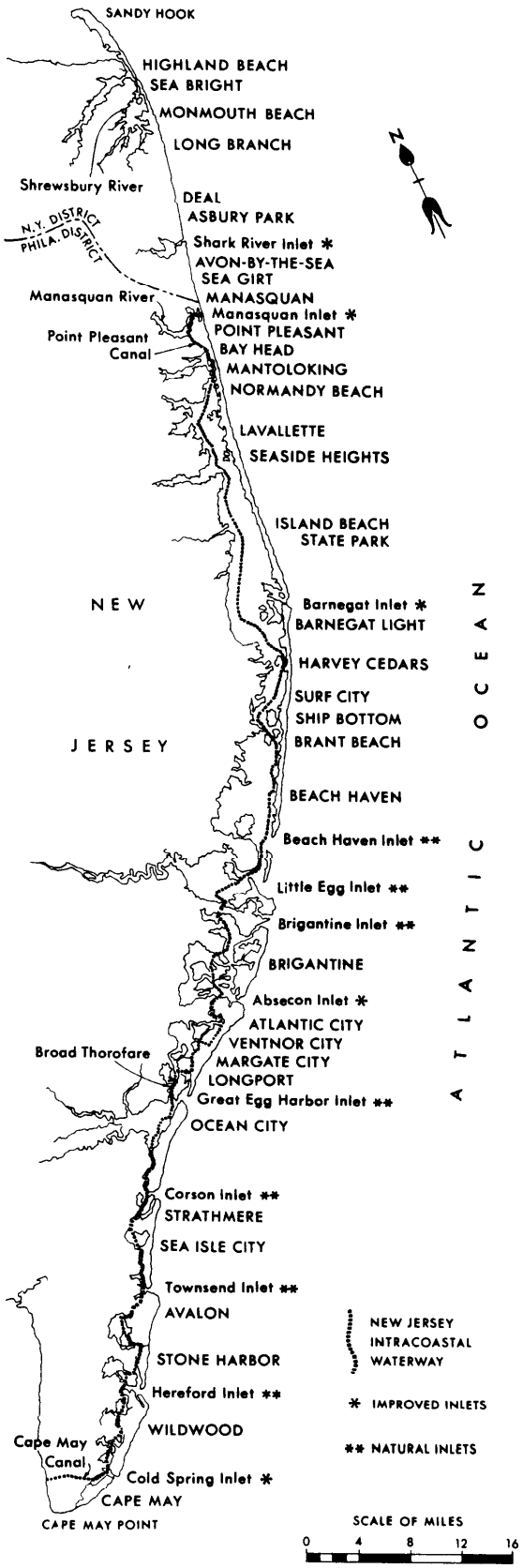
It took the submarine menace of World War II to draw from the Corps, in 1942, a favorable, though divided, review report. The Board of Engineers for Rivers and Harbors concluded that the value of a barge canal in time of war, together with prospective benefits in normal times, warranted the construction of a 14-foot-deep canal at an estimated cost of $145 million. Lieutenant General Eugene Reybold, the Chief of Engineers, believing that the war had demonstrated the value of a ship canal that could be built for only 29 percent more, recommended the construction of the 27-foot-deep locked canal for which plans had been drawn.[59] No further reports on the New Jersey ship canal have been completed, and the "Missing Link" in the Intracoastal Waterway is not likely soon to be forged. Changing concepts of war have lessened the military incentive for the canal, and the large problems of cost in relation to benefits and of salt water intrusion still remain.

The New Jersey Intracoastal Waterway

Lacking a route across New Jersey, light-draft boats may take a sheltered passage down most of the New Jersey coast and into the lower end of Delaware Bay by the New Jersey Intracoastal Waterway. Beginning at Manasquan Inlet, 26 miles south of Sandy Hook, the waterway passes through the 2-mile Point Pleasant Canal to the head of Barnegat Bay, follows a series of bays, lagoons, and thoroughfares inside the New Jersey barrier islands to Cape May Harbor, thence crosses the southern tip of the state by the 3-mile Cape May Canal to enter Delaware Bay about 3 miles above Cape May point. The state of New Jersey constructed the waterway from Manasquan Inlet to Cape May Harbor, a distance of 106 miles, between 1908 and 1918. Although the authorized dimensions were 100 feet wide and 6 feet deep, the state dredged portions of the channel to depths of 10 and 12 feet. The Corps of Engineers dredged the Cape May Canal, a cut 12 feet deep and 100 feet wide, with Navy Department funds in 1942 as an emergency wartime measure to facilitate transportation along the coast.

In 1945 Congress adopted the New Jersey Intracoastal Waterway as a federal project and authorized a through channel 12 feet deep and generally 100 feet wide. The rationale for the project was that it would bring substantial recreational and commercial benefits and that the waterway was an essential part of the intracoastal route from Boston to Miami. Funds for dredging the 12-foot channel from Manasquan River to Cape May Harbor, however, were not forthcoming, and that portion of the project was soon

The Intracoastal Waterway: New Jersey



U.S. Army Corps of Engineers

deferred for restudy. The Corps maintains portions of the channel north of Cape May Harbor at the 10- and 12-foot depths originally dredged by the state, but elsewhere the controlling depth of the waterway is about 3 feet. Commercial traffic on the waterway, consisting in 1979 of 87,012 tons of fish and shellfish, is of minor importance.[60]

CONCLUSION

Two centuries of navigation development on the Atlantic seaboard has seen river improvement and canal construction to provide inland transportation, harbor improvement to serve foreign and coastwise commerce, and the construction of an intracoastal waterway to offer a sheltered passage the length of the coast. Influenced by changing commercial needs and political climates, this development has followed an uneven course.

During the colonial era the difficulty and often prohibitive cost of land transportation forced Americans to depend on waterways for travel and trade. Local authorities sometimes attempted navigation improvements, but the known instances are few. Atlantic harbors were deep enough in their natural states for the small ships of the time and mostly well sheltered. Numerous rivers were navigable by sloops for long distances inland, and above the head of sloop navigation shallow-draft boats could reach most communities.

American independence brought a need for better inland water communications. The interruption of coastwise shipping during the Revolution revealed the inadequacy of transportation facilities north and south along the seaboard. A surge of population westward to the Appalachians and beyond created a demand for better east-west connections. Soon the economic life of the nation quickened everywhere. Turnpike construction begun shortly after the Revolution greatly improved overland travel, but as goods still moved far more cheaply by water than by land, Americans continued to depend wherever possible on water routes. Private companies and state agencies set out as early as 1784 to improve river navigation, largely by constructing locks and canals at falls. Extensive construction of longer overland canals did not get under way until the 1820s, after the builders of the Erie Canal demonstrated that such huge undertakings were technologically and economically feasible. The river improvements frequently failed to bring significant results, but the dozen and a half major canals built along the seaboard helped greatly to fulfill transportation requirements of the age. Within a few decades, however, competition from railroads, which revolutionized land transportation, brought canal building to an end.

Albert Gallatin and other statesmen of broad national vision hoped to combine the many early nineteenth-century schemes for canals and roads into a coherent national system under the sponsorship of the federal government. But their plans met with only partial success. State and sectional jealousies, constitutional scruples, and partisan politics stood in the way of effective federal action. Federal appropriations helped build specific roads and canals, and the Army Corps of Engineers assisted in planning many internal improvements. But the transportation system in America was mostly shaped by the narrower interests of state governments and private enterprise.

The federal government did assume responsibility for river and harbor improvement. Work of a significant nature, performed by the Army Engineers, began in 1824 in response to greatly increased shipping activity. But the federal endeavors were fitful and of uncertain future for several decades. The political forces that obstructed federal development of roads and canals also impeded systematic navigation improvement. After the Civil War, however, a constantly growing volume of waterborne commerce carried in increasingly larger ships and a new political climate in the nation assured a strong federal role in river and harbor development. As an unprecedented program of navigation work continued to expand until about 1914, the Corps of Engineers improved almost every river and harbor on the East Coast that was expected to provide commercial benefits justifying the cost. Work then sharply declined for a decade-and-a-half and centered mainly on waterways of major commercial importance. In the 1930s public works spending and larger regular appropriations, which nearly doubled navigation work on the East Coast, restored a broader program. Interrupted by World War 11 and the Korean War, river and harbor improvement on the eastern seaboard resumed on a significant scale in 1956 and then gradually diminished. In 1980 the Corps of Engineers did not initiate a single new navigation project from Maine to Florida. By this time, however, they had deepened major Atlantic ports to 35 to 45 feet to accommodate deep-draft oil tankers and other large vessels. They had also improved numerous smaller ports important to the coastwise trade and harbors important to fishing fleets and recreational craft.

The Atlantic Intracoastal Waterway, conceived by Albert Gallatin in 1808, was not essentially completed until the 1930s. It is a hybrid creation comprised of two widely separated ship canals north of Norfolk, Virginia, and a string of barge canals south of that port. Although Gallatin and other advocates had in mind the advantages of a through route, the waterway came into being through a series of local projects developed in expectation of local benefits. Long-distance shipments along the seaboard are cheaper and quicker by large

coastwise vessels than by vessels suited to the restricted channels south of Norfolk. Commerce through the ship canals consists mostly of coastwise and foreign traffic en route to northern and Middle Atlantic ports. Commerce south of Norfolk is entirely domestic and mostly short haul, tributary to the nearest commercial centers and seaports. Although not a thoroughfare over which the goods of the North and South are exchanged, as envisioned by early planners, the waterway nevertheless carries large amounts of freight and is heavily used by recreational vessels.

HISTORICAL CHRONOLOGY OF ATLANTIC COAST WATERWAYS

1524 - Giovanni da Verrazano, a Florentine mariner seeking the Northwest Passage for the king of France, was the first navigator of whom we have definite record to coast the Atlantic seaboard from the Carolinas to Newfoundland. He put into New York Bay and Narragansett Bay.

1525 - Estevan Gomez, a Portuguese in Spanish service out to find the passage, discovered a number of rivers and bays from Cape Breton to Cape Cod, including the Penobscot River, which he followed to the head of navigation at the site of Bangor. He may have sailed as far south as Florida, but the record is not clear.

- While Gomez was sailing south for the Spanish king, Lucas Vasquez de Ayllon sailed north from the Spanish colony of Santo Domingo with a flotilla of five ships to find the passage and establish a colony. His colony, apparently located on the Cape Fear River, was decimated by fever and a difficult winter, and only a remnant of his expedition made it back to Santo Domingo.

1527 - John Rut, sailing for England to find the passage, searched the coasts of Cape Breton Island in Nova Scotia, and New England. He continued to the West Indies, but whether he explored more of the coast is not known.

1579 - Simon Ferdinand and John Walker, sent by Sir Humphrey Gilbert to find a site for a colony, explored Penobscot Bay and possibly Narragansett Bay in 1579-1580.

1584 - Simon Ferdinand, Philip Amadas, Arthur Barlowe, and Sir Richard Grenville, employed in 1584-1585 to establish a settlement for Sir Walter Raleigh (the ill-fated Roanoke Colony), found inlets through the Carolina banks, explored Pamlico and Albemarle sounds, and ascended several rivers flowing into them. Ferdinand also appears to have put into Chesapeake Bay, claiming to have been there before with Spanish mariners.

1585 - Settlers from the Roanoke Colony, rounding Cape Henry in a small boat, explored the southern shore of Chesapeake Bay, Hampton Roads, and the lower estuary of the York River.

1588 - Vicente Gonzales, sent to reconnoiter the Roanoke Colony, which Spain intended to destroy and replace with a Spanish settlement, unknowingly sailed past the inlets to the colony and on into Chesapeake Bay, which he explored to its head.

1602 - Bartholomew Gosnold, employed by English merchants, explored the New England coast from southern Maine to Buzzards Bay. He named Cape Cod, Martha's Vineyard, and the Elizabeth Islands, and established a temporary post on Cuttyhunk Island to barter with the Indians.

1603 - Martin Pring, on a similar trading expedition for English merchants, followed Gosnold's course but put into Massachusetts and Cape Cod bays, which Gosnold had sailed by. For some five weeks he operated a trading post at a good anchorage formerly identified as Plymouth Harbor but now thought to be Provincetown Bay.

1604 - Samuel de Champlain, searching for a site for a French colony and for the Northwest Passage, made three voyages between 1604 and 1606 on which he explored and charted the coast from Cape Breton Island to southern Massachusetts. More systematic than his predecessors, he navigated the Penobscot River and the lower reaches of the Kennebec, entered the harbors of Eastport, Machias, Gloucester, Boston, Plymouth, Barnstable, Nauset, and Chatham, and sailed through Vineyard Sound as far as Woods Hole.

1605 - George Waymouth, who three years earlier had looked for the Northwest Passage in icebound waters to the north, came to the coast of Maine to find a colonial refuge for English Catholics and fishing grounds for his merchant backers. He discovered Monhegan Island and an anchorage that he named St. George's Harbor.

1607 - Captain John Smith, under orders from the Virginia Company to find a passage to the Pacific Ocean, went up the James River and the tributary Chickahominy River looking for a lake at its source that Englishmen believed lay just beyond the Blue Ridge Mountains and fed rivers leading to the Pacific.

1608 - Continuing to look for the passage to the Pacific as well as for sites for new settlements, Smith explored numerous bays and creeks in Chesapeake Bay and ascended the Potomac, Patapsco, Sassafras, Patuxent, and Rappahannock rivers.

1609 - Henry Hudson, seeking the passage to the Orient for the Dutch East India Company, and using maps sent by John Smith, entered New York Harbor and followed the Hudson River to the head of navigation above Albany. He opened the way for the Dutch fur trade and the settlement of New Netherland.

1614 - Captain Adriaen Block, sailing a small vessel built on Manhattan Island, entered Long Island Sound through the Hell Gate and navigated the southern New England coast as far as Massachusetts Bay. Discovering the Connecticut River, he sailed to the head of navigation at Hartford.

- Captain Cornelis Jacobsen Mey, another Dutch navigator, charted Delaware Bay and bestowed his names on the Delaware capes.

- Captain John Smith meticulously explored the shores and waterways of New England (which owes its name to him) from Penobscot Bay to Cape Cod. His Description of New England, published in 1616, contained the most accurate maps and descriptions made up to that time.

1662 - The Dutch at New Amsterdam built a small breakwater to protect ships from ice floating from the Hudson River. Few other references to harbor improvement during the colonial period are readily found.

1686 - An early local effort at river improvement was the deepening of the Connecticut River channel between Hartford and Wethersfield through the combined efforts of the adjoining towns.

1716 - Providing aids to navigation was more necessary and common during the colonial period than was harbor improvement. In 1716 the first American lighthouse began operation at the entrance to Boston Harbor.

1762 - A lottery was organized in New York to raise funds for erecting a lighthouse on Sandy Hook.

1763 - The colonial assembly of New York authorized the appointment of a master and three or more wardens for the port of New York to commission pilots, repair buoys, and maintain lighthouses.

1770 - Citizens of Pennsylvania and New Jersey appointed commissioners to improve navigation on the Delaware River between Trenton and Easton. The next year the Pennsylvania and New Jersey assemblies granted the commissioners legal status. Funding, however, continued to be by subscription.

1773 - New Jersey residents raised 3,000 pounds by lottery to clear and deepen the channel of Elizabeth-Town Creek so that boats might be brought to a landing in the center of the town.

1774 - The first recorded harbor dredging on the Atlantic coast was the deepening of ship berths at Philadelphia by a horse-powered grab dredge.

1775 - The American Revolution revealed the isolation of the colonies from one another and the difficulties of moving goods along the seaboard when the ship traffic was interrupted. The Revolution also saw more western migration. Both developments created incentives for better transportation facilities.

1784 - One of the earliest attempts at harbor improvement was dredging in Baltimore Harbor with a Dutch-type mud mill that raised spoil with long-handled scoops operated by man-powered treadmills. Some form of dredging is also said to have been attempted in the Thames River of Connecticut in 1785, in the Hudson River between Albany and Troy in 1799, and in the Delaware River at New Castle in 1803.

1785 - The state of Pennsylvania constructed timber piers in the Delaware River at Marcus Hook to provide ships a refuge from drifting ice. This was the first of a number of "ice harbors'* built in the Delaware River.

- The Potomac Canal Company was organized, with George Washington as president, to open the Potomac River to navigation as far as Cumberland, Maryland, from where it would connect by road to the Ohio River. Essentially a river improvement concern, the company undertook canal construction only to bypass falls. The canals, however, absorbed so much of its resources that the company made only minor improvements in the river.

- The James River Company was chartered to improve navigation on the James River and to link it by turnpike to the Kanawha River, a tributary of the Ohio. This enterprise also owed its conception to Washington.

1789 - The First Congress of the United States directed that all expenses for the maintenance and repair of lighthouses, beacons, buoys, and public piers should be paid for from the Treasury of the United States and that all contracts for work be made by the Secretary of the Treasury with the approval of the President. The Treasury assumed control from local authorities of the 12 lighthouses operating on the Atlantic coast.

1790 - Beginning in 1790 several states made harbor improvements under federal enabling acts. Georgia was permitted to levy tonnage duties to pay for work at Savannah Harbor;

Maryland to improve Baltimore harbor; Rhode Island to dredge Providence Harbor; and Pennsylvania to construct ice harbors in the Delaware River.

1792 - A stock company began construction of a canal around the falls on the Susquehanna River near Columbia, Pennsylvania, and improved navigation through rapids for about 17 miles below Columbia, allowing flatboats to bring produce from interior Pennsylvania and New York to Chesapeake Bay. The project was completed in 1798.

- Work began on a canal to surmount falls on the Connecticut River at South Hadley, Massachusetts, the first in a series of canals bypassing falls that opened flatboat navigation far into New Hampshire and Vermont. The system was completed when the Enfield, or Windsor Locks, Canal opened in 1829.

1793 - Construction began on the Dismal Swamp Canal to connect Albemarle Sound, North Carolina, with the Chesapeake Bay at Norfolk. Inexperience, inefficiency, and a paucity of funds retarded progress until federal engineering assistance and stock subscriptions totaling $200,000 helped transform a muddy ditch into a viable waterway opened in 1828.

1796 - A canal to circumvent falls in the Merrimack River was constructed at the future site of Lowell, Massachusetts--Americafs first textile city. By 1814 companies affiliated with the Middlesex Canal Company had constructed six systems of locks and canals at falls and rapids farther up the river. The project opened barge traffic to Concord, New Hampshire.

1798 - Congress approved the incorporation of a company by Massachusetts that would construct a pier at the mouth of the Kemebunk River in Maine to protect the channel.

1800 - The Union Company improved sloop navigation on the Connecticut River below Hartford by maintaining the channel through shoals. Like the companies that constructed canals around river falls, the Union Company was authorized to collect tolls.

- The Santee and Cooper Canal, begun in 1792, opened water transportation from the interior of South Carolina via the Santee River system and the Cooper River to Charleston. Twenty-two miles long, it was the first major canal constructed in the United States. It never became profitable. Railroad competition ultimately forced its abandonment in 1858.

1802 - Under the 1789 provision relating to navigation safety, Congress appropriated $30,000 for the Treasury to erect and maintain piers in the Delaware River. Accordingly, piers were constructed at New Castle, Delaware, to provide a harbor of refuge from floating ice.

1803 - The Middlesex Canal of Massachusetts, started in 1793, was completed. It permitted the trade of the Merrimack Valley to flow to Boston. Running 27 miles and passing through eight aqueducts and 20 locks, the canal represented the greatest feat of canal construction in America before the Erie. The Middlesex Canal was never profitable and succumbed to railroad completion in 1853.

1808 - Albert Gallatin, the U.S. Secretary of the Treasury, submitted a comprehensive plan to bind the new nation together with a government-sponsored system of roads and canals. He proposed the construction of an inland water-way along the Atlantic coast from Boston, Massachusetts, to St. Marys, Georgia. The principal work would be the construction of four canals, which he estimated would cost $3 million. He thought that his whole program could be completed in ten years.

1812 - The state of North Carolina chartered the Roanoke Navigation Company. The company constructed a canal around the falls of the Roanoke River at Weldon.

1815 - President Madison urged upon Congress the construction of roads and canals and suggested a constitutional amendment to invest the federal government with that authority.

- South Carolina and Georgia, each faced with competition after 1815 from western producers of cotton, launched ambitious programs for improving their waterways to lessen the cost of marketing crops. Both programs were poorly administered, and the shallow, swift, shoal-infested streams of the Piedmont never succumbed to the designs of the planners.

1816 - On November 16 Congress established the Board of Engineers for Fortifications, consisting of three Corps of Engineers officers and one naval officer, to choose sites and plan fortifications. The board and the Topographical Engineers gradually became involved in surveys relating to internal improvements.

- The state of Virginia created a Fund for Internal Improvement, to be administered by a Board of Public Works, through which navigation projects and the con-struction of roads, bridges, and railroads were carried out until the Civil War.

1817 - New York state began to construct the Erie Canal.

- A bill sponsored by Representative John C. Calhoun for federal funding of internal improvements squeaked through Congress, but President Madison, still believing in the need for a constitutional amendment, vetoed it.

1818 - Pennsylvania authorized the operators of the Lehigh coal mines to improve navigation on the Lehigh River in order to move their anthracite down the Lehigh and Delaware rivers to Philadelphia.

1819 - On January 7 Secretary of War John C. Calhoun submitted a plan, much like Gallatin's, for a national system of roads and canals. He emphasized the benefits for national defense and recommended the extensive use of Army Engineers in making surveys and plans. In hopes of attracting trade and developing a major seaport, North Carolina established a Board for Internal Improvements.

1820 - The Treasury Department constructed piers at the mouth of the Kennebunk River in Maine to improve the channel.

1822 - On May 7 Congress authorized the Treasury to construct a breakwater at the Isle of Shoals lying off Portsmouth, New Hampshire, and to erect piers at Cape Henlopen at the entrance to Delaware Bay to form a harbor of refuge.

1823 - President Monroe adopted the constitutional position that Congress could appropriate funds for internal improvements of national benefit if control of the improvement companies remained with the states. He also recommended that Army Engineers survey the routes for several canals to be built by private companies.

- The Corps of Engineers was called upon to plan the improvement of the harbor of Presque Isle, Pennsylvania, on Lake Erie and to design the piers at Cape Henlopen that Congress had directed the Treasury to construct.

1824 - On April 30 Congress passed the General Survey Act authorizing the President to employ Army and civil engineers to make surveys, plans, and estimates for roads and canals of national importance. President Monroe established the Board of Engineers for Internal Improvements to administer the act.

On May 24 Congress appropriated $75,000 for navigation improvements on the Mississippi and Ohio rivers. President Monroe assigned this work to the Corps of

Engineers, thus initiating the Corps' role in carrying out as well as planning waterway development. Two days later Congress voted further appropriations for improving the harbor of Presque Isle and for repairing Plymouth Beach, Massachusetts, which sheltered the town's harbor.

1825 - The Schuylkill Navigation, opened to traffic in 1825, and the Union Canal, opened in 1827, was a waterway system designed to bring to Philadelphia the trade of interior Pennsylvania and southwestern New York via the Susquehanna River and its tributaries.

- The Erie Canal was completed. The longest canal in the United States and the largest construction job yet undertaken in America, it funneled much of the commerce of the West to New York City. Even before its completion, sections opened to traffic as early as 1819 had phenomenal success and inspired a canal-building mania in the United States.

1826 - On May 20 Congress approved the first omnibus rivers and harbors act providing for more than 20 works and surveys. Congress passed similar bills annually thereafter through 1838. Fifty works of improvement were carried out along the Atlantic seaboard.

1827 - The Cumberland and Oxford Canal in Maine was completed. Connecting Sebago Lake with Casco Bay, the canal remained an important outlet for the products of southeastern Maine into the 1870s.

1828 - The Blackstone Canal, linking Worcester, Massachusetts, to Providence, Rhode Island, opened. A boon to the development of the area during its brief existence, it succumbed in 1847 to railroad competition.

- The Delaware and Hudson Canal, the northernmost of the "anthracite canals," opened to carry coal to New York and New England markets. The canal extended from Honesdale, Pennsylvania, to the Hudson River at Rondout.

- The Chesapeake and Ohio Canal Company was organized to construct a canal up the Potomac River Valley from Georgetown to Cumberland, Maryland. The canal did not reach Cumberland until 1850 and never achieved the goal of crossing the Appalachian divide with 264 locks and a four-mile tunnel. The canal did carry considerable tonnage and continued to be used into the twentieth century. Always suffering from railroad competition, it never became a profitable enterprise.

- The Dismal Swamp Canal between Chesapeake Bay and Albemarle Sound was the first of the four canals of Gallatin's proposed inland waterway to be completed. Already 15 years under construction by a private company when Gallatin issued his report, it became a viable enterprise only after receiving federal financial and engineering assistance in 1826.

1829 - The Chesapeake and Delaware Canal, connecting the Chesapeake Bay with the Delaware River, was the second of Gallatin's proposed chain of canals to open. It was constructed by a private corporation, which after a failing start in 1804-1805, resumed work in 1823. The company received engineering assistance from the Corps of Engineers in 1823 and federal financial assistance, through the purchase of company stock, in 1825 and 1829. The Chesapeake and Delaware reduced the distance of water transportation from Philadelphia to Baltimore by more than 300 miles and became a major carrier of the nation's waterborne commerce.

- The Lehigh Canal opened to barge Pennsylvania anthracite from fields at White Haven to the Delaware River at Easton.

1831 - The Morris Canal, connecting Newark Bay with the Delaware River at Easton, opened to transport anthracite to New York City and to stimulate agriculture and industry in northern New Jersey. The canal employed 23 *'inclined planes," or cable railways, to transport barges over an elevation of 914 feet. Although it could not handle boats of more than 25 tons, the canal did a considerable business and contributed materially to the economic development of the area.

1832 - Pennsylvania completed construction of the Delaware Division Canal, an anthracite canal connecting with the Lehigh Canal at Easton. The canal paralleled the Delaware River south to Bristol. From there barges could navigate the river to Philadelphia.

1834 - The Pennsylvania Main Line Canal, connecting Philadelphia with Pittsburgh on the Ohio River, opened to compete with the Erie Canal for western commerce. From Philadelphia to Columbia on the Susquehanna River, the transportation was by rail, as was a 36-mile crossing of the crest of the mountains by the Allegheny Portage Railroad. The Main Line did a considerable volume of business, but its construction and operation, together with a system of branch canals, virtually bankrupted the state before the canal and its branches were sold in the 1850s.

1835 - The James River Company was reorganized as the James River and Kanawha Company. Making the last attempt to connect the Atlantic to the West by canal, the company constructed a waterway nearly 200 miles up the James River Valley from Richmond to Covington. The company suspended work in 1856 for lack of funds and abandoned plans to pierce the Appalachian divide with a tunnel. Despite railroad competition the canal did a substantial business, but it never recovered financially from high construction costs.

The New Haven and Northampton Canal, built to divert the commerce of the Connecticut River Valley from Hartford to New Haven, opened.

Poorly constructed and constantly beset by difficulties, it was abandoned in 1847.

1838 - The Delaware and Raritan Canal, another anthracite canal, opened from Bordentown on the Delaware River to the Raritan River connecting with New York harbor. It was the third of Gallatin's proposed canals to be completed. For a few years it carried greater tonnage than did the Erie.

Congress in effect repealed the General Survey Act of 1824 by enacting legislation prohibiting the employment of Army Engineers by private companies.

Local and sectional rivalries, constitutional objections, partisan politics, and the Depression beginning in 1837 combined to signal an end to the annual rivers and harbors acts of the past dozen years. Projects carried out along the Atlantic seaboard included preserving natural harbor breakwaters by firming beaches and building seawalls, constructing artificial breakwaters and ice-breaker piers, dredging rivers and harbors, and erecting contraction works to deepen channels by the scour of concentrated water currents. Except for a limited measure in 1844 providing for works in the interior, there was not another general rivers and harbors act until 1852. Some appropriations continued to be made, but those for the East Coast were limited to a few minor projects justified by military requirements.

1840 - The Susquehanna and Tidewater Canal opened to circumvent rapids and falls extending some 40 miles up the Susquehanna River from the Chesapeake Bay. The canal represented Baltimore's bid to capture trade from Philadelphia. Traffic, which soon became heavy, flowed not only to Baltimore but also to Philadelphia by way of the Chesapeake and Delaware Canal.

1852 - On August 30 Congress appropriated in excess of $2 million for more than 100 works and surveys, 46 of which were on the East Coast. Thereafter, until the close of the Civil War, Congress voted appropriations for only seven improvements; four in the Middle West and three in the East.

1856 - The first national platform of the Republican Party included a declaration that appropriations by Congress for river and harbor improvements were constitutional and justified by the obligation of the government to protect the lives and property of its citizens.

- Construction began on the Albemarle and Chesapeake Canal, which opened to traffic three years later.

1860 - The tonnage of American ships engaged in all employments had increased from 1.2 million tons in 1830 to 5.4 million tons. The annual tonnage of American vessels entering and clearing American ports had increased between five and six times. The size of ships had also greatly increased. In 1830 a ship exceeding 400 tons was very large; by 1860 many vessels displaced 1,500 or more tons. These developments made the large-scale renewal of river and harbor work imperative.

1863 - A waterways convention called by 94 members of Congress brought 2,000 delegates to Chicago to demand improvements on the Erie Canal and other waterways. Such conventions, beginning as early as 1845, added to the pressures for a broad federal program of river and harbor improvement.

1864 - On June 28 Congress authorized the Secretary of War to expend $350,000 to repair harbors on the seaboard and the Great Lakes.

1866 - On June 23 Congress appropriated nearly $3.7 million for navigation improvements throughout the country. The development of waterways continued to expand until about 1914, during which time more than 500 rivers and harbors were improved on the East Coast. Work at major harbors in this period often raced with growing volumes of commerce and increasing size of ships.

1867 - On March 2 Congress authorized the first project to improve the main ship channel at Boston Harbor. This and several more projects through 1902 gradually enlarged the channel from 18 feet deep and 100 feet wide to 35 feet deep and between 1,200 and 1,500 feet wide.

- Work begun at Providence River and Harbor in 1852 was renewed. Under nine project modifications through 1910, the channel from Providence into Narragansett Bay, which originally had a controlling depth of 4.5 feet, was expanded to a 30-foot depth and 600-foot width.

1870 - Between 1870 and 1912 more than a half-dozen projects gradually increased the governing low-water depth of the Cape Fear River leading to the port of Wilmington, North Carolina, from 7.5 feet to 26 feet.

1871 - The Rivers and Harbors Act of March 3 resumed improvement of the Patapsco River channel to Baltimore harbor begun in 1853. Successive projects until 1905 increased the channel depth from 17 to 35 feet.

- A National Commercial Convention meeting in Baltimore launched a movement for the construction of a ship canal, which it hoped would be built by the United States government, between the Chesapeake and Delaware bays. As a result of entreaties by the canal's advocates, the Corps of Engineers between 1878 and 1883 made surveys of six alternative ship canal routes across the Delmarva Peninsula.

1873 - Projects adopted from 1873 to 1910 increased the channel depth of the Savannah River to the port of Savannah from 7 feet at mean low water to 26 feet.

1876 - Congress adopted the first project for the improvement of Norfolk Harbor. Further authorizations through 1910 provided for the gradual development of a 35-foot main channel from Hampton Roads to beyond the Norfolk Navy Yard on the South Branch of the Elizabeth River.

1878 - On June 18 Congress authorized the first in a series of projects running to 1910 that deepened the entrance channel to Charleston Harbor from 12 to 28 feet.

1883 - The Florida Coast Line Canal & Transportation Company began construction of the Florida East Coast Carol by dredging waterways paralleling the coast and connecting them with canals. The work was completed in 1912.

1885 - The first systematic and permanent improvement of the Delaware River to Philadelphia began with a Corps study in 1885. Between then and 1910, several projects increased the controlling depth of the channel from 17 to 35 feet.

1886 - The Rivers and Harbors Act of August 5 authorized the Corps to begin improvement of New York Harbor. Although the entrance channel had a controlling depth of 24 feet, by the 1880s large ships could come in only on flood tides. The channel was deepened to 30 feet, and then by a project adopted in 1899, to 40 feet.

1892 - The Lake Drummond Canal and Water Company purchased the Dismal Swamp Canal, which had been deteriorating since the Civil War. Thoroughly reconstructed by its new owners, the canal regained the major share of commerce passing between Albemarle Sound and Norfolk. The canal prospered until 1912, when the United States began construction of an inland waterway between Norfolk and Beaufort Inlet by way of the Albemarle and Chesapeake Canal.

1894 - A special commission authorized by Congress and chaired by Chief of Engineers Thomas L. Casey recommended that the United States purchase the Chesapeake and Delaware Canal and convert it to a sea-level ship canal.

- Prompted by the inadequacy of the Delaware and Raritan Canal to meet modern shipping requirements, the city of Philadelphia commissioned a study of other routes across New Jersey for the construction of a ship canal. The commission recommended a route cutting more directly across the state south of the existing canal, but no action was taken.

1907 - The Atlantic Deeper Waterways Association was organized in Philadelphia to lobby for the construction of an inland waterway from Boston to Key West.

- A special commission appointed in 1906 to determine the cost and advantages of converting the Chesapeake and Delaware Canal into a ship canal reported that the reconstructed canal would be the most important link in the proposed intracoastal waterway and a valuable benefit.

1909 - In the Rivers and Harbors Act of March 3, Congress authorized the first complete surveys for an intracoastal waterway along the Atlantic coast.

- A syndicate formed by August Belmont, a New York investment banker, began construction of the Cape Cod Canal. When completed in 1914, the canal forged the final link in Secretary Gallatin’s projected chain of canals, but it did not follow the inland route that he had proposed.

1912 - Reporting on the intracoastal waterway survey from Boston to Beaufort, the Corps of Engineers recommended the purchase of the Chesapeake and Delaware Canal and its conversion into a ship canal. The Corps also recommended construction of a 12-foot-deep waterway between Norfolk and Beaufort along the route of the Albemarle and Chesapeake Canal.

On February 17 Congress authorized the purchase of the Albemarle and Chesapeake Canal for $500,000, and the construction of a waterway 12 feet deep and at least 90 feet wide from Norfolk to Beaufort Inlet. Construction was completed in 1932.

1913 - The Corps of Engineers submitted a survey report on the Beaufort, North Carolina, to Key West, Florida, section of the proposed intracoastal waterway. The report revealed serious differences of opinion among the special board conducting the survey, the Chief of Engineers, and the Board of Engineers for Rivers and Harbors as to what action should be taken, and no projects resulted from it.

1917 - Congress adopted the project, “Waterway between Beaufort, S.C., and St. Johns River, Fla. ," which provided for a channel seven feet deep. The project consolidated three projects adopted earlier. All work called for was completed in 1932.

The project, "Beaufort to Jacksonville, N.C.," providing for a channel three feet deep, incorporated improvements begun on the New River in 1836, between Beaufort and Swansboro in 1886, and between Swansboro and the New River in 1890.

1919 - The United States purchased the Chesapeake and Delaware Canal for $2.5 million. Bills to accomplish this had repeatedly been introduced in Congress since 1907.

1920 - The annual reports of the Chief of Engineers from 1920 to 1930 noted that under the current program, improvement of only the more important rivers and harbors was contemplated. In accordance with this policy, from 1920, to 1929, Congress authorized only 48 projects or modifications of existing projects for the Atlantic seaboard.

1925 - Several projects for improving specific localities in the natural waterway between Charleston and Beaufort, South Carolina, adopted between 1881 and 1902 were incorporated into the single project, "Waterway from Charleston to Beaufort, S.C.” Providing for a channel seven feet deep, the project was completed in 1929.

1927 - Congress authorized the construction of the "Inland Waterway, Beaufort to Cape Fear River, N.C." Incorporating the earlier project that had established a 3-foot channel between Beaufort and Jacksonville, North Carolina, the projects provided for a channel 12 feet deep and not less than 90 feet wide extending to the Cape Fear River. The work was completed in 1932.

- Congress authorized the construction of the "Intracoastal Waterway, Jacksonville to Miami, Fla.," provided local interests acquired the necessary rights-of-way and the Florida East Coast Canal, and transferred them cost free to the United States. The state of Florida purchased and conveyed the canal properties to the United States in 1929. The waterway, with channel dimensions 8 feet deep and 100 feet wide, was completed in 1935.

- The conversion of the Chesapeake and Delaware Canal into a sea-level canal 12 feet deep and 90 feet wide at bottom was completed. By 1932 cargo tonnage passing through the waterway was more than double the tonnage of 1920.

1928 - The United States acquired the Cape Cod Canal for $11.5 million. Haggling over price and opposition within Congress had delayed the purchase, which was first authorized in 1917.

1929 - The United States purchased the Dismal Swamp Canal for $500,000. In 1925 Congress had voted authorization to acquire the canal as an adjunct to the inland waterway from Norfolk to Beaufort Inlet. The canal is now used primarily by recreational boaters.

1930 - Construction of the "Intracoastal Waterway from Cape Fear River to Winyah Bay, S.C.," began. The project, which provided for a channel 8 feet deep and 75 feet wide, was completed in 1936.

- Beginning in 1930 expenditures for navigation improvements increased considerably and remained at a high level throughout the decade. Public works and emergency relief programs accounted in part for the increase. Giving attention to both large and small waterways, Congress authorized 265 projects for the Atlantic seaboard.

1932 - The Corps of Engineers recommended the construction of a waterway 10 feet deep and 90 feet wide between Winyah Bay and Charleston, South Carolina. Starting in 1900 several

separate projects had improved the natural waterway between these localities to a minimum depth of 4 feet. The new project was included in the public works program started in 1933, authorized by Congress in 1935, and completed in 1936.

1933 - The reconstruction of the Cape Cod Canal began as an emergency relief measure by the Public Works Administration. In 1935 Congress authorized new project plans, and by 1940 reconstruction was essentially completed. From a narrow waterway that had failed to become a paying enterprise under private ownership, the canal was rebuilt into a passage 32 feet deep and 480 feet wide at bottom. Commerce currently averages about 12.5 million tons annually.

- The Delaware and Raritan Canal, after more than a half-century of declining traffic, ceased operation. The next year the Pennsylvania Railroad relinquished its rights to the waterway to the state of New Jersey.

1935 - Congress authorized the construction of the "Intracoastal Waterway, Miami to Key West, Fla." The waterway, however, was to extend only as far as Cross Bank in Florida Bay, where it would connect with Key Largo and Plantation Key. A Corps of Engineers report had concluded that the construction of a seven-foot channel was justified only to that point. The necessary dredging was accomplished in 1938-1939.

- Congress approved the enlargement of the Chesapeake and Delaware Canal to 27 feet deep and 250 feet wide at bottom, initiated with funds from the Emergency Relief Appropriations Act. The work was completed in 1938. Cargo tonnage carried through the canal nearly quadrupled between 1935 and 1940.

1937 - Congress authorized increasing the channel dimensions of the Intracoastal Waterway from the Cape Fear River to Savannah to 12 feet deep and not less than 90 feet wide. This action extended the dimensions that already existed on the waterway from the Cape Fear River to Norfolk. Work was completed in 1940.

1938 - On the request of carriers using the Intracoastal Waterway, Congress authorized the enlargement of the channel between Savannah and the St. Johns River to 12 feet deep and 90 feet wide. The Corps completed the work in 1941.

1941 - World War II restricted river and harbor work to a minimum as projects not directly connected with defense and war efforts were suspended. Only eight construction projects on the East Coast were continued or initiated. All were to facilitate the movement of naval or supply vessels.

1942 - Because of the submarine threat to Atlantic coast shipping during World War II, the Corps of Engineers, after years of reporting adversely on the construction of a canal across New Jersey to unite the Delaware River with New York Bay as the Delaware and Raritan Canal had formerly done, finally endorsed the proposal. The Board of Engineers for Rivers and Harbors recommended building a 14-foot-deep barge canal, while the Chief of Engineers favored a 27-foot-deep ship canal. No action was taken, and a canal across New Jersey continues to be the "Missing Link" in the Intracoastal Waterway.

1945 - The enlargement of the Intracoastal Waterway from Jacksonville to Miami, Florida, to 12 feet deep and 125 feet wide was authorized. An economic study report of 1960 led to a reduction of the project depth to 10 feet for the portion of the waterway between Fort Pierce and Miami. Construction was completed in 1965.

- On the basis of a Corps of Engineers review report submitted in 1942, Congress authorized the completion of the Intracoastal Waterway to Key West with a seven-foot channel. The work was never funded, and following an economic study report of 1963, it was placed in the inactive category.

- The New Jersey Intracoastal Waterway, constructed by the state between 1908 and 1918, was authorized as a federal project with the channel to be deepened from 6 to 12 feet. The improvement was justified in part on the grounds that the waterway, as an alternative to a canal across New Jersey, was an essential part of the intracoastal route from Boston to Miami. The project was soon deferred for restudy, and construction has not been undertaken.

1947 - Legislation consolidated the six intracoastal waterway projects from Norfolk to the St. Johns River into the "Atlantic Intracoastal Waterway between Norfolk, Vs., and St. Johns River, Fla."

1954 - Congress authorized the enlargement of the Chesapeake and Delaware Canal to 35 feet deep and 450 feet wide. By 1970 the project was approximately 87 percent completed. Since then only minor work has been carried out.

1956 - River and harbor work on the East Coast was resumed on a sizable scale with 38 projects under construction.

1958 - The number of Atlantic seaboard navigation projects started each year began gradually to decline until in fiscal year 1980 none were started.

1979 - Between 1945 and 1979 more than 250 improvement projects were initiated on the Atlantic seaboard. The main channels of 26 major harbors were dredged to depths of 35 to 45 feet. Lesser commercial ports were improved, as were many small harbors used primarily by fishing and recreational fleets.

NOTES

Chapter 1

1. Samuel Eliot Morison, The European Discovery of America: The Southern Voyages, A.D. 1499-1616 (New York: Oxford University Press, 1974), pp. 503-511; Lawrence Co Wroth, The Voyage of Giovanni da Verrazzano, 1524-1528 (New Haven: Yale University Press, 1970), pp. 71-90; Samuel Eliot Morison, The European Discovery of America: The Northern Voyages, A.D. 500-1600 (New York: Oxford University Press, 1971), pp. 277-317.

2. Morison, Northern Voyages, pp. 166-209, 233-454, 479-545, 569-605; James A. Williamson, The Voyages of the Cabots and the Discovery of North America (London: Argonaut Press, 1929), pp. 166-170, 184-197; John Bartlett Brebner. The Explorers of North America, 1492-1806 (New York: Macmillan Co., 1933), pp. 109-165, 197-217; David Beers Quinn, England and the Discovery of America, 1481-1620 (New York: Alfred A. Knopf, 1974), pp. 93-171, 182-191, passim; Nellis M. Crouse, In Quest of the Western Ocean (New York: William Morrow & Co:, 1928), pp. 30-196, passim; George Born Manhart, The English Search for a Northwest Passage in the Time of Queen Elizabeth, Studies in English Commerce and Exploration in the Age of Elizabeth (Philadelphia: University of Pennsylvania Press, 1924), pp. 31-83, 99-121, 140-144.

3. Quoted in Brebner, Explorers, p. 32.

4. Morison, Northern Voyages, pp. 233-237, 326-334; Quinn, Discovery of America, pp. 171-182.

5. Morison, Northern Voyages, pp. 468, 619-625, 640-644; Quinn, Discovery of America, pp. 250-251, 254-258.

6. Quoted in Quinn, Discovery of America, p. 240.

7. Ibid., pp. 240-241, 383, 388-390, 413-414, 423-427; Henry F. Howe, Prologue to New England (New York: Farrar & Rinehart, 1943), pp. 55-77, 84-97.

8. Quoted in Brebner, Explorers, pp. 154, 156.

9. Ibid., p. 156; Howe, New England, pp. 79-83, 98-141.

10. Quinn, Discovery of America, pp. 254, 256, 265, 275-276, 436.

11. Brebner, Explorers, pp. 264-265; Philip L. Barbour, The Three Worlds of Captain John Smith (Boston: Houghton Mifflin co., 1964), pp. 154-157, 200-230; Crouse, Western Ocean, pp. 209-218.

12. Brebner, Explorers, pp. 205-207, 265-267; Llewelyn Powys, Henry Hudson (New York: Harper & Brothers, 1928), pp. 24-38; 45-59, 77-111.

13. Brebner, Explorers, pp. 267-269; Howe, New England, pp. 219-233; Curtis P. Nettels, The Roots of American Civilization, 2d ed. (New York: Appleton-Century-Crofts, 1963), p. 195; Christopher Ward, The Dutch & Swedes on the Delaware, 1609-1664 (Philadelphia: University of Pennsylvania Press, 1930), pp. 26-30.

14. Quoted in Howe, New England, p. 245.

15. Quoted in ibid., pp. 238, 243. See also Barbour, John Smith, pp. 306-312; 325-326.

16. Quoted in Nettels, American Civilization, p. 160.

17. The fact that waterways determined the location of the first American settlements is revealed in a number of general histories. E.g., see Nettels, American Civilization, pp. 154-185, 196-225, passim; James Truslow Adams, The Founding of New England (Boston: Little, Brown, and Co., 1930), chaps. 5,6,8, 9, passim; Samuel Eliot Morison, Henry Steele Commager, and William E. Leuchtenburg, The Growth of the American Republic, 2 vols, 8th ed. (New York: Oxford University Press, 1969), 1: 23-24, 43-44, 54, 60.

18. Caroline E. MacGill et al. History of Transportation in the United States before 1860 (Washington, DC: Carnegie Institution of Washington, 1917), pp. 5, 254; Adams, New England, p. 7.

19. See Nettels, American Civilization, pp. 225-264.

20. John G.B. Hutchins, The American Maritime Industries and Public Policy, 1789-1914, Harvard Economic Studies, vol. 71 (Cambridge: Harvard University Press, 1941), pp. 159-160, 209-210; Winthrop L. Marvin, The American Merchant Marine: Its History and Romance from 1620 to 1902 (New York: Charles Scribners Sons, 1902), pp. 22-24; George Rogers Taylor, The Transportation Revolution, 1815-1860, The Economic History of the United States, vol. 4 (New York: Rinehart & Co., 1951), pp. 108-109; Edward Chase Kirkland. Men. Cities. and Transportation: A Study in New England History, 1890-1900, 2 vols. (Cambridge: Harvard University Press, 1948), 1:18.

21. Hutchins, Maritime Industries, pp. 146, 179-180; Robert Greenhalgh Albion, The Rise of New York Port, 1815-1860 (New York: Charles Scribners Sons, 1939), p. 24.

22. Thomas E. Rush, The Port of New York (Garden City, NY: Doubleday, Page & CO., 1920), pp. 22, 235. Cf. Albion, New York Port, and Writers Program of the Work Projects Administration, New York, A Maritime History of New York (Garden City, NY: Doubleday, Doran and Company, 1941).

23. David F. Bastian, "The Development of Dredging Through the 1850's," in National Waterways Roundtable Papers: Proceedings on the History and Evolution of U.S. Waterways and Ports (Ft. Belvoir, VA: U.S. Army Engineer Water Resources Support Center, Institute for Water Resources, 1980), pp. 2-3, 4; Frank E. Snyder and Brian H. Guss, The District: A History of the Philadelphia District, U.S. Army Corps of Engineers, (Philadelphia: U.S. Army Engineer District, 1974), p. 64.

24. Albion, New York Port, pp. 17-19, 24-25, 34-35.

25. Rush, Port of New York, pp. 32-33; Writers' Program of the Work Projects Administration, Massachusetts, Boston Looks Seaward: The Story of the Port, 1630-1940 (Boston: Bruce Humphries, 1941), pp. 42-43.

26. Writers' Program, Massachusetts, Boston Looks Seaward, pp. 41-42; Patrick Beaver, A History of Lighthouses (Secaucus, NJ: Citadel Press, 1973), pp. 82-83.

27. Wheaton J. Lane, From Indian Trail to Iron Horse: Travel and Transportation in New Jersey: 1620-1860 (Princeton: Princeton University Press, 1939). pp. 59-60; Hutchins, Maritime Industries, p. 147.

28. Lane, Indian Trail to Iron Horse, pp. 68-69.

29. W. DeLoss Love, "The Navigation of the Connecticut River," Proceedings of the American Antiquarian Society, New Series 15 (1903):394; Carter Goodrich, "The Virginia System of Mixed Enterprise: A Study of State Planning of Internal Improvement s," Political Science Quarterly 64 (1949):358; MacGill et al., Transportation, pp. 254-255; Carter Goodrich, Government Promotion of American Canals and Railroads, 1800-1890 (New York: Columbia University Press, 1960), p. 102; Lane, Indian Trail to Iron Horse, pp. 64, 67, 70-71.

Chapter 2

1. Gallatin's "Report on Roads and Canals," 4 April 1808, American State Papers: Miscellaneous, edited by Walter Lowrie et al., 38 vols. (Washington, DC: Gales and Seaton, 1832-1861), 1:724-921. The Report proper is on pp. 724-741; the rest is appendix.

2. T. Harry Williams, Richard N. Current, and Frank Freidel, A History of the United States, 2 vols., 2d ed., rev. (New York: Alfred A. Knopf, 1964), 1:303-304; Taylor, Transportation Revolution, p. 18.

3. James D. Richardson, cd., A Compilation of the Messages and Papers of the Presidents, 1789-1897, 10 vols. (Washington, DC: Government Printing Office, 1896-1899), 1:567-568.

4. George Dangerfield, The Awakening of American Nationalism, 1815-1828 (New York: Harper & Row, 1965), pp. 18-19; Taylor, Transportation Revolution, pp. 21-22.

5. Calhoun's "Report on Roads and Canals," 7 January 1819, American State Papers: Miscellaneous, 2:533-537; Forest G. Hill, Roads, Rails & Waterways: The Army Engineers and Early Transportation (Norman: University of Oklahoma Press, 1957), pp. 6, 23-34; "Report of the Board of Engineers on the defense of the seaboard,'" 7 February 1821. American State Papers: Military Affairs, 2:305; Laws of the United States Relating to the Improvement of Rivers and Harbors, 3 vols. and index (H. Dec. 1491, 62d Cong., 3d sess.; and H. Dec. 379, 76th Cong., 1st sess.) (Washington, DC: Government Printing Office, 1913; 1940), 1:22, 26.

6. Richardson, Messages and Papers, 2:216.

7. Laws Relating to Rivers and Harbors, 1:26; Dangerfield, American Nationalism, pp. 200-201; Hill, Roads, Rails & Waterways, pp. 49, 60-61, 91-95; Taylor, Transportation Revolution, pp. 20-22; Carter Goodrich, "National Planning of Internal Improvements," Political Science Quarterly 63 (1948):36-39.

8. Williams et al., History of the United States, 1:344-345.

9. MacGill et al., Transportation, p. 144; Christopher Roberts, The Middlesex Canal, 1793-1860, Harvard Economic Studies, vol. 61 (Cambridge: Harvard University Press, 1938), p. 3.

10. Edward Chase Kirkland. Men, Cities, and Transportation: A Study in New England History, 1890-1900, 2 vols. (Cambridge: Harvard University Press, 1948), 1:66-67, 69, 73-74; MacGill et al., Transportation, pp. 144, 146; Love, "The Navigation of the Connecticut River," pp. 404-415.

11. Roberts, Middlesex Canal, pp. 117, 124-133; MacGill et al., Transportation, pp. 144, 146.

12. MacGill et al., Transportation, p. 143.

13. Alvin F. Harlow, Old Towpaths: The Story of the American Canal Era (Port Washington, NY: Kennikat Press, 1964), pp. 15-16.

14. Walter S. Sanderlin, The Great National Project: A History of the Chesapeake and Ohio Canal, The Johns Hopkins University Studies in Historical and Political Science, vol. 64, no. 1 (Baltimore: Johns Hopkins Press, 1946), pp. 29-40; Goodrich, Carols and Railroads, p. 76; MacGill et al., Transportation, pp. 265-266; "Great Falls canal and locks: Civil engineering landmark," Civil Engineering 42 (November 1972):53-56.

15. Wayland Fuller Dunaway, History of the James River and Kanawha Company, Columbia University Studies in History, Economics, and Public Law, vol. 104, no. 2 (New York: Columbia University, 1922), pp. 9-47, 72-74, 81-88; Goodrich, Canals and Railroads, pp. 87-94; MacGill et al., Transportation, p. 270.

16. MacGill et al., Transportation, pp. 257-258; Clifford Reginald Hinshaw, Jr., "North Carolina Canals Before 1860," North Carolina Historical Review 25 (1948): 33-40.

17. Roberts, Middlesex Canal, pp. 17, 134, 136-137, 181-186, 191-196; MacGill et al., Transportation, pp. 148-151.

18. MacGill et al., Transportation, pp. 276-279; Harlow, Old Towpaths, pp. 17-18.

19. Charles Clinton Weaver, Internal Improvements in North Carolina Previous to 1860, The Johns Hopkins University Studies in Historical and Political Science, series 21, nos. 3-4 (Baltimore: Johns Hopkins Press, 1903), pp. 68-73; Alexander Crosby Brown, The Dismal Swamp Canal (Chesapeake, VA: Norfolk County Historical Society of Chesapeake, 1967), pp. 31-35; Laws Relating to Rivers and Harbors, 1:32; Hinshaw, "North Carolina Canals Before 1860," pp. 19-30.

20. Ronald E. Shaw, Erie Water West (Lexington: University of Kentucky Press, 1966), pp. 198-218, 236-239; Taylor, Transportation Revolution, pp. 33-34.

21. Goodrich, Canals and Railroads, pp. 51-165, passim; Goodrich, "National Planning," pp. 31, 35; Taylor, Transportation Revolution, pp. 48-52.

22. Taylor, Transportation Revolution, p. 37; MacGill et al., Transportation, p. 143; Goodrich, Canals and Railroads, pp. 126-127; U.S. Department of the Interior, Census Office, Tenth Census of the United States, 1880: Transportation, 4:756, 761.

23. Kirkland, Men, Cities, and Transportation, 1:81-84; Taylor, Transportation Revolution, pp. 37-38; Harlow, Old Towpaths, pp. 159-161; Tenth Census: Transportation, 4:757.

24. Kirkland, Men, Cities, and Transportation, 1:70-71, 75-81; Taylor, Transportation Revolution, p. 38; Harlow, Old Towpaths, pp. 161-164; Tenth Census: Transportation, 4:757-758.

25. Roberts, Middlesex Canal, pp. 19-26; MacGill et al., Transportation, pp. 146, 152-156; Justin Winsor, cd., The Memorial History of Boston, 1630-1880, 4 vols. (Boston: Ticknor and Co., 1881), 4:113-116.

26. MacGill et al., Transportation, p. 143.

27. Aubrey Parkman, Army Engineers in New England: The Military and Civil Work of the Corps of Engineers in New England, 1775-1975 (Waltham, MA: U.S. Army Engineer District, "1978), pp. 30-31.

28. Ibid., pp. 28-30; William James Reid, The Building of the Cape Cod Canal, 1627-1914, privately printed, 1961, pp. 1-8.

29. Delaware and Hudson Company, A Century of Progress: History of the Delaware and Hudson Company, 1823-1923 (Albany: J.B. Lyon Co., 1925), pp. 15-40, 64-65, 124-131; Harlow, Old Towpaths, pp. 186-193; Taylor, Transportation Revolution, p. 39; Tenth Census: Transportation, 4:734.

30. Taylor, Transportation Revolution, pp. 39-40; Harlow, Old Towpaths, pp. 181-183.

31. Taylor, Transportation Revolution, p. 40; Tenth Census: Transportation, 4:739, 742-743.

32. Goodrich, Canals and Railroads, pp. 124-125; Harlow, Old Towpaths, pp. 195-202; Taylor, Transportation Revolution, p. 40; Tenth Census: Transportation, 4:735; Hill, Roads, Rails

& Waterways, pp. 31-32; Henry Varnum Poor, History of the Railroads and Canals in the United States of America, 1860, reprint (New York: Augustus M. Kelley, 1970), pp. 411-413; Lane, Indian Trail to Iron Horse, pp. 224-250.

33. Taylor, Transportation Revolution, pp. 40-41; MacGill et al., Transportation, pp. 227-234; Goodrich, Canals and Railroads PP. 123-124; Tenth Census: Transportation, 4:735; Lane, Indian Trail to Iron Horse, pp. 253-277; Hill, Roads, Rails & Waterways. p. 52.

34. Ralph D. Gray, The National Waterway: A History of the Delaware and Chesapeake Canals, 1769-1965 (Urbana: University of Illinois Press, 1967), pp. 1-155, passim; Taylor, Transportation Revolution, pp. 41-42; Goodrich, Canals and Railroads, pp. 121-122; Poor, Railroads and Canals, pp. 569-571; Hill, Roads, Rails & Waterways, p. 30; MacGill et al., Transportation, pp. 217-221.

35. Taylor, Transportation Revolution, p. 41; MacGill et al., Transportation, pp. 210-217; Tenth Census: Transportation, 4:740-741, 743; Poor, Railroads and Canals, pp. 540-544, 549-551; Harlow, Old Towpaths, pp. 86-91, 172-174.

36. MacGill et al., Transportation, pp. 222-227; Harlow, Old Towpaths, pp. 169-172; Taylor, Transportation Revolution, p. 41; Hill, Roads, Rails & Waterways, pp. 30-31.

37. Julius Rubin, "An Imitative Public Improvement: The Pennsylvania Main Line," in Canals and American Economic Development, ed. Carter Goodrich (New York: Columbia University Press, 1961), pp. 67-114; Goodrich, Canals and Railroads, pp. 63-69; Taylor, Transportation Revolution, pp. 43-45; MacGill et al., Transportation, pp. 234-248; Tenth Census: Transportation, 4:736-739; Poor, Railroads and Canals, p. 558; Harlow, Old Towpaths, pp. 92-103; Hill, Roads, Rails & Waterways, p. 54.

38. Sanderlin, Great National Project, pp. 45-295, passim; Taylor, Transportation Revolution, pp. 42-43; MacGill et al. Transportation, pp. 264-269; Goodrich, Canals and Railroads, pp. 76-79, 81; Poor, Railroads and Canals, pp. 602-606.

39. Dunaway, James River and Kanawha Company, pp. 92-204, passim; Taylor, Transportation Revolution, p. 42; MacGill et al., Transportation, pp. 264-265, 270-271; Goodrich, Canals and Railroads, p. 95; Hill, Roads, Rails & Waterways, pp. 99-100.

40. Dunaway, James River and Kanawha Company, pp. 211-239; MacGill et al., Transportation, pp. 271-273; U.S. Congress, House, Report of the Chief of Engineers, February 8, 1871, H.

Ex. Dec. 110, 41st Cong., 3d sess., 1871, hereafter cited as H. Ex. Doc. 110; U.S., Army, Annual Report of the Chief of Engineers, 1874, vol. 2, Part 2 (Washington, DC: Government Printing Office, 1874), pp. 86-129, hereafter cited as ARCE, 1874.

41. See Taylor, Transportation Revolution, pp. 52-55, for a discussion of these factors.

Chapter 3

1. Roberts, Middlesex Canal, pp. 142-147; Kirkland, Men, Cities, and Transportation, 1:62-64.

2. Kirkland, Men, Cities, and Transportation, 1:67-69, 75; Parkman, Army Engineers in New England, 1775-1975, p. 72; Love, "The Navigation of the Connecticut River," pp. 398-400.

3. Taylor, Transportation Revolution, pp. 39-40; Harlow, Old Towpaths, p. 179; Tenth Census: Transportation, 4:741-742; Snyder and Guss, A History of the Philadelphia District, pp. 74, 76.

4. Dunaway, James River and Kanawha Company, pp. 27-28, 31-32, 33-35, 39, 45.

5. Sanderlin, Great National Project, pp. 34-36; Goodrich, Canals and Railroads, p. 76; Poor, Railroads and Canals, p. 602.

6. Goodrich, "Virginia System," pp. 360, 362, 374.

7. Weaver, Internal Improvements in North Carolina, pp. 49-67; Goodrich, Canals and Railroads, pp. 108-109; Hinshaw, "North Carolina Canals Before 1860," pp. 4-15, 33-38.

8. MacGill et al., Transportation, pp. 255, 257-258; Alfred Glaze Smith, Jr., Economic Readjustment of an Old Cotton State: South Carolina, 1820-1860 (Columbia: University of South Carolina Press, 1958), pp. 138-149, 154-155; Goodrich, Canals and Railroads, pp. 102-103; Jamie W. Moore and Dorothy P. Moore, "The Effect of Harbor Improvement on Inland Commerce and Economic Development, The Case of Charleston." in National Waterways Roundtable Papers: Proceedings On the History and Evolution of U.S. Waterways and Ports (Ft. Belvoir, VA: U.S. Army Engineer Water Resources Support Center, Institute for Water Resources, 1980), p. 82.

9. MacGill et al., Transportation, pp. 256-260.

10. Taylor, Transportation Revolution, pp. 108-110; Hutchins, Maritime Industries, pp. 173, 209-210, 242; Marvin, American Merchant Marine, pp. 197, 207.

11. Bastian, "Development of Dredging," pp. 2-3; and Guss, A History of the Philadelphia District, pp. 32, 64.

12. Laws Relating to Rivers and Harbors, 1:15-18, 19. Permission for Georgia to levy tonnage duties was continued until 1838 and for Maryland until 1871. Ibid., 1:20-21, 24, 41, 83, 97, 116, 140-141.

13. U.S., Statutes at Large, vol. 1, 1:53-54 (1789).

14. Laws Relating to Rivers and Harbors, 1:18, 25-26; Snyder and Guss, A History of the Philadelphia District, p. 27; Parkman, Army Engineers in New England, 1775-1975, p. 38.

15. Laws Relating to Rivers and Harbors, 1:21, 22-27, 30-31, 33.

16. Ibid ., 1:33-87.

17 . Parkman, Army Engineers in New England, 1775-1975, pp. 35-39: Hill. Roads. Rails & Waterwavs, pp. 29-30; Snyder and Guss, A History-of the-Philadelphia District, pp. 5-14, 65-66; Weaver, Internal Improvements in North Carolina, p. 56; U.S. Congress, House, Appropriations and Expenditures for Rivers and Harbors, H. Ex. Doc. 64, 48th Cong., 1st sess., 1884, pp. 6-47, passim, 148, hereafter cited as H. Ex. Doc. 64.

18. Hill, Roads, Rails & Waterways, pp. 158, 166, 169, 177.

19. For details on early steamship routes see Kirkland, Men, Cities, and Transportation, 1:20-26; Tenth Census: Transportation, 4:667-668, 675.

20. Kirkland, Men, Cities, and Transportation, 2:196, 212; Taylor, Transportation Revolution, pp. 112-119; Hutchins, Maritime Industries, pp. 331-333.

21. Hutchins, Maritime Industries, p. 229.

22. Hill, Roads, Rails & Waterways, pp. 170, 178-179, 181, 184-185, 190-192, 195-196; Goodrich, "National Planning,'* pp. 36-44; Emory R. Johnson, "Rivers and Harbors Bills," Annals of the American Academy of Political and Social Science 2 (1892):789-790.

23. Laws Relating to Rivers and Harbors, 1:88-118; George E. Buker, Sun, Sand and Water: A History of the Jacksonville District, U.S. Army Corps of Engineers, 1821-1975 (Jacksonville, FL: U.S. Army Engineer District, 1981), pp. 114-116.

24. Isaac Lippincott, "A History of River Improvement," Journal of Political Economy 22 (1914):641; Laws Relating to Rivers and Harbors, 1:119-124.

25. Ho Ex. Doc. 64, pp. 4-47, 126-213, passim; Parkman, Army Engineers in New England, 1775-1975, pp. 45-46; Snyder and Guss, A History of the Philadelphia District, pp. 14, 27-30.

26. Laws Relating to Rivers and Harbors, 1:127, 129, 131-136.

27. Hutchins, Maritime Industries, pp. 257-260, 272, 289; Taylor, Transportation Revolution, pp. 109, 122, 124; Marvin, American Merchant Marine, pp. 229, 362.

28. Lippincott, "River Improvement," pp. 633, 638-640, 642-646; Gray, National Waterway, p. 158.

29. Lippincott, "River Improvement," pp. 632, 649-650; Parkman, Army Engineers in New England, 1775-1975, p. 48.

30. Laws Relating to Rivers and Harbors, 1:44, 151-156; W. Stun Holt, The Office of the Chief of Engineers of the Army: Its Nonmilitary History, Activities, and Organization (Baltimore: Johns Hopkins Press, 1923), p. 136.

31. Hutchins, Maritime Industries, pp. 443, 488-492.

32. ARCE, 1900, 1:161-166; ARCE, 1914, 1:239-241; Marion J. Klawonn. Cradle of the Corps: A History of the New York District, U.S. Army Corps of Engineers. 1775-1975 (New York: U.S. Army Engineer-District, 1977), pp. 166-177.

33. ARCE, 1883, 1:450; ARCE, 1902, 1:98-99; ARCE, 1914, 1:80-81.

34. ARCE, 1900, 1:189-191; ARCE, 1914, 1:305-307.

35. ARCE, 1900, 1:231-232; ARCE, 1914, 1:375-377. See also Harold Kanarek, The Mid-Atlantic Engineers: A History of the Baltimore District, U.S. Army Corps of Engineers, 1774-1974 (Baltimore, MD: U.S. Army Engineer District, 1978), pp. 45-59.

36. ARCE, 1914, 1:437-438.

37. ARCE, 1900, 1:274-275; ARCE, 1914, 1:511-513.

38. ARCE, 1914, 1:537-538; 543-545.

39. ARCE, 1883, 1:79-80; ARCE, 1900, 1:102-103; ARCE, 1914, 1:116-118.

40. Kirkland, Men, Cities, and Transportation, 2:150-151; Gray, National Waterway, pp. 189-191.

41. Kirkland. Men. Cities. and Transportation. 2:151-185, 215; Hutchins, Maritime Industries, pp. 545-549, 564; Marvin, American Merchant Marine, pp. 364-365, 373-374.

42. Gray, National Waterway, pp. 229-231, 234-235; Laws Relating to Rivers and Harbors, 3:1628-1738, passim.

43. Parkman, Army Engineer in New England, 1775-1975, p. 58; ARCE, 1979, 1:12-13.

44. Laws Relating to Rivers and Harbors, 3:1860-1864, 1897-1899, 1966-1968. Expenditures taken from ARCE, 1913-1929. Beginning in 1920 Congress voted lump sums for improvements rather than specifying the amounts appropriated for each project, and authorizations for projects were made in separate rivers and harbors acts. Through 1938 the ARCE stated the amounts allotted to each project.

45, ARCE, 1930, 1:4.

46. ARCE, 1930-1938; Laws Relating to Rivers and Harbors, 3:2090-2099, 2330-2335, 2512-2516, 2576-2578.

47. ARCE, 1942, 1:2; ARCE, 1943, 1:2; ARCE, 1944, 1:4; ARCE, 1945, 1:3; Snyder and Guss, A History of the Philadelphia District, p. 142.

48. Laws Relating to Rivers and Harbors, 4:2909-2915, 2949, 3007-3008, 3095-3096, 3166-3169.

49. The first volume of each Annual Report of the Chief of Engineers, 1945-1950 (pp. 1-3) lists the principal East Coast projects on which work was performed between the wars. The first volume of each annual report for 1951-1955 (pp. 3-6) lists the principal works under construction during the Korean War.

50. ARCE, 1956-1980.

51. U.S., Department of the Army, Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1979, Part 1, Waterways and Harbors, Atlantic Coast, provides statistics on commodities and traffic for each waterway. The Water Resources Development booklets on each state, published by the Corps Divisions, also provide valuable information on waterways.

52. ARCE, 1955, 1:70-72; Waterborne Commerce, 1979.

Chapter 4

1. Gray, National Waterway, pp. 1-7; Reid, Building of the Cape Cod Canal, pp. 2-4; Jerome Cranmer, "Improvements Without Public Funds: The New Jersey Canal," in Canals and American Economic Development, ed. Carter Goodrich (New York: Columbia University press, 1961), p. 117; Brown, Dismal Swamp Canal, pp. 31-32.

2. Gray, National Waterway, pp. 20-27; Goodrich, Canals and Railroads, pp. 26-27.

3. Gallatin's "Report on Roads and Canals," American State Papers: Miscellaneous, 1:725.

4. Gray, National Waterway, pp. 24, 29-55, 62-64, 81-84, 91-100.

5. Brown, Dismal Swamp Canal, pp. 32-44; Hinshaw, "North Carolina Canals Before 1860," pp. 21-22; "Subscription to the Chesapeake and Delaware and Dismal Swamp Canals," communicated to the House of Representatives, February 20, 1817, American State Papers: Miscellaneous, 2:438-442.

6. U.S., Congress, House, Dismal Swamp Canal, H. Doc. 15, 19th Cong., 1st sess., 1826, pp. 7-8, hereafter cited as H. Doc. 15; U.S., Congress, House, Survey of-the waters of Virginia & N. Carolina, H. Doc. 125, 19th Cong., 1st sess., 1826, p. 5, hereafter cited as H. Doc. 125; Laws Relating to Rivers and Harbors, 1:32.

7. U.S., Congress, House, Message from the President . . . December 5, 1826, and Documents accompanying, H. Ex. Doc. 2, 19th Cong., 2d sess., 1826, pp. 221-225, hereafter cited as H. Ex. Doc. 2; Hinshaw, "North Carolina Canals Before 1860," p. 24; Brown, Dismal Swamp Canal, p. 52; Laws Relating to Rivers and Harbors, 1:49.

8. Brown, Dismal Swamp Canal, pp. 49-51; Hinshaw, "North Carolina Canals Before 1860," pp. 24-29.

9. Hill, Roads, Rails & Waterways, p. 52.

10. Cranmer, "New Jersey Canals," pp. 117-126; MacGill et al., Transportation, pp. 227-230; Lane, Indian Trail to Iron Horse, pp. 253-261.

11. Tenth Census: Transportation, 4:735; Taylor, Transportation Revolution, pp. 401-441; MacGill et al., Transportation, pp. 233-234; Lane, Indian Trail to Iron Horse, pp. 262-263.

12. Albion, New York Port, pp. 134-135; Taylor, Transportation Revolution. D. 157.

13. Brown, Dismal Swamp Canal, pp. 75-77; Hinshaw, "North Carolina Canals Before 1860," pp. 41-56; "subscription to the Chesapeake and Delaware and Dismal Swamp Canals," American State Papers, pp. 438-439.

14. G.D. Luetscher, "Atlantic Coastwise Canals: Their History and Present Status," Annals of the American Academy of Political and Social Science 31 (January-June 1908) :92-93;"Gray, National Waterway, pp. 182-183.

15. Gray, National Waterway, pp. 150, 154, 158-166; U.S., Congress, Senate, Survey with a view to the construction of a ship-canal to connect the waters of Delaware and Chesapeake Bays, S. Ex. Doc. 39, 46th Cong., 2d sess., 1880, hereafter cited as S. Ex. Doc. 39; U.S. Congress, Senate, Surveys for a ship canal to connect Chesapeake and Delaware Bays, S. Ex. Doc. 6, 48th Cong., 1st sess., 1883, pp. 3-27, hereafter cited as S. Ex. Doc. 6.

16. U.S., Congress, House, Chesapeake and Delaware Canal, H. Ex. Doc. 102, 53d Cong., 3d sess., 1894, pp. 4-6, hereafter cited as H. Ex. Doc. 102; Gray, National Waterway, pp. 184-188.

17. Gray, National Waterway, pp. 188-192; Francis G. Newlands, "The Use and Development of American Waterways," Annals of the American Academy of Political and Social Science 31 (January-June 1908):50; Joseph E. Ransdell, "Legislative Program Congress Should Adopt for Improvement of American Waterways," Annals of American Academy of Political and Social Science 31 (January-June 1908):36-37.

18. U.S., Congress, Senate. Waterway to Connect Waters of Chesapeake and Delaware Bays, S. Doc. 215, 59th Cong., 2d sess., 1907, pp. 1-20, hereafter cited as S. Doc. 215; Gray, National Waterway, pp. 193-203.

19. Gray, National Waterway, pp. 203-206, 224; Ransdell, "Legislative Program," pp. 37, 41-42.

20. U.S., Congress, House, Intracoastal Waterway, Boston, Mass. , to Beaufort, N.C., Section, H. Doc. 391, 62d Cong., 2d sess. , 1912, pp. 3-6, hereafter cited as H. Doc. 391; Gray, National Waterway, pp. 204, 224. A second report in 1913 recommended deepening the Chesapeake and Delaware Canal to 12 feet and widening it bottom to 90 feet, with further enlargement to depend upon the increase in traffic resulting from this conversion and the abolition of tolls. U.S., Congress,

House. Intracoastal Waterway. Boston. Mass., to Beaufort, N.C.: Final-Report on Sections from New York Bay to Delaware River and from Delaware River to Chesapeake Bay, H. Doc. 196, 63d Cong., 1st sess., 1913, pp. 5-6, hereafter cited as H. Doc. 196.

21. Gray, National Waterway, pp. 221, 225, 229-239.

22. Ibid., pp. 241-242, 245-247. For a detailed description of the work of reconstruction see Earl I. Brown, "The Chesapeake and Delaware Canal," Transactions of the American Society of Civil Engineers 95 (1931):716-763.

23. U.S., Congress, House, Committee on Rivers and Harbors, Inland Waterway from Delaware River to Chesapeake Bay, Del. and Md. (Ship Canal), H. Com. Doc. 24, 73d Cong., 2d sess., 1933, pp. 2, 6-8, hereafter cited as H. Corn. Doc. 24; Gray, National Waterway, pp. 249-253.

24. U.S., Congress, Senate, Inland Waterway from Delaware River to Chesapeake Bay, Del. and Md., S. Doc. 123, 83d Cong., 2d sess., 1954, pp. 9-11, hereafter cited as S. Doc. 123; ARCE, 1955, 2:154-155; ARCE, 1956-1980; Gray, pp. 253-256; Waterborne Commerce, 1979, pp. 73-74, 166.

25. U.S., Congress, House, Dismal Swamp Canal, H. Ex. Doc. 77, 39th Cong., 1st sess., 1866, hereafter cited as H. Ex. Doc. 77; U.S., Congress, House, Dismal Swamp Canal, H. Ex. Doc. 135, 40th Cong., 2d sess., 1868, hereafter cited as H. Ex. Doc. 135.

26. U.S., Congress, House, Letter from the Secretary of the Treasury in Reference to the interest of the government in the Dismal Swamp Canal, H. Ex. Doc. 19, 45th Cong., 2d sess., 1878, pp. 1-2, 9-12, 14-15: Brown, Dismal Swamp Canal. pp. 89-93: ARCE. 1893. 2:1356.

27. Brown, Dismal Swamp Canal, pp. 104-108; ARCE, 1899, 1:229; ARCE, 1902, 1:223.

28. Brown, Dismal Swamp Canal, p. 111.

29. H. Doc. 391, pp. 108-113, 120; ARCE, 1932, 1:501.

30. ARCE, 1932, 1:496-501; U.S., Congress, House, Inland Waterway from Norfolk, Vs., to Beaufort Inlet, N.C., H. Doc. 1136, 64th Cong., 1st sess., 1916, pp. 6-8, hereafter cited as H. Doc. 1136; Waterborne Commerce, 1979, p. 99.

31. Brown, Dismal Swamp Canal, pp. 113-114, 123-125; U.S., Congress, House, Committee on Rivers and Harbors, Inland Waterway from Norfolk, Vs., to Beaufort Inlet, N.C., H. Com.

Doc. 5, 67th Cong., 2d sess., 1922, hereafter cited as H. Com. Doc. 5; ARCE, 1930, 1:574; ARCE, 1966, 2:324-325; U.S., Army, Corps of Engineers, North Atlantic Division, Water Resources Development in Virginia 1981 (New York: U.S. Army Engineer Division, 1981), p. 8.

32. Parkman, Army Engineers in New England, 1775-1975, pp. 87-88; ARCE, 1870, 1:481-490.

33. Reid, Cape Cod Canal, pp. 13-33; Parkman, Army Engineers in New England, 1775-1975, p. 88.

34. H. Doc. 391, pp. 5-6, 21-22.

35. Reid, Cape Cod Canal, pp. 60-62; Parkman, Army Engineers in New England, 1775-1975, p. 90; U.S., Congress, House, Committee on Rivers and Harbors, Cape Cod Canal, H. Com. Doc. 3, 69th Cong., 1st sess., 1926, pp. 19-23, hereafter cited as H. Com. Doc. 3.

36. Reid, Cape Cod Canal, pp. 64-65, 70-83, 90-92, 96-98; Parkman, Army Engineers in New England, 1775-1975, pp. 90-96; U.S., Congress, House, Correspondence Concerning the Purchase of the Cape Cod Canal, H. Doc. 139, 67th Cong., 2d sess., 1921, pp. 2-6, hereafter cited as H. Doc. 139.

37. Parkman, Army Engineers in New England, 1775-1975, pp. 96-98; U.S., Congress, House, Cape Cod Canal Mass., H. Doc. 795, 71st Cong., 3d sess., 1931, pp. 1-4, hereafter cited as H. Doc. 795.

38. Parkman, Army Engineers in New England, 1775-1975, pp. 98-102; U.S., Congress, House, Committee on Rivers and Harbors, Cape Cod Carol Mass., H. Com. Doc. 15, 74th Cong., 1st sess., 1934, pp. 2-16, hereafter cited as H. Com. Doc. 15; Laws Relating to Rivers and Harbors, 3:2331.

39. Parkman, Army Engineers in New England, 1775-1975, pp. 103-106; Reid, Cape Cod Canal, pp. 113-116.

40. U.S., Congress, House, Intracoastal waterway, Beaufort, N.C., to Key West, Fla., Section, H. Doc. 229, 63d Cong., 1st sess., 1913, pp. 9-18, hereafter cited as H. Doc. 229.

41. Ibid., p. 10; ARCE, 1932, 1:554-556.

42. ARCE, 1915, 2:1803-1804; ARCE, 1917, 1:585-589; ARCE, 1926, 1:532-533.

43. ARCE, 1947, 1:632; ARCE, 1980, 6:2-3.

44. ARCE, 1880, 1:848; ARCE, 1932, 1:559, 591-592; ARCE, 1938, 1:528; ARCE, 1946, 1:683; U.S., Congress, House, Intracoastal Waterway from Cape Fear River, N.C., to St. Johns River, Fla., H. Doc. 6, 75th Cong., 1st sess., 1936, pp. 1-2, hereafter cited as H. Doc. 6.

45. ARCE, 1915, 1:565-566, 2:1808; ARCE, 1932, 1:596-597; U.S., Congress, House, Waterway, Charleston to Winyah Bay, S.C., H. Doc. 78, 63d Cong., 1st sess., 1913, pp. 2-6, hereafter cited as H. Doc. 78; ARCE, 1927, 1:602; ARCE, 1930, 1:682.

46. U.S., Congress, House, Intracoastal Waterway from Cape Fear River, N.C., to St. Johns River, Fla., H. Doc. 11, 72d Cong., 1st sess., 1932, p. 3, hereafter cited as H. Doc. 11; ARCE, 1938, 1:566; ARCE, 1946, 1:710.

47. ARCE, 1932, 1:613-614; ARCE, 1905, 1:267-268; U.S., Congress, Senate, Waterway from Charleston, S.C., to Savannah, Ga., S. Doc. 178, 68th Cong., 2d sess., 1924, pp. 2-8, hereafter cited as S. Doc. 178; U.S., Congress, House, Fenwicks Cut at Ashepoo River to Coosaw River, S.C., H. Doc. 129, 72d Cong., 1st sess., 1931, p. 2, hereafter cited as H. Doc. 129; ARCE, 1937, 1:537; ARCE, 1947, 1:685.

48. ARCE, 1915, 2:1823; ARCE, 1932, 1:630-632; ARCE, 1938, 1:606; Us., Congress, House, Channel Between the St. Johns River and Cumberland Sound, Fla., H. Doc. 898, 62d Cong., 2d sess., 1912, pp. 2, 5, hereafter cited as H. Doc. 898.

49. ARCE, 1915, 2:1821-1822; U.S., Congress, House, Skidaway Narrows, Georgia, H. Doc. 450, 58th Cong., 2d sess., 1904, pp. 2-3, hereafter cited as H. Doc. 450; U.S., Congress, House, Savannah-Fernandina Waterway, H. Doc. 1236, 60th Cong., 2d sess., 1908, pp. 4-7, hereafter cited as H. Doc. 1236.

50. ARCE, 1915, 2:1814; U.S., Congress, House, Archers Creek, S.C., H. Doc. 513, 62d Cong., 2d sess., 1912, pp. 2-3, hereafter cited as H. Doc. 513.

51. ARCE, 1932, 1:632-633; ARCE, 1947, 1:727-729, 752-753; Us., Congress, House, Cape Fear River, N.C., to St. Johns River, Fla., H. Doc. 618, 75th Cong., 3d sess., 1938, pp. 3-5, hereafter cited as H. Doc. 618; U.S., Congress, House, Generals Cut, Ga., H. Doc. 581, 63d Cong., 2d sess., 1914, p. 2, hereafter cited as H. Doc. 581; U.S., Congress, House, Terry Creek and Back River, Ga., H. Doc. 1391, 62d Cong., 3d sess., 1913, pp. 2-3; hereafter cited as H. Doc. 1391; U.S., Congress, Senate, Cut Between Baileys Cut of Satilla River and-Dover Creek, Ga., S. Doc. 43, 71st Cong., 2d sess., 1929, pp. 1-2, hereafter cited as S. Doc. 43; U.S., Congress, House, Intra-

coastal Waterway Between Charleston, S.C., and St. Johns River, Fla. (Alternate Route Via Frederica River, Ga.), H. Doc. 114, 77th Cong., 1st sess., 1941, p. 3, hereafter cited as H. Doc. 114.

52. ARCE, 1915, 2:1825-1826; ARCE, 1932, 1:676-677; Buker, Sun, Sand and Water, pp. 114-120.

53. U.S., Congress, House, Florida East Coast Canal, H. Doc. 1147, 65th Cong., 2d sess., 1918, pp. 2-3, hereafter cited as H. Doc. 1147; U.S., Congress, House, Intracoastal Waterway from Jacksonville, Fla., to Miami, Fla., H. Doc. 586, 69th Cong., 2d sess., 1926, pp. 2-5, 15-16, hereafter cited as H. Doc. 586; George E. Buker, "The Ugly Duckling: The Beginnings of Florida's Intracoastal Waterway," in National Waterways Roundtable Papers: Proceedings On the History and Evaluation of U.S. Waterways and Ports (Ft. Belvoir, VA: U.S. Army Engineer Water Resources Support Center, Institute for Water Resources, 1980), p. 99.

54. U.S., Congress, Senate, Intracoastal Waterway from Jacksonville to Miami, Fla., S. Doc. 71, 71st Cong., 2d sess., 1930, p. 2, hereafter cited as S. Doc. 71; U.S., Congress, House, Intracoastal Waterway from Jacksonville to Miami, Fla., H. Doc. 740, 79th Cong., 2d sess., 1945, p. 3, hereafter cited as H. Doc. 740; ARCE, 1932, 1:678; ARCE, 1947, 1:775-776; ARCE, 1961, 2:463; ARCE, 1966, 2:441-442.

55. U.S., Congress, Committee on Rivers and Harbors, Waterway from Miami to Key West, Fla., H. Com. Doc. 44, 72d Cong., 1st sess., 1932, pp. 2-5, hereafter cited as H. Com. Doc. 44; U.S., Congress, House, Intracoastal Waterway from Miami to Key West, Fla., H. Doc. 742, 79th Cong., 2d sess., 1945, pp. 5-8, hereafter cited as H. Doc. 742; ARCE, 1938, 1:641; ARCE, 1946, 1:815-816; ARCE, 1963, 2:446.

56. Lane, Indian Trail to Iron Horse, pp. 264-265, 272, 276-277; H. Doc. 391, p. 52; U.S., Congress, Senate, Atlantic Intracoastal Canals, S. Doc. 279, 65th Cong., 2d sess., 1918, p. 71, hereafter cited as S. Doc. 279.

57. S. Doc. 279, pp. 71-79; H. Doc. 391, pp. 22-23, 52-61; H. Doc. 196, pp. 6-8, 10.

58. U.S., Congress, House, Committee on Rivers and Harbors, New York Bay-Delaware River Section, Intracoastal Waterway, H. Com. Doc. 6, 66th Cong., 3d sess., 1920, pp. 2-3, hereafter cited as H. Com. Doc. 6; U.S., Congress, House, Committee on Rivers and Harbors, New York Bay-Delaware River Section of the Intracoastal Waterway, H. Com. Doc. 38, 71st Cong., 2d sess, 1930, pp. 2-4, hereafter cited as H. Com. Dec. 38; U.S.,

Congress, House, New York Bay-Delaware River Section of the Intracoastal Waterway, H. Doc. 219 73d Cong., 2d sess., 1934, pp. 1-4, hereafter cited as H. Doc. 219; U.S., Congress, House, Committee on Rivers and Harbors, New York Bay-Delaware River Section of the Intracoastal Waterway, H. Com. Doc. 93, 74th Cong., 2d sess., 1936, pp. 1-3, hereafter cited as H. Corn. Dec. 93.

59. U.S., Congress, Senate, New York Bay-Delaware River Section of the Intracoastal Waterway, S. Doc. 139, 79th Cong., 2d sess., 1945, pp. 1-3, hereafter cited as S. Doc. 139.

60. U.S., Congress, House, Inland Waterway on the Coast of New Jersey between Cape May and New York Bay, H. Doc. 727, 65th Cong., 2d sess., 1918, pp. 2-3, 6, hereafter cited as H. Doc. 727; U.S., Congress, House, New Jersey Intracoastal Waterway, He Doc. 133, 76th Cong., 1st sess., 1939, pp. 3, 5, hereafter cited as H. Doc. 133; ARCE, 1980, 3:13.

BIBLIOGRAPHY

Public Documents

American State Papers. Edited by Walter Lowrie et al. 38 vols. Washington: Gales and Seaton, 1832-1861.

Laws of the United States Relating to the Improvement of Rivers and Harbors. 3 vols. and index. (H. Doc. 1491, 62d Cong., 3d sess.; H. Doc. 379, 76th Cong., 1st sess.) Washington, DC: Government Printing Office, 1913, 1940.

Richardson, James D., ed. A Compilation of the Messages and Papers of the Presidents, 1789-1897. 10 Vols. Washington, DC: Government Printing Office, 1896-1899.

U.S. Army. Corps of Engineers. Annual Reports of the Chief of Engineers, 1870-1980. Washington, DC: Government Printing Office, 1870-1981.

Waterborne Commerce of the United States, Calendar Year 1979, Part 1, Waterways and Harbors, Atlantic Coast. Vicksburg, MS: Lower Mississippi Valley Division, 1979.

North Atlantic Division. Water Resources Development in Virginia 1981. New York: U.S. Army Engineer Division, 1981.

U.S. Congress. House. Appropriations and Expenditures for Rivers and Harbors. H. Ex. Doc. 64, 48th Cong., 1st sess., 1884.

Archers Creek, S.C. H. Doc. 513, 62d Cong., 2d sess., 1912.

Cape Cod Canal, Mass. H. Doc. 795, 71st Cong., 3d sess., 1931.

Cape Fear River, N.C., to St. Johns River, Fla. H. Doc. 618, 75th Cong., 3d sess., 1938.

Channel Between the St. Johns River, and Cumberland Sound, Fla. H. Doc. 898, 62d Cong., 2d sess., 1912.

Chesapeake and Delaware Canal. H. Ex. Doc. 102, 53d Cong., 3d sess., 1894.

Correspondence Concerning the Purchase of the Cape Cod Canal. H. Doc. 139, 67th Cong., 2d sess., 1921.

Dismal Swamp Canal. H. Doc. 15, 19th Cong., 1st sess., 1826.

Dismal Swamp Canal. H. Ex. Doc. 77, 39th Cong., 1st sess., 1866.

Dismal Swamp Canal. H. Ex. Doc. 135, 40th Cong., 2d sess., 1868.

Fenwicks Cut at Ashepoo River to Coosaw River, S.C. H. Doc. 129, 72d Cong., 1st sess., 1931.

Florida East Coastal Canal. H. Doc. 1147, 65th Cong., 2d sess., 1918.

Generals Cut, Ga. H. Doc. 581, 63d Cong., 2d sess., 1914.

Inland Waterway from Norfolk, Vs., to Beaufort Inlet, N.C. Doc. 1136, 64th Cong., 1st sess., 1916.

Inland Waterway on the Coast of New Jersey between Cape May and New York Bay. H. Doc. 727, 65th Cong., 2d sess., 1918.

Intracoastal Waterway, Beaufort, N.C., to Key West, Fla., Section. H. Doc. 229, 63d Cong., 1st sess., 1913.

Intracoastal Waterway between Charleston, S.C., and St. Johns River, Fla. (Alternate Route Via Frederica River, Ga.). H. Doc. 114, 77th Cong., 1st sess., 1941.

Intracoastal Waterway, Boston, Mass., to Beaufort, N.C.: Final Report on Sections from New York Bay to Delaware River and from Delaware River to Chesapeake Bay. H. Doc. 196, 63d Congo, 1st sess., 1913.

Intracoastal Waterway, Boston, Mass., to Beaufort, N.C., Section. H. Doc. 391, 62d Cong., 2d sess., 1912.

Intracoastal Waterway from Cape Fear River, N.C., to St. Johns River, Fla. H. Doc. 11, 72d Cong., 1st sess., 1932.

Intracoastal Waterway from Cape Fear River, N.C., to St. Johns River, Fla. H. Doc. 6, 75th Cong., 1st sess., 1936.

Intracoastal Waterway from Jacksonville, Fla., to Miami, Fla. H. Do. 586, 69th Cong., 2d sess., 1926.

Intracoastal Waterway from Jacksonville to Miami, Fla. H. Doc.740, 79th Cong., 2d sess., 1945.

Intracoastal Waterway from Miami to Key West, Fla. H. Do. 742, 79th Cong., 2d sess., 1945.

New York Bay-Delaware River Section of the Intracoastal Waterway, H. Com. Doc. 93, 74th Cong., 2d sess., 1936.

Waterway from Miami to Key West, Fla. H. Com. Doc. 44, 72d Cong., 1st sess., 1932.

U.S. Congress. Senate. Atlantic Intracoastal Canals. S. Doc. 279, 65th Cong., 2d sess., 1918.

Cut Between Baileys Cut of Satilla River and Dover Creek, Ga. S. Doc. 43, 71st Cong., 2d sess., 1929.

Inland Waterway from Delaware River to Chesapeake Bay, Del. and Md. S. Doc. 123, 83d Cong., 2d sess., 1954.

Intracoastal Waterway from Jacksonville to Miami, Fla. S. Doc. 71, 71st Cong., 2d sess., 1930.

New York Bay-Delaware River Section of the Intracoastal Waterway. S. Doc. 139, 79th Cong., 2d sess., 1945.

Survey with a view to the construction of a ship-canal to connect the waters of Delaware and Chesapeake Bays. S. Ex. Doc. 39, 46th Cong., 2d sess., 1880.

Surveys for a ship canal to connect Chesapeake and Delaware Bays. S. Ex. Doc. 6, 48th Cong., 1st sess., 1883.

Waterway from Charleston, S.C., to Savannah, Ga. S. Doc. 178, 68th Cong., 2d sess., 1924.

Waterway to Connect Waters of Chesapeake and Delaware Bays. S. Doc. 215, 59th Cong., 2d sess., 1907.

U.S. Department of the Interior. Census Office. Tenth Census of the United States, 1880: Transportation, vol. 4.

U.S. Statutes at Large. vol. 1 (1789).

Books and Articles

Adams, James Truslow. The Founding of New England. Boston: Little, Brown, and Coo, 1930.

Albion, Robert Greenhalgh. The Rise of New York port, 1815-1860. New York: Charles Scribner's Sons, 1939.

Barbour, Philip L. The Three Worlds of Captain John Smith. Boston: Houghton Mifflin Co., 1964.

Bastian, David F. "The Development of Dredging Through the 1850's." In National Waterways Roundtable Papers: Proceedings On the History and Evolution of U.S. Waterways and Ports. Ft. Belvoir, Vs.: U.S. Army Engineer Water Resources Support Center, Institute for Water Resources, 1980.

Beaver, Patrick. A History of Lighthouses. Secaucus, NJ: Citadel Press, 1973.

Brebner, John Bartlett. The Explorers of North America, 1492-1806. New York: Macmillan Co., 1933.

Brown, Alexander Crosby. The Dismal Swamp Canal. Chesapeake, VA: Norfolk County Historical Society of Chesapeake, 1967.

Brown, Earl I. "The Chesapeake and Delaware Canal." Transactions of the American Society of Civil Engineers 95 (1931):716-763.

Buker, George E. Sun, Sand and Water: A History of the Jacksonville District, U.S. Army Corps of Engineers, 1821-1975. Jacksonville, FL: U.S. Army Engineer District, 1981.

"The Ugly Duckling: The Beginnings of Florida's Intracoastal Waterway." In National Waterways Roundtable Papers: Proceedings On the History and Evolution of U.S. Waterways and Ports. Ft. Belvoir, VA: U.S. Army Engineer Water Resources Support Center, Institute for Water Resources, 1980.

Clowes, Ernest S. Shipways to the Sea: Our Inland and Coastal Waterways.. Baltimore: Williams & Wilkins Co., 1929.

Cranmer, Jerome. "Improvements Without Public Funds: The New Jersey Canals." In Canals and American Economic Development, pp. 115-166. Edited by Carter Goodrich. New York: Columbia University Press, 1961.

Crouse, Nellis M. In Quest of the Western Ocean. New York: William Morrow & Co., 1928.

Dangerfield, George. The Awakening of American Nationalism, 1815-1828. New York: Harper & Row, 1965.

Delaware and Hudson Company. A Century of Progress: History of the Delaware and Hudson Company, 1823-1923. Albany: J.B. Lyon Co., 1925.

Dunaway, Wayland Fuller. History of the James River and Kanawha Company. Columbia University Studies in History, Economics, and Public Law, vol. 104, no. 2. New York: Columbia University Press, 1922.

Goodrich, Carter. Government Promotion of American Canals and Railroads, 1800-1890. New York: Columbia University Press, 1960.

"National Planning of Internal Improvements." Political Science Quarterly 63 (1948):16-44.

"The Virginia System of Mixed Enterprise: A Study of State Planning of Internal Improvements." Political Science Quarterly 64 (1949): 355-387.

Granger, M.L. History of the Savannah District, 1829-1968. Savannah, GA: U.S. Army Engineer District, 1968.

Gray, Ralph D. The National Waterway: A History of the Chesapeake and Delaware Canal, 1769-1965. Urbana: University of Illinois Press, 1967.

"Great Falls canal and locks: Civil engineering landmark." Civil Engineering 42 (November 1972):53-56.

Harlow, Alvin F. Old Towpaths: The Story of the American Canal Era. Port Washington, NY: Kennikat Press, 1964.

Hill, Forest G. Roads, Rails & Waterways: The Army Engineers and Early Transportation. Norman: University of Oklahoma Press, 1957.

Hinshaw, Clifford Reginald, Jr. '*North Carolina Canals Before 1960." North Carolina Historical Review 25 (1948):1-56.

Holt, W. Stun. The Office of the Chief of Engineers of the Army : Its Nonmilitary History , Activities, and Organization. Baltimore: Johns Hopkins Press, 1923.

Howe, Henry F. Prologue to New England. New York: Farrar & Rinehart, 1943.

Hutchins, John G.B. The American Maritime Industry and Public policy, 1789-1914. Harvard Economic Studies, vol. 71. Cambridge: Harvard University Press, 1941.

Johnson, Emory R. "Inland Waterways, Their Relation to Transportation." Supplement to Annals of the American Academy of Political-and Social Science (September 1893): 1-164.

"Rivers and Harbors Bills. " Annals of the American Academy of Political and Social Science 2 (1892):782-812.

Jones, Chester Lloyd. '*The Anthracite-Tidewater Canals.*' Annals of the American Academy of Political Science 31 (January-June 1908):102-116.

Kanarek, Harold. The Mid-Atlantic Engineers: A History of the Baltimore District, U.S. Army Corps of Engineers, 1774-1974. Baltimore, MD: U.S. Army Engineer District, 1978.

Kirkland, Edward Chase. Men, Cities, and Transportation: A Study in New England History, 1890-1900. 2 vols. Cambridge: Harvard University Press, 1948.

Klawonn, Marion J. Cradle of the Corps: A History of the New York District, U.S. Army Corps of Engineers, 1775-1975. New York: U.S. Army Engineer District, 1977.

Lane, Wheaton J. From Indian Trail to Iron Horse: Travel and Transportation in New Jersey, 1620-1860. Princeton: Princeton University Press, 1939.

Lippincott, Isaac. "A History of River Improvement." Journal of Political Economy 22 (1914):630-660.

Love, W. DeLoss. "The Navigation of the Connecticut River."' Proceedings of the American Antiquarian Society, New Series 15 (1903):385-441.

Luetscher, G.D. "Atlantic Coastwise Canals: Their History and Present Status." Annals of the American Academy of Political and Social Science 31 (January-June 1908):92-101.

MacGill, Caroline E. et al. History of Transportation in the United States before 1860. Washington: Carnegie Institution of Washington, 1917.

Manhart, George Born. The English Search for a Northwest Passage in the Time of Queen Elizabeth. Studies in English Commerce and Exploration in the Reign of Elizabeth. Philadelphia: University of Pennsylvania Press, 1924.

Marvin, Winthrop L. The American Merchant Marine: Its History and Romance from 1620 to 1902. New York: Charles Scribners Sons, 1902.

Moore, Jamie W., and Moore, Dorothy P. "Effect of Harbor Improvement on Inland Commerce and Economic Development, The Case of Charleston." In National Waterways Roundtable

Papers: Proceedings On the History and Evolution of U.S. Waterways and Ports. Ft. Belvoir, VA: U.S. Army Engineer Water Resources Support Center, Institute for Water Resources, 1980.

Morison, Samuel Eliot. The European Discovery of America: The Northern Voyages, A.D. 500-1600. New York: Oxford University Press, 1971.

The European Discovery of America: The Southern Voyages, A.D. 1499-1616. New York: oxford University Press, 1974.

Morison, Samuel Eliot, Commager, Henry Steele, and Leuchtenburg, William E. The Growth of the American Republic. 2 vols., 8th ed. New York: Oxford University Press, 1969.

Nettels, Curtis P. The Roots of American Civilization. 2d ed. New York: Appleton-Century-Crofts, 1963.

Newlands, Francis G. "The Use and Development of American Waterways." Annals of the American Academy of Political and Social Science 31 (January-June 1908):48-66.

Parkman, Aubrey. Army Engineers in New England: The Military and Civil Work of the Corps of Engineers in New England, 1775-1975. Waltham, MA: U.S. Army Engineer Division, 1978.

Poor, Henry Varnum. History of the Railroads and Canals of the United States of America. 1860. Reprint. New York: Augustus M. Kelley, 1970.

Powys, Llewelyn. Henry Hudson. New York: Harper & Brothers, 1928.

Quinn, David Beers. England and the Discovery of America, 1481-1620. New York: Alfred A. Knopf, 1974.

Ransdell, Joseph E. "Legislative Program Congress Should Adopt for Improvement of American Waterways." Annals of the American Academy of Political and Social Science 31 (January-June 1908):36-47.

Reid, William James. The Building of The Cape Cod Canal, 1627-1914. Privately printed, 1961.

Ringwalt, J.L. Development of Transportation Systems in the United States. Philadelphia: J.L. Ringwalt, 1888.

Roberts, Christopher. The Middlesex Canal, 1793-1860. Harvard Economic Studies, vol. 61. Cambridge: Harvard University Press, 1938.

Rubin, Julius. "An Imitative Public Improvement: The Pennsylvania Main Line." In Canals and American Economic Development. Edited by Carter Goodrich. New York: Columbia University Press, 1961, pp. 67-114.

Rush, Thomas E. The Port of New York. Garden City, NY: Doubleday, Page & Company, 1920.

Sanderlin, Walter S. The Great National Project: A History of the Chesapeake and Ohio Canal. The Johns Hopkins University Studies in Historical and Political Science, vol. 64, no. 11 Baltimore: Johns Hopkins Press, 1946.

Shaw, Ronald E. Erie Water West. Lexington: University of Kentucky Press, 1966.

Smith, Alfred Glaze, Jr. Economic Readjustment of an Old Cotton State: South Carolina, 1820-1860. Columbia: University of South Carolina Press, 1958.

Snyder, Frank E., and Guss, Brian H. The District: A History of the Philadelphia District, U.S. Army Corps of Engineers, 1866-1971. Philadelphia: U.S. Army Engineer District. 1974.

Taylor, George Rogers. The Transportation Revolution, 1815-1860. The Economic History of the United States, vol. 4. New York: Rinehart & Co., 1951.

Walker, Paul K. "Building American Canals: Part l--The Federalist Period," and "Part 2--From Erie to the Present." Water Spectrum 12 (Winter 1979-1980):18-25 and (Summer 1980):12-23.

Ward, Christopher. The Dutch & Swedes on the Delaware, 1609-1664. Philadelphia: University of Pennsylvania Press, 1930.

Ward, George Washington. The Early Development of the Chesapeake and Ohio Canal Project. The Johns Hopkins University Studies in Historical and Political Science, vol. 17, nos. 9-11. Baltimore: Johns Hopkins Press, 1899.

Weaver, Charles Clinton. Internal Improvements in North Carolina Previous to '1860. The' Johns Hopkins University Studies in Historical and Political Science, series 21, nos. 3-4. Baltimore: Johns Hopkins Press, 1903.

Williams, T. Harry, Current, Richard N., and Freidel, Frank. A History of the United States. 2 vols., 2d cd., rev. New York: Alfred A. Knopf, 1964.

Williamson, James A. The Voyages of the Cabots and the Discovery of North America. London: Argonaut Press, 1929.

Winsor, Justin, ed. The Memorial History of Boston, 1630-1880. 4 vols. Boston: Ticknor and Co., 1881.

Writers' Program of the Work Projects Administration, Massachusetts. Boston Looks Seaward: The Story of the Port, 1630-1940. Boston: Bruce Humphries, 1941.

Writers Program of the Work Projects Administration, New York. A Maritime History of New York. Garden City, NY: Doubleday, Doran and Company, 1941.

Wroth, Lawrence C. The Voyages of Giovanni da Verrazzano, 1524-1528. New Haven: Yale University Press, 1970.

*U.S. GOVERNMENT PRINTING OFFICE: 1983-399-067

January 1983
Navigation History NWS-83-10