Wes Hall. *An Underwater Archaeological Survey of Heron's Colonial Bridge Crossing Site over the Northeast Cape Fear River near Castle Hayne, North Carolina.* (Under the direction of Gordon P. Watts and Dr. William N. Still, Program in Maritime History and Underwater Research), Department of History, East Carolina University, November 1992.

The goal of this survey was to confirm, by historical research and underwater archaeological techniques, the location of Heron's colonial bridge crossing. A secondary objective was to assess the archaeological potential of the river crossing by examining and documenting exposed cultural material and features related to the site on the river bottom. In order to understand the significance of the site, extensive background research was necessary. First, historical research into the early settlement and development of the Cape Fear region was conducted. Second, specific investigations were conducted on any person ever associated with the bridge crossing site. Third, to understand the archaeological potential of the site, research into the early wooden bridge construction was conducted. Finally, an archaeological site assessment was achieved by surveying the bottom surface at the crossing site using divers and remote sensing techniques.

An Underwater Archaeological Survey of Heron's Colonial Bridge Crossing Site over the Northeast Cape Fear River near Castle Hayne, North Carolina

A Thesis
Presented to the
Faculty of the Department of History
East Carolina University

In Partial Fulfillment
of the Requirements
for the Degree
Master of Arts
in the
Program in Maritime History
and Underwater Research

by
Wes Hall
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Introduction

Heron's Colonial Drawbridge

Information about bridge construction in America prior to the early nineteenth century is very limited. Most of our knowledge concerning pre-nineteenth century bridges has been extracted from historic travel accounts, paintings or drawings. The development of the "arched truss," and later horizontal truss bridge types, enabled early nineteenth century bridge builders to cross wide, relatively deep and swift flowing rivers.[1] Prior to this advancement in bridge design, fixed bridges, constructed over large rivers, were rare. Even more unusual, were river bridges that were designed with a mechanical "draw" to permit the passage of ship traffic. No formal archaeological study of these early bridge types has been undertaken. Archaeological investigations at early bridge crossing sites are the sole remaining method of enhancing our knowledge of pre-nineteenth century American bridge construction. Historical records of early bridge design have been lost or were never available.

One such opportunity for study is the crossing site at one of America's earliest drawbridges, or Heron's Bridge. Heron's Bridge was built across the Northeast Cape Fear River in the colonial Province of North Carolina in 1767-68. This early bridge was more than 400 feet long with a 30-foot-wide draw span. The Bridge was built along the preferred north-south road that connected the most important towns in the Colonial

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[1] Llewellyn Nathaniel Edwards, *A Record of History and Evolution of Early American Bridges* (Orono, Maine: University Press, 1959), p. 23, hereinafter cited as L. N. Edwards, *Early American Bridges*.

Province. The "Duplin Road," as it was known to early residents of Wilmington, North Carolina, was an important and well-traveled segment of the main coastal road system.[2] The bridge was built by the prominent plantation owner and government official, Benjamin Heron. Heron's Bridge had the distinction of being the first drawbridge in North Carolina and one of the earliest built over a navigable river in America. Even though Heron's Bridge was important transportation an improvement for local inhabitants, and must have been an impressive engineering achievement at the time, little information about how it was built has survived in the historic record.

The existence of Heron's historic drawbridge first received public attention in 1940, when an historic marker was place at the juncture of U.S. Highway 117 and the Northeast Cape Fear River.[3] Prior to this time, knowledge of the Bridge was limited to a few historians familiar with North Carolina's colonial records. Even after the existence of the Bridge was acknowledged, uncertainty about the exact location of the bridge crossing continued. No in depth research into the history of the bridge crossing was conducted until the early 1980s. In 1981, an underwater archaeological investigation was initiated by East Carolina University's Program in Maritime History and Underwater Research on two sunken ferry vessels near the location of the historic Blossom's Ferry crossing on the Northeast Cape Fear River. The underwater investigation of the vessels at Blossom's Ferry site continued through 1983 as a Fall semester project for graduate students. During the 1983 season, historical research and physical evidence were discovered that suggested

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[2] During the eighteenth century, Duplin County bordered New Hanover County to the north at approximately the same location that Pender County meets Duplin County today.

[3] Michael Hill, State Department of Archives and History (interviewed 9 February 1992).

the Blossom's Ferry crossing site was the location of Heron's Bridge. Historical evidence included Benjamin Heron's Will and subsequent deed records related to the property. Physical evidence included a partially intact large wooden trestle and scattered timbers that appeared to be related to an early bridge structure. Since the focus of East Carolina University's project was the two ferries located at the crossing, no investigation of the bridge remains was undertaken at that time.

Location and Environment

The historic "Duplin Road" (or "Great Road") crossed the Northeast Cape Fear River, 9 road miles north of historic Wilmington.[4] The crossing was constructeded along a portion of the River that forms part of the northern border between present-day New Hanover and Pender Counties (Figure 1). At the historic crossing site, a gradual meander cuts the south side of the River, creating a 15-foot-high bank immediately east of the bridge/ferry landing. The north side was bound by a swamp one quarter mile in width. During periods of high water the north side of the River floods. Although the location seems to be a poor choice for a ferry or bridge crossing, it is the first location north of Wilmington where the swamp, along the river, narrows to less than one mile in width. Colonial road builders chose the most suitable location to cross not only the river but the associated swamp.

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[4] The road north from Wilmington was also referred to as the "Great Road." Evangeline Walker Andrews ed., with the collaboration of Charles Mclean Andrews, *Journal of a Lady of Quality: Being the Narrative of a Journey from Scotland to the West Indies, North Carolina, and Portugal, in the Years 1774-1776*, by Janet Schaw (New Haven: Yale University Press, 1922), p. 202, hereinafter cited as Andrews, *Journal of a Lady of Quality*.

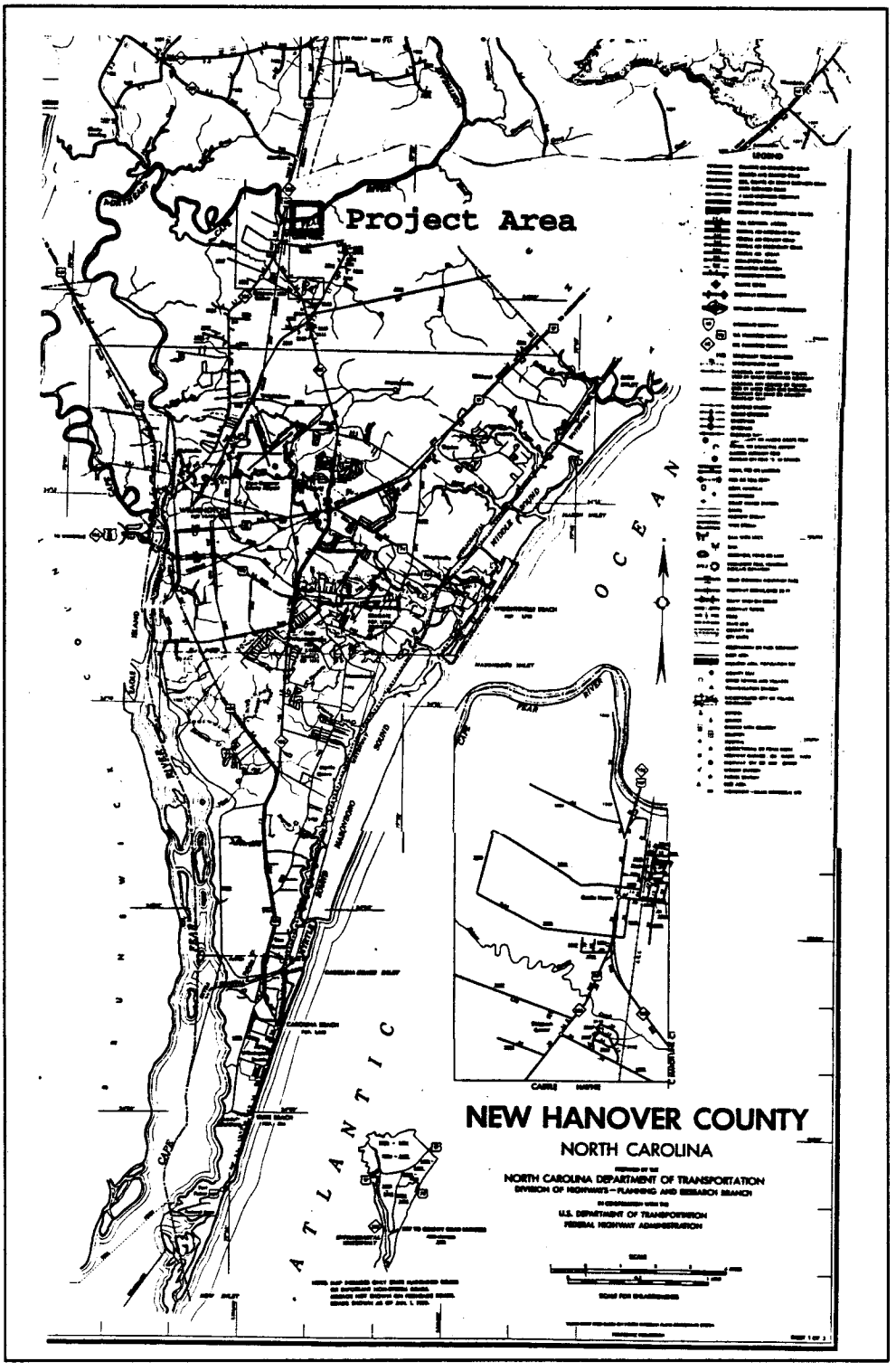

Figure 1. Project Location Map.

The Northeast Cape Fear River is part of the greater Cape Fear River drainage system that includes a 1740 square mile region directly north of Wilmington. The entire Northeast Cape Fear River basin lies within the Coastal Plain, with an average stream gradient of less than 6 inches per mile. Approximately 50 miles of the River is affected by tides.[5] The main stem of the River and its tributaries typically drain low-lying humus-laden swamplands. Tannic acid is leached from the humus, staining the water a reddish brown, much like strong tea. The tannin stain diffuses light, giving the River its characteristic black color. The majority of the 150-mile-long river runs directly North to South. The course of the Northeast Cape Fear River is contrary to the majority of North Carolina's coastal river systems whose drainage systems run primarily West to East.

The River cuts through a deposit of marl that lies near the ground surface throughout the region. In fact, the marl deposit that underlies much of eastern North Carolina is named Castle Hayne Marl because of its proximity to the surface in the region near the town of Castle Hayne, less than a mile from the crossing.[6] In the central portion and beneath the water on the southern side of the River, the marl is exposed, creating a hard relatively flat bottom surface or fragmentary ledges. From the central part of the River to the North the marl becomes more and more deeply buried below river sediments.

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[5] G. L. Giese, H. B. Wilder, and G. G. Parker, Jr. *Hydrology of Major Estuaries and Sounds of North Carolina*, (U.S. Geological Survey Water Resources Investigations 79-46: Prepared in cooperation with the North Carolina Department of Natural Resources and Community Development, 1979), p 107.

[6] Wright Horton, Jr. and Victor A. Zullo, The Geology of the Carolina, (Knoxville: The University of Tennesse Press, 1991), p. 252.

Previous Investigations

The location of Heron's Bridge crossing was first recorded and identified as the site of Blossom's Ferry by an archaeological survey of New Hanover County conducted by the Underwater Archaeology Unit of the North Carolina Division of Archives and History. The archaeological survey was funded through Title II of the Comprehensive Employment and Training Act of 1973. Blossom's Ferry was first recorded as a terrestrial archaeological site and was named after the last ferry owner Samuel Blossom. Blossom operated the ferry from 1882 until 1925.[7]

In 1979, an informal underwater reconnaissance of the south side of the Northeast Cape Fear River was carried out by the author. During the search, a single ferry and eighteenth and nineteenth century cultural material were identified. The author informed members of the Underwater Archaeology Branch of the North Carolina Division of Archives and History about the discovery which prompted the Underwater Archaeology Branch to conduct a magnetometer survey of the site in August 1980. During a follow-up examination in July 1981, the Underwater Archaeology Branch relocated a "flat-bottom barge-like vessel" at the site.[8]

In October 1981, one of the first projects conducted by the newly formed Program in Maritime History and Underwater Research of East Carolina University was a two-day underwater reconnaissance level investigation of the Blossom Ferry site. During the reconnaissance, a second flat-bottom vessel was discovered in close proximity to the first. Preliminary

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[7] Gordon P. Watts, Jr. and Wesley K. Hall, *An Investigation of Blossom's Ferry on the Northeast Cape Fear River*, (Greenville, North Carolina: Program in Maritime History and Underwater Research, Department of History, East Carolina University, 1986) ECU Research Report no. 1, p. 11. hereinafter referred to as Watts and Hall, *An Investigation of Blossom's Ferry on the Northeast Cape Fear River*.

[8] Ibid.

mapping preformed at both vessels confirmed that they were ferries. Artifacts collected in association with the eastern-most ferry included a lead-glazed earthenware crock, three-leg cast iron pipkin, and fragments of a creamware plate. The recovered artifacts recovered suggested that the vessel dated as early as the mid-eighteenth century. Construction details associated with the vessel helped to support an eighteenth century construction date. Artifactual material found in association with the West vessel combined with construction details suggested to investigators a late-eighteenth to early-nineteenth century construction date.

On 20 July 1982, Daniel Koski-Karell conducted a proton precession magnetometer survey of the proposed Interstate 40 bridge crossing only a few hundred feet downstream from the site of Blossom's Ferry. Although five magnetic anomalies were identified, all proved to be modern debris.[9]

In the fall of 1982 and 1983 East Carolina University's Program in Maritime History and Underwater Research conducted the third and fourth survey of the two ferries. During the 1983 project, both vessels were completely excavated and documented by underwater mapping techniques.[10] During the course of the 1983 project, a bottom surface reconnaissance in the areas where the ferries would have crossed the River resulted in the identification of a scatter of large cut timbers and a single timber framed bridge trestle. At that time, the scope of the project did not permit further investigation of the timber scatter or trestle.

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[9] Daniel Koski-Karell, *Cultural Resource Investigation of the Project Area of a Proposed Highway Bridge over the Northeast Cape Fear River, Pender and New Hanover Counties, North Carolina*, (Raleigh: North Carolina Department of Transportation, 1982).

[10] Watts and Hall, *An Investigation of Blossom's Ferry on the Northeast Cape Fear River*, p. 19.

Project Objectives

The goal of the this survey was to confirm by historical research and underwater archaeological techniques, the location of Heron's colonial bridge crossing. A secondary objective was to assess the archaeological potential of the river crossing by examining and documenting exposed cultural material and features related to the site on the river bottom. In order to understand the significance of the site, extensive background research was necessary. First, historical research into the early settlement and development of the Cape Fear region was conducted. Second, specific investigations were conducted on any person ever associated with the bridge crossing site. Third, to understand the archaeological potential of the site, research into the early wooden bridge construction was necessary. Finally, an archaeological site assessment was achieved by a surveying of the bottom surface at the crossing site using divers and remote sensing techniques.

Colonization and Development of the Cape Fear Region

Early Exploration and Settlement

A 38-year-old Florentine named of Giovanni da Verrazzano holds the distinction of being the first recorded European explorer to travel up what is today known as the Cape Fear River.[1] On March 1, 1524, Verrazzano arrived off the coast of North America aboard his ship *La Dauphine* after a disastrous voyage. He had lost three of his four original ships in a terrible storm. Verrazzano only months earlier had convinced the King of France, Francis I, to grant him ships to search for a faster route to the Asian trading center of Cathay. When Verrazzano recorded in his log "Landfall, 34 degrees N", he thought he had found the "happy shores of Cathay". Instead, Verrazzano literally sailed his ship into the mouth of the Cape Fear River.[2] Verrazzano stayed in the region only long enough to make observations, then he continued north along the coast as far as present day New York before returning to France. In a letter written to apprise King Francis I of his journey, Verrazzano described the land and the native inhabitants. The letter contained the earliest description of the Cape Fear Region.[3]

Under similar circumstances the Spaniards became the next Europeans to arrive in southeastern North Carolina. In 1526, an expedition of five hundred settlers sailing from Hispaniola, led by Lucas Vasquez de Ayllon, was blown north of its intended destination. In an attempt to enter the

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[1] R. D. W. Conner, "The Voyage of Verrazzano: The First Exploration of the N.C. Coast by Europeans," *North Carolina Booklet*, XVI (April 1917), 209-218.

[2] Diane Cobb Cashman, *Cape Fear Adventure: An Illustrated History of Wilmington.* (Chatsworth, California: Windsor Publications, 1982) p. 8.

[3] Lawrence Lee, *The Cape Fear in the Colonial Days*, (Chapel Hill: The University of North Carolina Press, 1965) p. 14, hereinafter cited as Lee, *The Cape Fear in the Colonial Days*.

mouth of a river at 34 degrees north (latitude), one of de Ayllon's ships foundered on a sand bar and was destroyed. The Spaniard, de Ayllon like Verrazzano had found accidentally the mouth of the Cape Fear River. Unlike Verrazzano however, de Ayllon stayed in the area to explore and build a replacement ship.[4] After an extended stay in the Cape Fear area and upon completing construction of the new vessel, de Ayllon moved the settlers closer to their original destination, present-day South Carolina. They resettled along the South Carolina coast, but de Ayllon became sick during the first winter and died. Without de Ayllon's leadership, the first white settlement in the United States never flourished.[5]

Sir Walter Raleigh, with the blessings of Queen Elizabeth, attempted to make the next settlement in America at Roanoke Island in 1585. English claims to the New World were based on the 1497 voyage of John Cabot who had discovered America in the vicinity of Cape Breton Island. Religious and economic turmoil in England prevented advancement of Cabot's claims for almost a century until the reign of Queen Elizabeth I. Sir Walter Raleigh had inherited the rights to occupy lands in the New World from his half brother Sir Humprey Gilbert. In 1584, he sent an expedition to explore the coast of present day North Carolina. With favorable reports from the exploration, Raleigh outfitted a group of colonist under the leadership of Ralph Lane to settle at Roanoke Island in 1585. Lane proved to be a poor choice as leader. In 1586, when Sir Francis Drake passed by the Island, he found the new colony on the verge of starvation, and he returned to England. Raleigh, with additional support from the Queen, tried a second time to establish a settlement

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[4] The Cape Fear River was the site of the first ship constructed in North America.

[5] Woodbury Lowery, *The Spanish Settlements Within the Present Limits of the United States, 1513-1561* (New York: G. P. Putman's and Sons, 1911) pp. 160-165, 447-452.

on Roanoke Island in 1587. This time Raleigh placed the colonist under the leadership of John White. This settlement also failed when all of the colonist mysteriously disappeared. The group came to be known as the famous "Lost Colony".[6]

Although Sir Walter Raleigh's efforts to create a settlement in America failed, the publicity of his attempts helped to kindle a strong desire for an English presence in North America. In 1607, the first permanent foundations for the English claim's to North America were laid on the James River, in present-day Virginia. Settlers, supported by two groups of merchants from London and Plymouth, created the first continuing English settlement in America at Jamestown. With economic support from English merchants, Jamestown became a success within a few years.

The success at Jamestown encouraged the English development in other areas of the New World. Pilgrims were settled in New England in the early 1620s. The Pilgrims were followed by a group of Puritans who settled Massachusetts Bay Colony in the late 1620s. Then, in the early 1630s, Maryland became a haven for English Roman Catholics.[7]

During this same period, King Charles I of England established the Province of Carolana. The new province was originally set up in 1629 as a grant to Sir Robert Heath, who was Attorney General to the crown. The grant assigned to Heath the region between 31° and 36° latitude extending from sea to sea (Figure 2).[8] However, Heath's first efforts toward

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[6] Lee, *The Lower Cape Fear in the Colonial Days,* pp. 19-22.

[7] Ibid. p 23.

[8] Jodocus Hondius "Virginiae Item et Floridae Americae Provinciarum, nova Descriptio," William. P. Cumming, *North Carolina in Maps* (Raleigh: State Department of Archives and History, 1966), Mercator-Hondius 1606, Plate III hereinafter cited as *North Carolina in Maps*.

settling the new province proved to be unfavorable with the King. Heath saw the new region as a place to resettle refugees who were fleeing then troubled France. His first proposal was designed to establish a colony of French Huguenots along the Cape Fear River. The King, not wanting anything but faithful Englishmen in the New World, effectively thwarted Heath's plan. King Charles I issued an order requiring only English subjects faithful to the Church of England to be allowed to settle in the Province of Carolana. Heath, not wishing to displease King Charles I, quickly aborted his plans and relinquished his grant to Lord George Berkley.[9]

Establishing a settlement in the new Province of Carolana during the seventeenth century was not to be easy. England became embroiled in yet another period of internal problems and civil war that lasted until King Charles I was beheaded in 1649. England's economy and external growth were stifled because of the conflicts. Not until 1660 when Charles Stuart (or Charles II), son of Charles I, became King of England did a new period of restoration emerge.[10]

After Charles II became King, he found himself indebted to those who had helped him regain his royal status. He sought to repay eight of his supporters in 1663 by issuing a charter that conveyed the area of the original Heath grant to eight "Lords Proprietors," who included some of the most prominent men in England. In 1665, a new charter was issued that expanded the boundaries of the new province renamed "Carolina". The new boundaries were set at 29° to 36-1/2° (Figure 3).[11] The new boundaries were designed to include

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[9] Lee, *The Lower Cape Fear in the Colonial Days*, p. 24.
[10] Ibid. p. 26
[11] John Ogilby, "A New Discription of Carolina By Order of the Lords Proprietors," *North Carolina in Maps*, Ogilby-Moxon ca. 1672, Plate V.

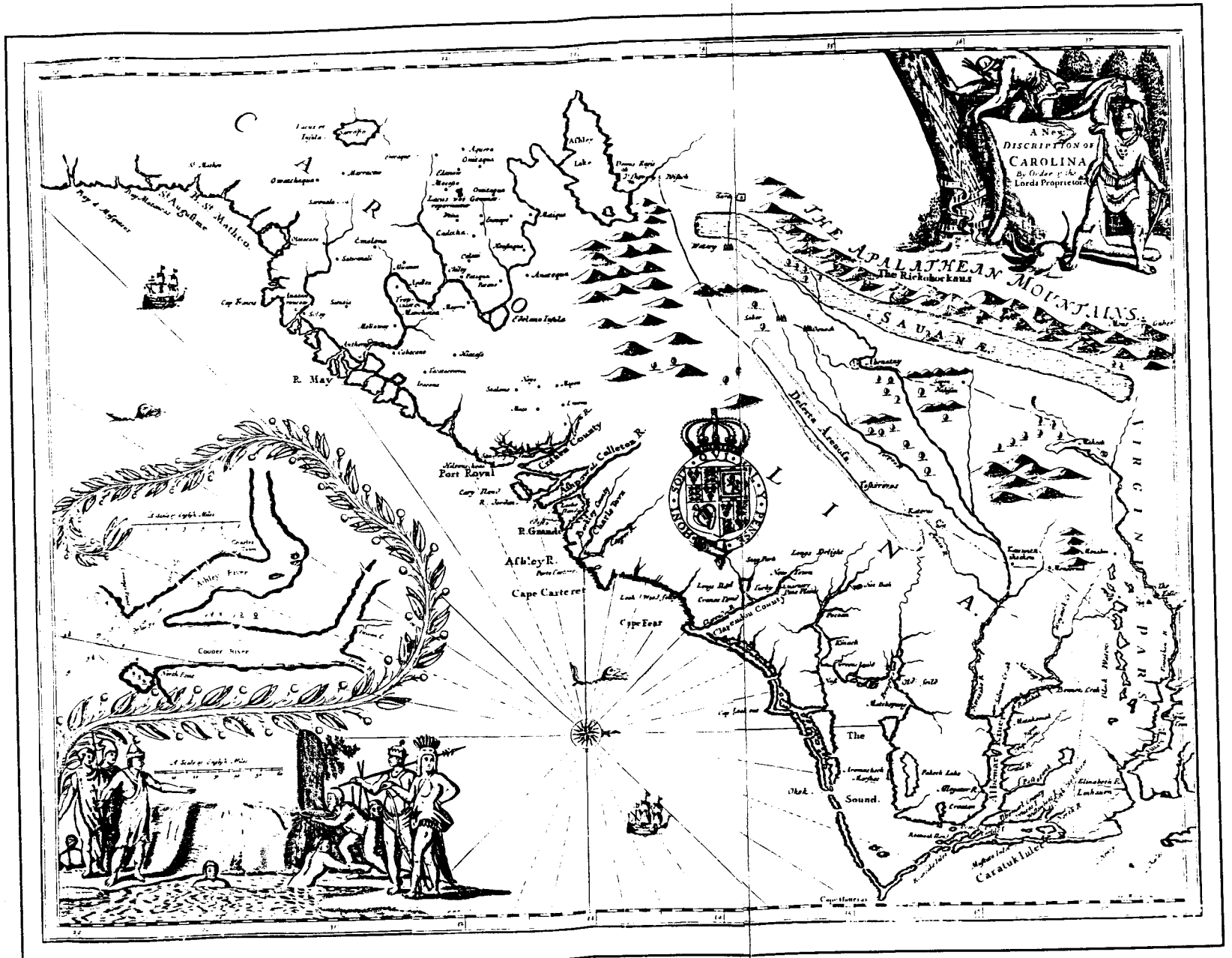

Figure 3. Ogilby c. 1672. Early Map including the region of North Carolina.

colonists from Virginia who had occupied the Albemarle region and the region of Spanish occupied St. Augustine in present-day Florida.[12]

At the same time in America, there was renewed interest in the Cape Fear region when in 1662 an expedition under the leadership of Captain William Hilton explored the River in his ship *Adventure*. The expedition was sponsored by Puritans from the Massachusetts Bay Colony who wished to resettle in a more southerly climate. The group had formed a company with specific intentions to explore the Cape Fear region and report to potential Puritan settlers. Finding the land habitable and rich in natural resources, Hilton successfully negotiated with the Indian inhabitants for rights to a large section of land along the Lower Cape Fear River. Hilton then returned to New England to inform the company and settlers. Interest in the Cape Fear region was acute. Almost immediately New Englanders formed an expedition to settle along the Cape Fear River. The first colonists arrived in the winter of 1663. Their stay was short, however. Within four months the colony was abandoned, and the settlers returned to New England.

The exact reason that the settlers left the new settlement is unknown. The colonist may well have been discouraged when they received word that the King had granted the land to the Lords Proprietors. Within a few months after the attempted settlement, associates of the Massachusetts Bay Company in England met with the Lords Proprietors to promote the resettlement of Puritans in Carolina. By the latter part of 1663 the Lords Proprietor had drafted "A Declaration and

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[12] The First Charter Granted by King Charles the Second to the Lords Proprietors to Carolina, and The second Charter Granted by King Charles the Second to the Lords Proprietors to Carolina dated the thirtieth day of June in the Seventeenth Year of his reign, A.D., 1665, *Colonial Records*, I, 20-33, 102-114.

Proposal to All that Will Plant in Carolina." The proposal to the Puritans of New England gave them less political freedom than they had enjoyed in the Massachusetts Bay Colony. In addition, it contained an impractical system of land division and boundaries that had no provisions for terrain or quality of farm ground. Hence, Puritans protested the Lords Proprietors proposal, but the Proprietors refused to yield.[13]

By August 1663, Captain Hilton had disassociated himself from the Massachusetts Bay Colony and returned to the region to further explore the area on behalf of a group from the island of Barbados. Captain Hilton, along with several representatives of Barbadian settlers, sailed from Barbados with the intention of completing a detailed exploration of the Cape Fear region. Hilton spent almost two months exploring the terrain surrounding the Cape Fear River and Northeast Cape Fear River.[14]

John Vassall, a prominent figure in Barbados with strong political support in London, was a driving force in promoting Hilton's second exploration of the Cape Fear region. It was Vassall who was eventually chosen to negotiate with the Lords Proprietors for the right to begin a settlement on the Cape Fear River. It was also John Vassall who led a group of Barbadians to the Cape Fear River in May 1664. The Barbadian group settled on the west side of the Cape Fear River approximately 20 miles upstream from the mouth. The settlement, called Charles Town, was loosely organized but lasted more than three years. Trouble with the Indian inhabitants and lack of real support from the Lords Proprietors forced Vassall's settlers to completely abandon

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[13] Proposealls of Several Gentlemen of Barbadoes August this 12th 1663, *Colonial Records*, I, 39-40, also Lee, *The Lower Cape Fear in the Colonial Days*, p. 36.
[14] Ibid.

the colony by the fall of 1667. Timing apparently played a major role in the failure of the Cape Fear settlement. At the time of the attempted settlement, the Lords Proprietors were preoccupied with the "Great Plague" in London and a war with both the French and the Dutch. Both of these events kept the Lords Proprietors from providing needed support to the remote settlement.[15] Charles Town was the last attempt to establish a permanent settlement in the region of the Cape Fear River until the end of the first quarter of the eighteenth century.

In 1670, while the Cape Fear region continued under the domain of the Indians, the settlement of Charles Town was started in present-day South Carolina. At approximately the same time, to the north of the Cape Fear, colonists began trickling down from settlements in New England and Virginia into the region of the Albemarle Sound. Over the next 50 years, planters emanating from Charles Town began to inhabit a larger and larger area of coastal South Carolina. As time passed, South Carolina became a strong producer of naval stores, rice, and furs. In the early part of the eighteenth century, England began a policy of subsidizing the production of naval stores (including tar, pitch, turpentine and lumber) in the American colonies.[16] These subsidies or bounties stimulated planters in South Carolina to seek unclaimed tracts of pine forests from which to produce these valuable commodities. Because of the coastal geography of South Carolina, it wasn't long before the more accessible pine forests were claimed. South Carolina planters wishing to take advantage of the boom in naval store production began seeking unclaimed lands to the north along the Cape Fear River.[17]

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[15] Ibid.
[16] Lee, *The Lower Cape Fear in the Colonial Days*, p. 62.
[17] Ibid p. 93.

On 3 June 1725, with the support of George Burrington (later named the first Royal Governor of North Carolina) Colonel Maurice Moore obtained a land grant containing title to 1500 acres on the west bank of the Cape Fear River. On part of this land Moore laid out a new town called Brunswick.[18] In the same year Colonel John Porter was granted 640 acres of land on the west bank just below Moore's holdings.[19] By 1728, land grants of record included 9,210 acres to Maurice Moore; 12,780 acres to Roger Moore; 1,280 acres to Eleazer Allen; 3,280 to Samuel Swann;s and 640 to John Porter.[20]

Southeastern North Carolina was first settled and developed by a close-knit and wealthy group of planters who had already established themselves in America. Most of the first settlers, who included Maurice Moore and his brothers, were from South Carolina. They were either related or closely associated. They were motivated by the potential profits held in the virgin region of the Cape Fear River. They also sought to escape strictly enforced taxation in South Carolina.[21] Because of their financial and social connections in South Carolina and their influence in England, this group came to North Carolina with inherent political power. They also arrived with ready-made slave labor forces trained in the forests and fields of South Carolina.

This type of development, beginning with capital investment supported by slave labor, was first established in Barbados. The concept then was carried to South Carolina and continued by new plantations in the Cape Fear region. The ability of

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[18] Ibid p. 118.

[19] Alfred Moore Waddell, *A History of New Hanover County and the the Lower Cape Fear Region, 1723-1800,* (Wilmington: no publish., 1909) I, 18.

[20] Malcom Ross, *The Cape Fear,* (New York: Holt, Rinehart and Winston, 1965) p. 30.

[21] Mr. Urmstone to General Nicholson, North Carolina 12 April 1714, *Colonial Records,* II, 128.

these few elite and powerful planters to obtain such large holdings had a profound effect on the character and development of North Carolina. The new inhabitants settling in the Cape Fear region were experienced planters and businessmen familiar with the cultivation of rice and the production of naval stores. Hence, when they came to the Cape Fear region they were prepared to begin immediate development of these labor intensive products. By 1731, 28 wealthy planters had secured the majority of the land along the Lower Cape Fear River.[22] Within just a few years, the center of political power and rule, once held in the Albemarle region, shifted to the Cape Fear region. Eventually, the original group of aristocratic Cape Fear plantation owners, referred to by Governor Burlington as the "Family", fell into political disfavor. Even so, the basic plantation system they brought with them provided the foundation of the lower Cape Fear region's economy until the America Civil War.

By the mid-1730s few individuals without substantial financial support were able to purchase land and settle in the lower Cape Fear. Late comers, small farmers, and poor settlers were forced to seek unclaimed land in the upper reaches of the Northeast Cape Fear River and the Cape Fear drainage system.[23]

On November 27, 1729, New Hanover Precinct was created by the new General Assembly of North Carolina, and the port of Brunswick Towne was designated as the county seat. Brunswick Towne, located 12 miles upstream from the mouth of the Cape Fear River was developed by Maurice Moore at the location of

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[22] Harry Roy Merrens, *Colonial North Carolina in the Eighteenth Century-A Study in Historical Geography,* (Chapel Hill: The University of North Carolina Press, 1964), p. 22.

[23] Ibid.

his first land grant along the Cape Fear River. The cultivation of rice and the abundant pine forests from which lumber and naval stores were produced soon provided the basis for making the Cape Fear region the colony's major economic center. Brunswick Towne became the focal point of activity. Naval stores, sawn lumber, shingles, and staves produced by mills and plantations along the Cape Fear were loaded and transported by ship to England and other British colonies. As plantations developed, the variety of exports increased to include corn, rice, and indigo. With good deep water access to both the ocean and interior, Brunswick Towne developed into the busiest seaport in North Carolina.[24] Unfortunately, the deep water access that contributed so much to the success of the Port of Brunswick also contributed to its decline. Spanish privateers, who preyed on shipping, were able to sail into the port and attack Brunswick Towne in 1748. Although the Spanish eventually were repelled, the vulnerability of Brunswick Towne to foreign attack was clear. Perhaps the most significant factor that contributed to the eventual decline of Brunswick Towne was the establishment and growth of New Carthage.

New Carthage was established in 1733 when James Wimble laid out roads and lots on the east bank of the Northeast Cape Fear River just upstream of its confluence with the Cape Fear River. On April 16 that same year, Wimble sold three lots. About that time, other individuals began buying property near the proposed town. In the next few years, the town gained interest; such that, by 1737, the principal property owners agreed to join together and plan a new town that included the land holdings of several owners. The town was called New Liverpool, but the name was seldom used. Instead, the

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[24] An abstract of the Shipping & Tonnage & number of negroes enter'd in North Carolina at a medium of 7 years end in ye 1 January 1755, *Colonial Records*, V, 314; also see Perfatory Notes, *Colonial Records*, V, xviii.

village was generally referred to as "the New Town" or "Newton". Despite the continuation of Brunswick Towne as the official port through which all Cape Fear River shipping cleared, Newton began to gain popularity. Much of Newton's early success can be traced to the continuation of a political dispute between the new Royal Governor Gabriel Johnson and the principals involved in the development of Brunswick Towne. Maurice Moore, his brothers, and their extended "Family" exerted political pressure to keep Brunswick Towne economically superior. However, Governor Johnson clearly placed his support behind Newton, and it began to thrive. By February 1740, a petition from the people of the "Village of Newton" to establish a "Town and Township by the Name of Wilmington" was approved by the General Assembly and signed by Governor Johnston.[25] Although Brunswick Towne continued to be the principal Port of Entry and Customs for shipping coming to and going from the Cape Fear region until well into the mid-eighteenth century, Governor Johnston required that the Collector of Customs as well as the Naval Officer maintain offices in Wilmington.[26]

Except for Elizabeth Town established in 1773 on the west Bank of the Cape Fear River approximately 50 miles upstream from Wilmington, no other town played a significant role in the development of the Cape Fear region. On the Northeast Cape Fear River, several prominent plantation owners worked together to organize the town of Exeter, about two miles downstream from the mouth of Holly Shelter Creek. Though incorporated in 1754, Exeter never developed into more than a small settlement.[27] In the latter part of the eighteenth century, a town called South Washington also was attempted, a

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[25] Council Journals, At a Council in New Bern 28 February 1739 (1740), *Colonial Records*, IV, 492, 509, 510, 515, 918.
[26] Lee, *The Lower Cape Fear in the Colonial Days*, p. 141.
[27] Ibid. pp. 141-142.

few miles upstream from Exeter in Duplin County. Although it was considered the county seat, it never developed into more than a few buildings and a river landing.[28]

Roads in Colonial North Carolina

In the early development of the Cape Fear region, as in other coastal regions of colonial North Carolina, settlers primarily relied on the waterborne transportation. The preference for the waterways was the direct result of the numerous rivers and sounds that dominated the geography of the eastern part of the colony. In turn, the initial development of adequate roads was hampered by the obstacles imposed by wetlands and waterways. Legislation to implement and regulate the construction and maintenance of roads in colonial North Carolina occurred in 1715, 1734, 1745, 1756, and 1764. Enactment of these laws demonstrated the general awareness of the importance of roads to the colony's development.[29] However, for the most part these laws and regulations were never fully acted upon or effectively administered. Numerous roads were authorized but never developed, or constructed only after extended delays. Roads that were built seldom were maintained properly. Courts were lax in prosecuting those who failed to maintain the roadways and bridges.

The physical environment probably was the greatest obstacle to the development of colonial roads. Much of southeastern North Carolina's geography was characterized either by swamp

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[28] Ibid. p. 143.

[29] Alan D. Watson, "Regulation and Administration of of Roads and Bridges in Colonial Eastern North Carolina," *The North Carolina Historical Review*, XLV (Autumn 1968), 400, 403, hereinafter cited as Watson, "Regulation and Administration of of Roads and Bridges in Colonial Eastern North Carolina."

or vast pine barrens. The wet conditions of the swamps and the sandy soil of the pine barrens presented poor conditions to construct and maintain early roads. A lack of adequate maintenance, stemming from a sparsely settled population, was another major reason cited as a cause for the lack of road development.[30] Mainly as a result of these conditions, colonial North Carolina had a reputation for possessing one of the poorest transportation systems among the colonies.[31]

The first complete road through North Carolina extended from Virginia to Charles Town, South Carolina. It probably had its beginnings during the late seventeenth century. The colonial road first was developed to connect Virginia to the Albemarle and, later, early settlements of Edenton and Bath Town. By about 1722 the road was continued South between Bath Town and New Bern. The legislation promoting the construction of the road stated: "Whereas a Road from Core-Point, to New Bern Town, would be of very great Use and Advantage to the Inhabitants of the upper parts of the Neuse River in particular, and to the County of Bath in general,...."[32] Later, only two years after Maurice Moore's first land grant along the Cape Fear River, the first ferry across the Cape Fear River was established at Brunswick Town. The establishment of the ferry (the "Haul Over") suggested that the coastal road then was open from Brunswick Towne to New Bern.[33]

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[30] Ibid. p. 417.

[31] Charles Christopher Crittenden, "Overland Travel and Transportation in North Carolina," *The North Carolina Historical Review,* VIII (July 1931), 257.

[32] An Act for a Road from the Core-Point, on the Pamptico, to New Bern Bern, on Neuse River, Walter Clark, ed., *The State Records of North Carolina,* (Winston, Goldsboro, and Raleigh, 16 volumes and 4 volume index [compiled by Stephen B Weeks for both the Colonial Records and State Records], 1895-1914), XXIII, 98, hereinafter cited as *State Records*.

[33] Records from General Court, Court House in Edenton, 1727, *Colonial Records*, II, 698.

Edward Moseley's 1733 Map of North Carolina shows the approximate location of the coastal road and the "Haul Over" for the first time (Figure 4).[34] The road was situated well inland to lessen the number and size of water crossings by travelers. By 1733, it extended to Charles Town in South Carolina. The close ties among the original influential settlers of the Cape Fear region, Charles Town, Edenton, and Virginia must have played an important role in the early development of the roadway. Moseley's map also shows that by 1733 ferry crossings had been established over the major water barriers along the road. At least two minor roads, shown on Moseley's Map, connected the plantation owners of the Northeast Cape Fear River with the main road. Marshall's Ferry, identified at the end of the southern spur, was operational as early as the fall of 1731. Anthony Green, who held the original land grant for the property, sold the land where the road and ferry were developed to John Marshall in the summer of 1731.[35]

Edward Moseley was one of the North Carolina's most influential and public spirited leaders during its early colonial era. He served as public surveyor intermittently for more than twenty-five years. Because of his postion, he must have been familar with early land grants, as well as the early condition of roads and transportation in the new colony.[36] Moseley's map indicates by name and approximate location the plantations or grantees in the Cape Fear region as of 1733.

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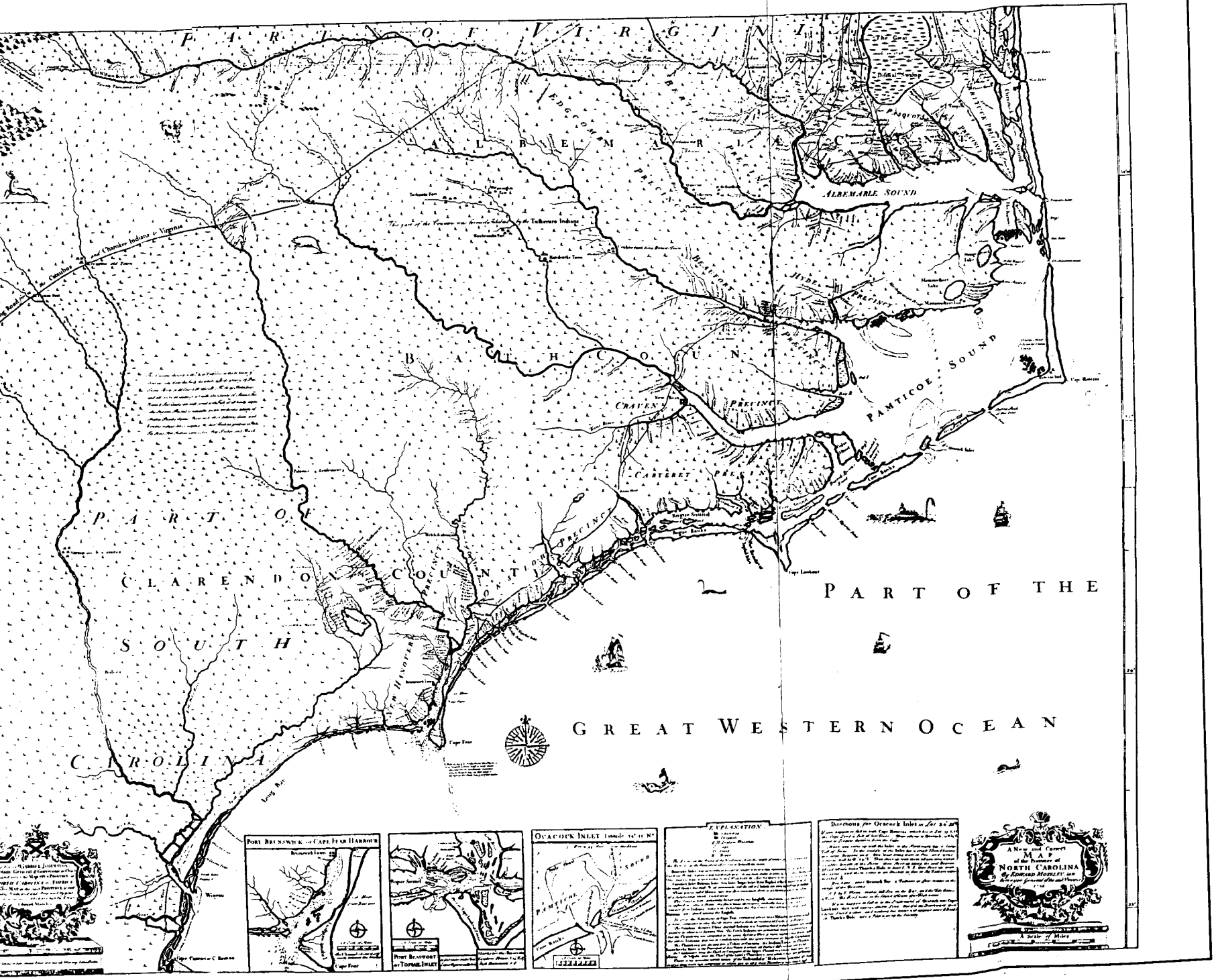
[34] Edward Moseley, "...A New and Correct Map of the Province of North Carolina...1733" *North Carolina in Maps*, Moseley 1733, Plate VI, hereinafter cited as Moseley 1733, *North Carolina in Maps*, Plate VI.

[35] Margret M. Hofmann, *Province of North Carolina 1663-1729 Abstracts of Land Patents*, (Weldon, North Carolina: The Roanoke News Company, 1979) ref. Secretary of State Records Books, Patent Book 2, 248, hereinafter cited as M. M. Hofmann, *Abstracts of Land Patents*.

[36] J. F. Shinn, Edward Moseley: A North Carolina Patriot and Statesman, Publication of the *Southern Historical Association*, III (January, 1899) 15-34.



Moseley's 1773 Map of the Province of North

Within only a few years after the first land grants along the Cape Fear River were issued, the availability of property on the major water routes was scarce. The late settlers to the region were forced inland or further upstream into the acquired unclaimed lands. The need by later settlers for access to the rivers and market places provided was one of the driving forces behind early roadway development.[37]

John Collet's 1770 Map of North Carolina, and Henry Mouzon's 1775 Map of North and South Carolina (Figures 5 and 6)[38] more than adequately demonstrated the increase in the network of roads in the forty-year period after 1733. Collet's and Mouzon's maps were more accurate than Moseley's. They also provided a great deal of information about road development in the eastern portion of North Carolina verses the Piedmont. Although the Piedmont region was settled several years after the Cape Fear region, by 1770 the Piedmont region had developed many more miles of roads. The coastal region still relied on the rivers and streams as primary transportation routes.

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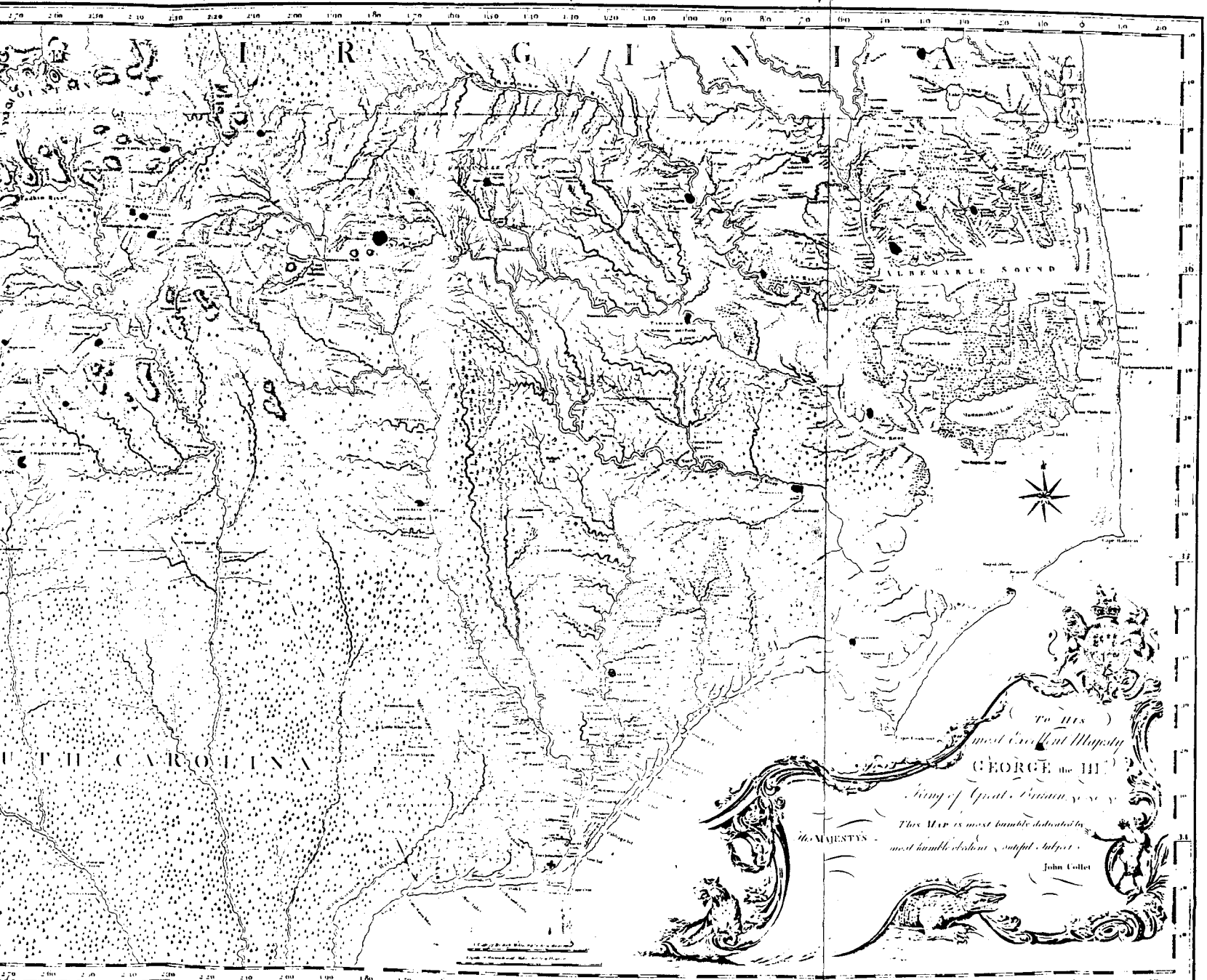
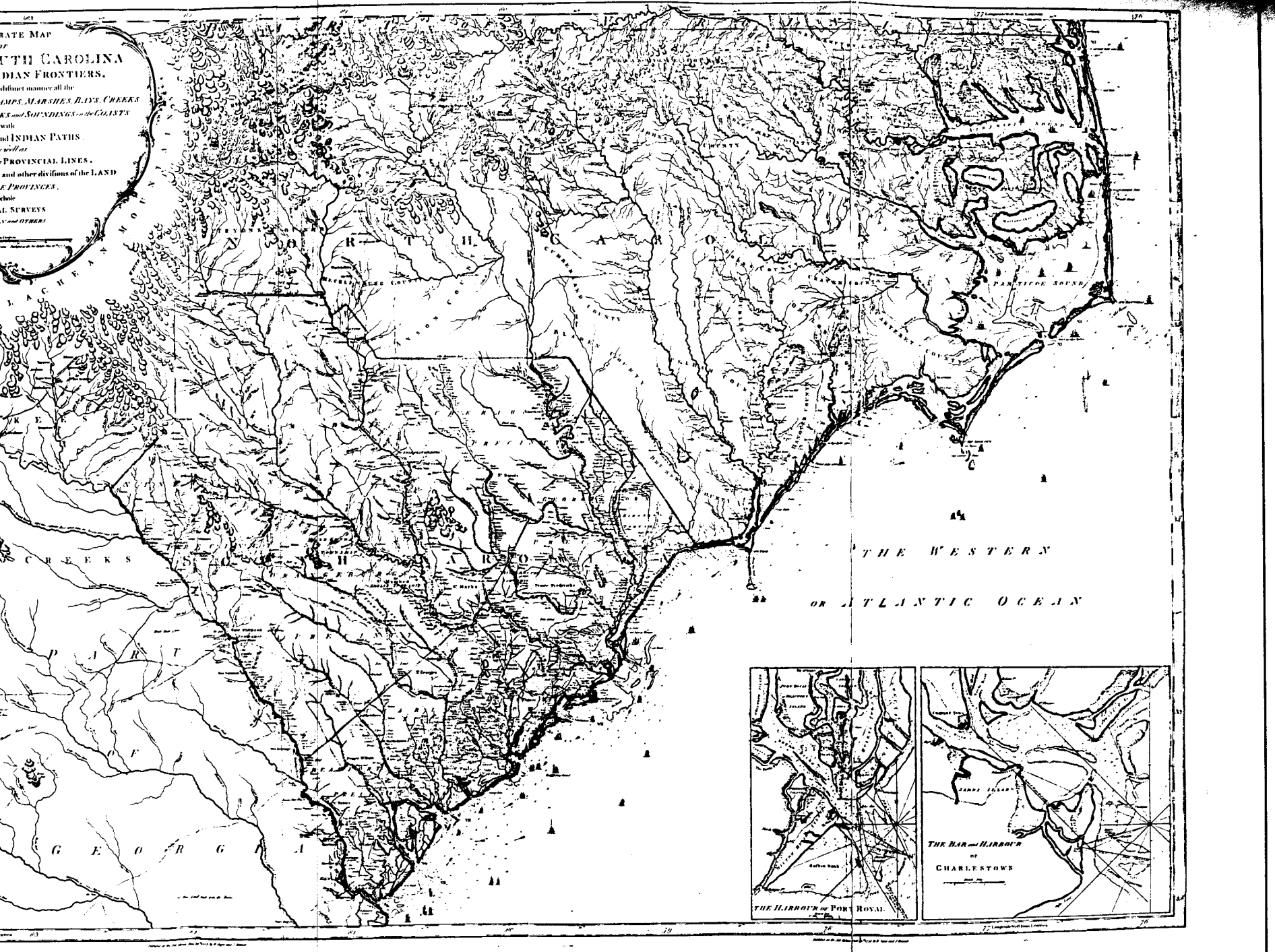
[37] Clonts, "Travel and Transportation in Colonial North Carolina," 17.

[38] Ibid, see John Collet, "A Compleat Map of North-Carolina from an actual Survey," and Henry Mouzon and Others, "An Accurate Map of North and South Carolina...," *North Carolina in Maps*, Collet 1770, Plate VII, and Mouzon 1775, Plate VIII.

Compleat MAP of NORTH-CAROLINA from an actual Survey

By Capt.n Collet Surveyor on Fort Johnston — Engraved by T.Kitchin





ouzon's 1775 Map of North Carolina and South
arolina.

The Northeast Cape Fear Crossing

Benjamin Heron and Heron's Bridge

The history of Heron's Bridge begins on 24 February 1729 when Anthony Green obtained a grant for 590 acres of land located on the east side of the Northeast Cape Fear River about eight miles downstream from Rocky Point.[1] Green kept the property only until June 1731, when he sold it to "John Marshall mariner."[2] Marshall made the first improvements to the property, and shortly after the purchase, he established the first ferry service across the Northeast Cape Fear River. When Marshall started the ferry service it served as a link among plantations located on the north and west side of the Northeast Cape Fear River, and the coastal road to Brunswick Towne (see Figure 3).[3] In May of 1736, Marshall sold the "new Ferry & a Plantation," that included property on both sides of the River, to "Benjamin Roberts of the City of Corke merch$^{t.}$"[4] It doesn't appear that Roberts ever occupied the property; although it seems likely that the ferry service continued during his ownership. There is no record of who managed its operation during this period. Following Benjamin Roberts' purchase of the ferry and plantation, there is an extended void in the record of ownership of the property. At some point William Monat acquired the plantation and the ferry. It was from Monat whom Benjamin Heron acquired the property, sometime in the mid-1750s.

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[1] M. M. Hofmann, *Abstracts of Land Patents*, Patent Book 2, 248.

[2] Anthony Green to John Marshall, New Hanover County Registry Records, (Office of the Register of Deeds, Wilmington, North Carolina), Book AB, 117-118, hereinafter cited as New Hanover County Registry Records.

[3] Moseley 1733, *North Carolina in Maps*, Plate VI.

[4] John Marshall to Benjamin Roberts, New Hanover County Registry Records, Book AB, 30-31.

Benjamin Heron was born in Lymington, Hamsphire, England on 21 December 1722.[5] He was first mentioned in North Carolina history as part of a force led by Captain James Innes to participate in an expedition to Cartagena in 1740.[6] How Heron first made his way to the Cape Fear region is not fully understood. After the Cartagena Expedition, Heron maintained strong ties to the Cape Fear region, perhaps in part because of his relationship with the daughter of local plantation owner Job Howes. As early as 8 January 1748, Lieutenant Benjamin Heron was mentioned in Job Howes' Will as owning property adjoining his own on the Northeast Cape Fear River.[7] In 1755 Benjamin Heron married Job Howes' daughter, Mary. As a wedding gift, Howes gave Heron a plantation called "The Mulberry," that he had purchased from Joseph Blake and his wife in 1752.[8] Between 1748 and his marriage to Mary Howes, Heron apparently was busy developing his plantation and other business interests in North Carolina and England.

On 2 December 1752, Benjamin Heron listed himself as the Captain of a "plantation" built ship called the *Heron* at anchor in Boston Harbor. The *Heron* was a ship of 180 tons burthen, registering its home port as Portsmouth, England. Interestingly, although the vessel was plantation built, it was owned by John Vinning, or Virning, a resident of Portsmouth. Benjamin Heron also identified his home as Portsmouth, England, although by this time he owned property

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[5] Donald R. Lennon, "Benjamin Heron," *Dictionary of North Carolina Biography*, ed. William S. Powell, (Chapel Hill and London: The University of North Carolina Press, 1988), III, H-K, 119, hereinafter cited as *Dictionary of North Carolina Biography*.

[6] Claiborne T. Smith, "James Innes" *Dictionary of North Carolina Biography*, III, H-K, 251-253. In June 1740, James Innes was appointed Captain in the British Army with a provincial commission to command a company of 100 men from the Cape Fear Region. The company was part of a regiment of North Americans raised to fight the Spanish in the Caribbean. The expedition was a disaster. Innes and Heron were among the twenty-five survivors to return to North Carolina in 1743. The remainder of the Cape Fear Company was killed by fever during a fruitless three month siege of the Spanish stronghold at Cartagena.

[7] Job Howes' Will, New Hanover County Registry Records, Book AB, 354.

[8] Joseph and Mary Blake to Job Howe, New Hanover County Registry Records, Book D, 231.

on the Northeast Cape Fear River.[9] The ship *Heron* continued its association with North Carolina for some years. In February 1766 the *Heron* was still operating between North Carolina and England, although by that time her Captain was listed as a man named Parker.[10]

After Benjamin Heron's marriage to Mary Howes, he must have settled in North Carolina on a more permanent basis. Including the marriage gift from Howes, Benjamin Heron came to own two large plantation tracts on the Northeast Cape Fear River. "The Mulberry," was situated on the northwest side, and the combined plantations "Marl Bluff" and "Mount Blake" lie directly across the River.[11] Heron maintained his primary residence at The Mulberry, about one mile northeast of the main road and ferry. In total, Heron's combined Northeast Cape Fear River plantations consisted of more than 2000 acres. By the mid-1760s, Heron reportedly had 56 slaves and an annual income in excess of £500 sterling.[12] Although Heron was obviously a plantation owner and captain of a commercial vessel, he also was referred to in several documents, as late as 1759, as a Lieutenant in his Majesties Royal Navy.[13]

Heron was one of the more ambitious and politically active planters in the colony. During the 1760s Heron developed his plantations along with his political influence. On 1 July 1761, Heron was appointed to the Office of the Clerk of Pleas for the province.[14] In 1762, he was appointed Secretary to

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[9] Record of Entry of the Ship *Heron* in Boston, 2 December 1752. Private Manuscript Collection, Item 590. North Carolina State Archives. Also see Job Howes' Will, New Hanover County Registry Records, Book AB, 353.

[10] Letter from Govenor Tryon to Board of Trade, *Colonial Records*, VII, 158-159.

[11] Samuel Swann's Plantation was situated immediately downstream from The Mulberry and was called "The Oak."

[12] William S. Price, Jr. "Men of Good Estates: Wealth Among North Carolina's Royal Councilors," *The North Carolina Historical Review*, XLIX (January 1972), 79.

[13] Parishioners join vestry of St. James Church, Letter Book of S.P.G., *Colonial Records*, VI, 59.

[14] Authur Dobbs to Benjamin Heron 1761, *Colonial Records*, VIII, 564.

the Crown.[15] Shortly afterwards, he also was appointed Naval Officer of the province. Then in 1764, he was made a Commissioner of pilotage for the Cape Fear region, as well as Secretary of the Governor's Council.[16]

Heron's first wife, Mary Howes Heron, died sometime in the early 1760s, and Heron subsequently married Alice Marsden. Heron had two daughters by the name of Mary and Elizabeth from his first marriage and at least one daughter by the name of Francis from his second marriage. Heron mentioned that his wife Alice was "with child" in a Codicil to his Will approximately one year before his death. However, there was no later record indicating that the child survived.[17]

Undoubtedly, Benjamin Heron or his appointee always maintained a ferry at the junction of the Duplin Road with the Northeast Cape Fear River. By 1760, the Duplin Road had become part of one of the most traveled north/south routes in the colonies. Several influential and politically powerful planters including Samuel and John Swann, Alexander Lillington, John Rutherford, Roger Moore and Heron himself lived or had plantations on the north and west side of the Northeast Cape Fear River. All were obliged to make frequent trips to Wilmington, making use of the road and ferry. The amount of traffic may have resulted in routine delays caused by the ferry. On Sundays, holidays, or other special

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[15] Official appointment as Secretary and Clerk of the Crown by Arthur Dobbs, *Colonial Records*, VI, 732.

[16] Donald R. Lennon, "Benjamin Heron," *Dictionary of North Carolina Biography*, III, H-K, 119.

[17] Benjamin Heron's Will, New Hanover County Wills, (Estate Records, Office of the Clerk of Superior Court, Wilmington, North Carolina), Book C, 137-142, hereinafter cited as Benjamin Heron's Will.

occasions, travelers, especially those in wagon or on horseback going to and from Wilmington, may have suffered long delays.[18]

Whether encouraged by his neighbors, or because of the potential for greater profits, Benjamin Heron petitioned the North Carolina General Assembly and was granted the right to build a bridge over the Northeast Cape Fear River in 1766.[19] Benjamin Heron was 44-years-old when the bill was passed and he received the approval to build a toll bridge:

> An Act to encourage Benjamin Heron, Esq., to build a bridge over the north-east branch of the Cape Fear river at or near the place where the ferry is now kept by Edward Davis
>
> I. Whereas, a bridge over the north-east branch of Cape Fear river at or near where the ferry is now kept by Edward Davis would be much for the convenience of all travellers; and as the land on both sides the River belongs to Benjamin Heron, Esq., the said Benjamin Heron is desirous of building a bridge there at his own expense, on the condition that the benefit thereof be vested in him, his heirs and assigns forever:
> II. Be it therefore enacted by the Governor, Council and Assembly, and by the authority of the same, That it shall be made lawful for the said Benjamin Heron, and his heirs, executors, administrators or assigns, to erect and build a good, strong and substantial bridge over the north-east branch of Cape Fear river, as near as he conveniently can to the place where the ferry is now kept by Edward Davis; which bridge shall have one wide arch of thirty feet for rafts and pettiauguas to pass through, and six feet high above high water mark, and be made to draw up

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[18] Ida Brooks Kellam and Elizabeth Francenia Mckoy, *St. James Church, Wilmington, North Carolina, Historical Records*, 1737-1852 (Lower Cape Fear Historical Society Historical Society, unpublished 1965). See names of church members and seating chart.

[19] An Act to encourage Benjamin Heron, Esq., to build a bridge over the north east branch of the Cape Fear river at or near the place where the ferry is now kept by Edward Davis, *State Records*, XXIII, 506-507.

occasionally for the navigation of vessels of large burthen; and after building and erecting the bridge as aforesaid, it shall and may be lawful for the said Benjamin Heron, his heirs, executors, administrators or assigns, to keep a sufficient gate thereon and take and receive from all persons that shall pass over the same at the following rates, that is to say: For every man and horse, six pence; for every four wheel carriage drawn by two horses or oxen, two shillings; and for every two wheel carriage drawn by one or two horses or oxen, one shilling; and for every horse or ox more, four pence each; and for every head neat cattle, three half pence; and for every twenty hogs or sheep, eighteen pence, and so in proportion for a greater or lesser number of hogs or sheep; and for all travellers on foot, four pence.

III. And be it further enacted by the authority aforesaid, That after the said bridge is so built and completely erected as aforesaid (provided it shall be completed within four years after the passing this act), it shall not be lawful for any person whatsoever to keep any ferry, build a bridge or set any person or persons, carriage or carriages, cattle, hogs or sheep, over the said river for fee or reward with in six miles of the same, under the penalty of twenty shillings, proclamation money, for each and every offense, to be recovered by a warrant by the said Benjamin Heron, his heirs, executors, administrators or assigns, before any magistrate of the county of New Hanover, to be applied to the use of the proprietor of the said bridge at the time of the offence being committed.

IV. And be it further enacted by the authority aforesaid, that when the said bridge shall be built and erected, as aforesaid, the said Benjamin Heron his heirs, excutors, adminstrator or assigns, shall for ever thereafter keep the same in good order and fit for passing over, and in case of any neglect shall be subject to the same pains and penalties as other keepers of public bridges and ferries are liable to by the laws of this province.[20]

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[20] Ibid.

By July 1768, when Heron made his Last Will and Testament, the bridge was complete.[21] Whether Heron actually directed the construction of the bridge or contracted it to be built is unknown. Heron's background certainly would have allowed him to inspect various bridges in Europe as well as Great Britain or other colonies. He may well have been the architect and builder.

In mid-1769, Heron became ill and left with his wife and two older daughters for England in an attempt to recover his health. He died in London on the 22 June 1770 at the age of 48, without returning to North Carolina.[22] Upon Heron's death the ownership of the bridge and plantation Mount Blake were transferred to Heron's daughter Elizabeth in accordance with his Will:

> Item. I give devise and bequeath to my daughter Elizabéth and to her heirs and assigns forever, all that my plantation called Mount Blake which I bought of Mr. William Monat together with the ferry house opposite thereto, and eight acres of land round the same laid off from the road in a square, together with the bridge, and all the appurtenances to the same belonging; which plantation of Mount Blake I direct to extend as high up the river as the creek, opposite the Mulberry house, which creek shall hereafter be the bound of the two plantations called Marl Bluff and Mount Blake.[23]

Although Heron died in 1770, the bridge continued to operate until 1781 when it was partially burned by the British.[24] The only available description of the finished bridge comes from the famous journal of Janet Schaw, who stayed in the Cape

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[21] Benjamin Heron's Will.

[22] Donald R. Lennon, "Benjamin Heron," *Dictionary of North Carolina Biography*, III, H-K, 119. Benjamin heron died at Islington, a borough of London and was buried in St. Georges Chapel, Windsor.

[23] Benjamin Heron's Will.

[24] Ibid. Application for Pension, James Jones, Miscellaneous Papers, *State Records*, XXII, 135.

Fear region for several months while visiting relatives. Although the portion of Miss Schaw's journal in which she describes the bridge was undated, events she relates concurrent with her narration places her in the vicinity of the bridge in mid to late summer of 1775. She includes her comments about the bridge as part of a description of the "great road" which was also known as the Duplin Road to inhabitants of the Cape Fear region:

> This road begins at Wilmington and goes clear across the country to Virginia on one side and South Carolina on the other, and as its course lies across the river, it is crossed by a bridge, which tho' built of timber is truly a noble one, broader than that over the Tay at Perth. It opens at the middle to both sides and rises by pullies, so as to suffer Ships to pass under it. The Road is sufficiently broad to allow fifty men to march abreast, and the woods much thinner of trees than anywhere I have seen them.[25]

Based on the description of Heron's Bridge given by Schaw in 1775, and on the requirements set by the Act permitting Benjamin Heron to build the bridge in 1766, the bridge was a multiple span beam bridge with stringers supported by pile bents or trestles. It also was fashioned with a double leaf tip-up type draw span of 30 feet wide. The use of the word "arch" in the Act to permit Heron to construct the bridge is misleading. The term "arch" was a commonly used (or misused) term during the eighteenth century to refer to the distance between abutments or supports. It frequently was used instead of the more modern term "span."[26]

Based on North Carolina law enacted in 1764, the width of the bridge was at least 12 feet. However, Janet Schaw's comment suggesting the bridge was "broader than that over the Tay at

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[25] Andrews, *Journal of a Lady of Quality*, p. 202.
[26] L. N. Edwards, *Early American Bridges*, p. 23.

Perth" suggests that Heron's Bridge was much wider than what might be considered average for the time (Figure 7).[27] A wide bridge would be more in tune with the "great road" on which "fifty men" could "march abreast."[28] In any case, Heron's Bridge was at least 403-feet-long over water.

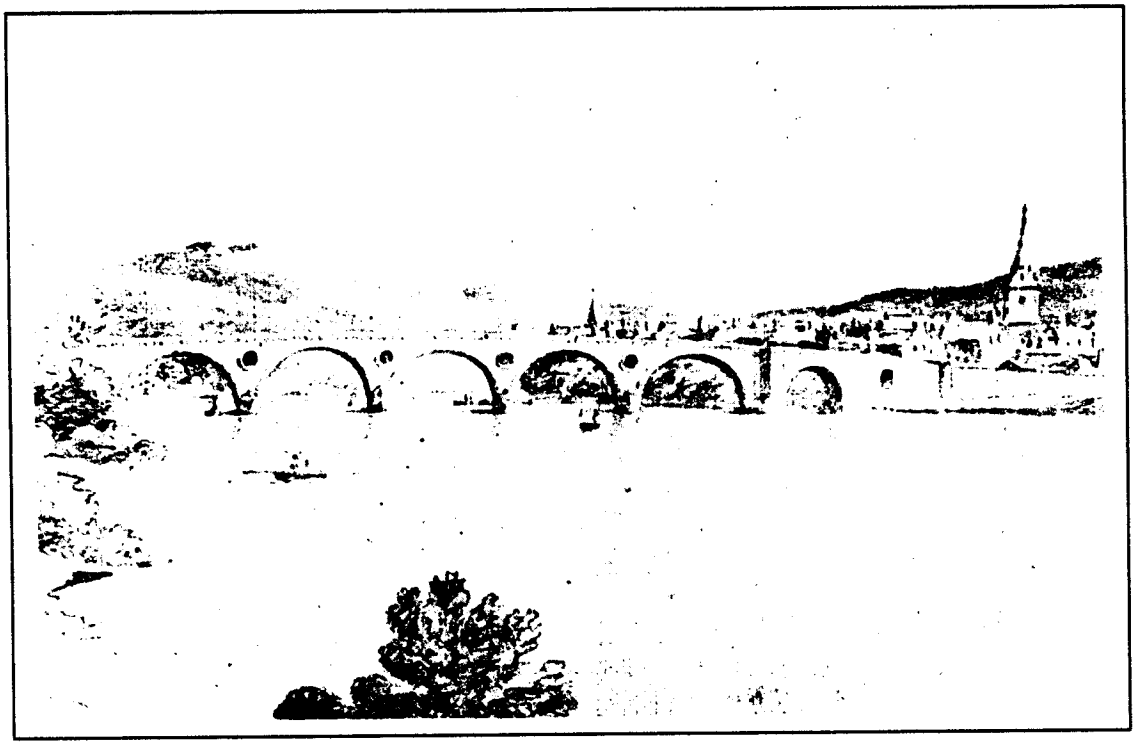

Figure 7. Tay Bridge, Perth, Scotland completed 1771.

Heron's Bridge was the first drawbridge in North Carolina and apparently was only the second timber-framed river bridge built with a draw in the American Colonies. The first drawbridge to be constructed across a river in America was built in 1761 by Samuel Sewall over the York River in York, Maine.[29]

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[27] Andrews, *Journal of a Lady of Quality*, p. 202. The bridge Miss Schaw was referring to was completed in 1772 and was designed by Smeaton an eminent British engineer. It was constructed of stone with nine arches and had a total length of 880 feet. The width of the bridge is uncertain.

[28] Ibid.

[29] George Alexander Emery, *Ancient City of Gorgeana and Modern Town of York (Maine) From Its Earliest Settlement Also Its Beaches And Summer Resorts* (York Corner: Courant

At the time of Benjamin Heron's death, Elizabeth, Heron's second daughter, was no more than 13-years-old. As a result, Alice Heron became "Executrise," and his friends Lewis Deroset, Frederick Jones, and Samuel Swann became Executors of his estate.[30] The operation of Heron's Bridge was administered by one or more executors until Elizabeth came of age or married. Because of Heron's relatively brief association with the bridge, local inhabitants soon began to refer to the bridge by other names. At some point, either before Benjamin Heron's death or within the space of a few years after, Henry Buford took over the day-to-day operation of Heron's Bridge.[31] Buford had formed a close association with Heron before 1768. He served as one of four witnesses to Benjamin Heron's Last Will and Testament.[32] In 1780, Henry Buford purchased 200 acres of land on the east side of the River adjoining Heron's Marl Bluff. Although he owned the adjoining property, he never owned the bridge or controlled the rights to it.[33] By the time of the Revolutionary War, the bridge was being referred to in various documents and diverse correspondence as Buford's Bridge, Beauford's Bridge, Beaufort's Bridge, Blueford's Bridge, Great Bridge, North East Bridge, Long Bridge, and Big Bridge.[34] The bridge had become a well-known regional landmark to inhabitants, but Benjamin Heron's name was no longer commonly associated with the bridge.

Steam Job Print, 1894), p. 169, hereinafter cited as Emery, *Ancient City of Gorgeana and Modern Town of York*.

[30] Benjamin Heron's Will.

[31] Council Minutes, *Colonial Records*, X, 996.

[32] Benjamin Heron's Will.

[33] Henry Buford Land Grant, New Hanover County Registry Records, Book H, Part II, 352.

[34] See various references to the Bridge, *State Records*, XV, 431, 535, 569, 782, 786, and XX, 131. Also see Council Minutes, 10 Augurst 1776, *Colonial Records*, X, 996. Heron's Bridge subsequently was referred to as "Long Bridge" or "Big Bridge" because of the Smith Creek Bridge also located on the "Duplin" or "Great Road" just north of Wilmington. Smith Creek Bridge was referred to as the "Little Bridge." See "An Act to encourage Caleb Grainger, to build a Bridge over Smith's Creek, near the Place known by the Name of Smith's Creek Ferry, in New Hanover County," *State Records*, XXIII, 385.

Heron's Bridge and the Revolutionary War

During the Revolutionary War, except for the Battle at Moore's Creek Bridge in 1776, there was little in the way of direct confrontation between opposing forces in the Cape Fear region until 1781. In early 1781, the Revolutionary War arrived with full force in southeastern North Carolina, and Heron's Bridge became one of the focal points of that confrontation.

On 21 January 1781, combined British naval and land forces under the command of Major James Craig sailed from Charleston with orders to capture Wilmington and take control of the Cape Fear River. The intent of the British was to gain control of the main river and secure small vessels to transport supplies to the main British Army under General Cornwallis. Cornwallis was preparing to move his forces north from South Carolina to Cross Creek situated on the Cape Fear River in Cumberland County. British naval forces sent to Wilmington were commanded by Captain Andrew Barkley of the *HMS Blonde*. Other ships in Barkley's command included two 16-gun sloops, the *Otter* and *Delight*, and four galleys: the *Dependance*, *Hammond*, *Comet*, and *Scourge*. There were also "victuallers & transports" accompanying the British fleet. The land forces consisted of approroximately 300 infantry under the direct command of Major Craig.[35]

The British arrived at the mouth of the Cape Fear River on 25 January. Because of strong tides and contrary winds the British ships were unable to maneuver upriver for three days.

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35 Captain Andrew Barkley to Marriot Arbuthnot, 12 February 1781, Public Records Office, Admiralty 1/486, fols. 1227-1230, transcripts in English Records Collection North Carolina State Archives. Major James Craig to Lieutenant Colonel Nisbet Balfour, 4 February 1781, K. G. Davies ed. *Documents of the American Revolution*, 1770-1783 (Dublin: Irish University Press, 21 volumes, 1972-1981), XX, 54-56.

On 28 January, Major Craig landed troops nine miles south of Wilmington at Ellis Plantation. When local rebel forces heard of the impending attack, they determined that Wilmington was too vulnerable and difficult to defend without risking its complete destruction. As a result, the rebel militia, under the command of Colonel Henry Young and Colonel James Kenan, loaded supplies and arms aboard seven vessels and retreated up the Duplin Road and Northeast Cape Fear River to a more defensible position at Heron's Bridge.

When Craig's troops arrived near Wilmington, a group of approximately 200 of the townspeople came out and surrendered to the British forces. Craig soon discovered that the rebel militia had escaped to Heron's Bridge. On 30 January, he launched a surprise night attack on the American's encampment, routing the rebel forces. The attack resulted in the capture of the bridge, and five of the seven supply vessels. A schooner and a sloop escaped the initial confrontation only to be chased upstream and forced aground and burned. In Major Craig's initial report on the capture of Wilmington, he described the confrontation with the militia and mentions the bridge:

> ...the open attack of the Post, we knew to be impracticable, as it consisted of a bridge with a narrow Causeway on the opposite end through a very deep Marsh, a Quarter of a mile in Breadth which terminated in a Hill on which they were encamped, the River on that side also offered a very favorable Bank for the defense of the bridge. We marched at 4 in the Afternoon, with 230 Rank and File and two three Pounders, leaving Major Manson with remainder to guard the Town, a little after noon one of the Light Infantry, with great spirit made himself Master of one of the Rebel Light Horse, who was on the lookout and from him we got such Intelligence as determined us to attempt surprising them, we accordingly moved on within

about a Mile of the Bridge and there lay on our Arms meaning to attack them between 3 & 4 in the morning. Volunteers immediately turned out for the dangerous Service of seizing the necessary Centinels, every precaution taken for securing any Patrols which might come near us, & I have not the smallest doubt of our having succeeded had not an unlucky Accident put an end to all our hopes, a Sergeant and a private Man found themselves so closely beset by Six Horse Men, before they were aware of it that they had not time to throw themselves into the woods, but were obliged to fire, as all Idea of surprising them was now over, we pushed forward directly and following the Patrols so closely that they had neither Time to take up the Bridge, or use any other precaution, the Light Infantry (with a part of Major Manson's Command attached to them) & Grenadiers formed within 50 yards of the Rebel Party on this Side of the Bridge who challenged us and fired, they were charged and run over the Bridge, as I found they had not taken the Bridge up, and seemed in a great Panick, I determined to push them and notwithstanding the Strength of the ground thought Circumstances bid fair for succeeding in an Attack on their Post itself, which would at once secure their Vessels and probably prevent their assembling again; Captains Nesbit and Pilcairn were therefore ordered to pass the Bridge and pursue the attack, which they did with the greatest Spirit. I formed the Companies of the 82nd with the Field Pieces to cover the Bridge in Case of Misfortune, and then advanced with the Marines to support the other companies; everything gave way, and in a few Minutes all was over, and we in Possession of the Rebel Camp, where we found a number of Arms, Canteens, some Provisions and, after waiting a sufficient Time to be sure they were totally dispersed, we returned over the Bridge, as I wished the Men to rest in Security after the fatigue of two Days March & laying five Nights either on their Arms or on their Decks of Sloops and Boats without Covering: I have since learned the Rebels have been between 230 & 300 as we did not extend our Search far, we only found three dead, & the

> darkness of the Night together with their precipitious Flight prevented our making more than 7 or 8 Prisoners, many however were wounded who are since got home,....[36]

A few days after Wilmington had been secured, Captain Barkley reported the engagement to his commanding officer and listed the rebel vessels captured:

> *HMS Blonde* 12 February 1781
>
> ....Our being so long detain'd below gave the rebels time to remove their effects, stores, provisions, & ammunition, up the N.E^{t}. River, in small craft. receiving information where those vessels lay, Major Craig march'd out with a detachment of troops. I at the same time sent a galley and two gunboats under the direction of Lt. Winter up the river; they were so fortunate as to get possession of them all next morning except a schooner and a sloop loaded with provisions & ammunitions which they were obilg'd to burn being a ground I enclose you a list of the other vessels captured:
>
> *Blonde* leaves *Delight*, *Otter* (sloops) w/4 galleys & gunboat for protection of victuallers & transports Capt. Barkley of the *HMS Blonde*.
>
> Vessels taken up the Cape Fear by a Detachment of the Army & Galley of Feb. 7, 1781.
>
> *Rose* a new Brigg of 120 tons two three pounders pearced for twelve guns- loaded with rice, tobacco, and bale goods
>
> Schooner *Betsy* 70 tons & six 9 pound caronades loaded with rice, flour, rum, & some ammunitions
>
> Schooner *Flying Fish* loaded with rice, flour, turpentine, & rum

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[36] Ibid.

> Schooner *Ceres* 25 tons loaded with rice, flour and ammunition
>
> Schooner *Wild Cat* 20 tons empty
>
> A schooner & sloop with stores and ammunitions & provisions burnt.[37]

In order to reduce the threat of retaliation from the rebel militia, Major Craig ordered Heron's Bridge burned. Later reports indicate that the bridge was only partially destroyed.[38] Meanwhile, American victories in South Carolina delayed British plans to move to Cross Creek. Craig's forces held Wilmington for several weeks. Problems created by shortage of small vessels for transports, and fluctuating support of regional loyalist prevented Craig from moving supplies to Cross Creek as originally ordered. In the meantime, rebel forces, now under the command of General Alexander Lillington, established their headquarters at The Mulberry Plantation and fortified defensive positions on the north side of the remains of Heron's Bridge.[39]

In late March 1781, when Cornwallis's Army finally reached Cross Creek he found that Craig had failed to transport supplies upriver to meet his forces. Without needed supplies Cornwallis had little choice but to march his army to Wilmington. Cornwallis reached Wilmington on 9 April and stayed 16 days considering his next move. Cornwallis chose to march his 1400-man army north to Virginia where he would combine forces with Major General William Phillips. Phillips

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[37] Ibid.

[38] Application for Pension by James Jones, Miscellaneous Papers, *State Records*, XXII, 135.

[39] Miscellaneous Communications between North Carolina Militia Commanders, *State Records*, XV, 431-432, 514, 520, 535, 559, also see Extract from the Minutes of New Hanover Superior Court, October Term, 1832, *State Records*, XV, 786.

was in command of an army of 5000 troops. Once Cornwallis reached the Chesapeake Bay area he planned to resume offensive operations.[40]

On 25 April, Cornwallis marched north out of Wilmington and forced Lillington's untrained and under supplied militia to retreat to Kinston. Since Heron's Bridge was partially destroyed, Cornwallis had to procure small boats to ferry his army across the Northeast Cape Fear River:

> ...Lieutenant-Colonel Tarleton with the advance guard, was directed to Seize as many boats as possible on the north-east branch of the Cape-fear river, and collect them at a place about fifteen miles above Wilmington. Some boats were secured, and Captain Ingles, of the royal navy, dispatched others from the King's Ships, to protect and expedite the passage of the army. The advance guard crossed with out loss of time, and took post on the opposite banks, till the stores, waggons, cannon, and troops, were brought over. As many rivers and creek intersected the country between this place and Virginia, it was thought expedient to mount two boats upon carriages, which could proceed with the army and might facilitate the passage of any waters.[41]

Throughout the summer and early fall of 1781, Major Craig and his troops remained in Wilmington. Craig spent his time encouraging and developing loyalist support. He also sponsored forays against the rebels in southeastern North Carolina. In mid-November when Major Craig learned of

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[40] Earl Cornwallis to Germain, 18 April 1781, Public Records Office, Cornwallis Papers, PRO 30/11/5, fols. 270-271, microfilm in Manuscript Division, Library of Congress, Washington, D.C.

[41] Lieutentant-Colonel Tarleton, *A History of the Campaigns of 1780 and 1781 in the Southern Provinces of North America,* (London: Printed for T. Cadell, in the Strand, 1787) p. 285.

Cornwallis's surrender at Yorktown, he evacuated his troops and approximately 1000 loyalists who had sought protection from the rebels in Wilmington.[42]

Post Revolution and Beyond

The Revolutionary War all but brought an end to the plantation lifestyle and commerce that existed on the Northeast Cape Fear River before the conflict. Almost all of the original plantation owners on the Northeast Cape Fear River were loyalist or owed their allegiance to the Crown. The war irreparably disrupted commercial ties with England. As a result, it took many years for plantations in the Cape Fear region to recover from the effects of the War.

Heron's Bridge apparently was repaired shortly after the War. This was supported by references to the bridge in petitions, testimony, and legislation in the present tense by 1785.[43] Also in 1794, William Campbell purchased the property "With the bridge crossing the said river & all rights thereunto appertaining & the buildings of every Sort belonging to the said Parcel of Land...," from Benjamin Heron's son-in-law John Mackenzie and daughter Elizabeth.[44] Campbell owned the property until his death and apparently built another bridge at the crossing sometime before 1810. In 1810, when Campbell also purchased the Mulberry Plantation from Heron's oldest daughter Mary Hooper, the deed described one of the boundaries as "a Pine Stump in the road at the old ferry

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[42] Gregory De Van Massey, "The British Expedition to Wilmington, January-November, 1781," *North Carolina Historical Review*, LXVI (October 1989), 410.

[43] An Act for establishing two places in the County of New Hanover for the Purpose of Holding General Musters therein, for Dividing the Militia of said county into two districts suitable and convenient for the inhabitants to attend muster at the respective places, and for appointing the place of holding court-martial in said County, *State Records*, XXIV, 947-948, also see House Minutes, *State Records*, XX, 594.

[44] John and Elizabeth Mackenzie to William Campbell, New Hanover County Registry Records, Book L, Part 2, 737.

landing below the foot of the new bridge."[45] Information about Campbell's Bridge is minimal. Except for references to the "Big Bridge" in early nineteenth century newspapers, no other historical account of Campbell's Bridge has yet been identified.

Following William Campbell's death, the property was inherited by Marsden Campbell, who sold the plantation "With the Bridge crossing the River and the rights thereunto" to Abel Morgan in 1824.[46] Morgan then sold the property "with the bridge across the said river, and all the rights thereunto" to Benjamin Best in 1827.[47] After Benjamin Best's death in the 1830s, his wife and family inherited the property and the bridge. Best's wife, who had remarried, eventually sold several tracts of land to satisfy outstanding debts. When James F. M^{c}Cree purchased the property at public auction in 1840, no mention was made of the existence of the bridge in the property transferral.[48] In early 1845, M^{c}Cree began advertising in the *Wilmington Chronicle* for contractors to bid on building a "Ferry Bridge" over the Northeast Cape Fear River:

> To Bridge Builders, Here and Abroad,
>
> The subscriber having determined to erect a Ferry Bridge across the North East branch of Cape Fear river, at the site of the old Big Bridge, will give the contract to the lowest bidder within two months. For Specifications, apply to:
> November 19, 1845
>
> James F. M^{c}Cree[49]

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[45] Mary Hooper to William Campbell, Pender County Registry Records, (Office of the Register of Deeds, Burgaw, North Carolina), Book 6, 156.
[46] Marsden Campbell to Abel Morgan, New Hanover County Registry Records, Book S, 178.
[47] Abel Morgan to Benjamin Best, New Hanover County Registry Records, Book S, 576.
[48] Reestablishment of Bridge Franchise by James F. M^{c}Cree, New Hanover County Registry Records, Book KK, 204.
[49] "To Bridge Builders, Here and Abroad," Wilmington Chronicle, 19 February 1845.

By June of 1847, contractors had completed a third bridge over the Northeast Cape Fear River at the original site of Heron's Bridge:

> BIG BRIDGE COMPLETED-The new and substantial Bridge across the North East branch of the Cape Fear River, nine miles north of Wilmington, belonging to the subscriber has just been finished and is now ready for travellers. It is said to be the strongest Bridge ever built in the County.
>
> J. F. M^{c}Cree[50]

In the same issue a reporter makes the following comment:

> BIG BRIDGE- The public will perceive, by an advertisement in today's Commercial that the Big Bridge, as it has been usually called, is rebuilt in the very best style. This information will gratify many of our readers, who have been deterred from travelling this route on account of a dislike to crossing a Ferry. The enterprising Proprietor of this bridge contracted to have it completed twelve months ago, but was unable to accomplish this objective till the present time.[51]

James M^{c}Cree maintained the bridge until fall 1859 when he sold the property "with the Bridge and ferry across said River" to George W.F. Averitt.[52] Averitt kept the property through the Civil War until 1866, then sold it to Jackson Wood, "including the ferry known as Big Bridge Ferry."[53]

The status of the bridge during the Civil War is somewhat of a mystery. When Wilmington finally fell into Union hands in February 1865, the Union forces were close on the heels of retreating Confederate forces as they evacuated Wilmington:

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50 "BIG BRIDGE COMPLETED," Wilmington Chronicle, 15 June 1847.

51 "Big Bridge," Ibid.

52 James F. M^{c}Cree to George W. F. Averitt, New Hanover County Registry Records, Book QQ, 94-195.

53 George W. F. Averitt to Jackson Wood, New Hanover County Registry Records, Book UU, 294-295.

> February 22.- Advanced about 10 a.m.; found the enemy's work's in our front evacuated; passed through the line of works in front of Wilmington about 12 n.; passed through the city and over took the enemy's rear guard at Smith Creek, about one mile from Wilmington, where they were endeavoring to destroy the bridge; drove them from the bridge, extinguished the fire and repaired it; followed them; overtook their rear guard about two miles from Northeast Ferry; drove them across ferry, capturing the pontoon bridge; kept up a sharp fire during the night to keep them from retaking it. During the night threw up a line of pits. Remained at Northeast Ferry until March 1, during which time received some 10,000 paroled prisoners from the enemy.[54]

By the beginning of the Civil War, the Weldon Railroad had constructed a railroad bridge only one-half mile downstream from McCree's Ferry Bridge. As a result, the railroad bridge and Ferry Bridge crossing were key objectives of the advancing Union army. It also served as a line of defense for the retreating Confederate forces:

> Headquarters Department of North Carolina
> Wilmington, February 24, 1865
>
> Lieut. Gen. U. S. Grant,
> Commanding Armies of the United States, City Point, Va.
>
> General: After the capture of Wilmington General Terry pursued the enemy as far as the Northeast River, he found the railroad and pontoon bridges destroyed. I have not learned whether any damage has been done to the railroad beyond the river. I shall push forward as soon as I can get any means of transportation. Wagons are beginning to arrive, and I hope the delay will not be long. The rebel agent of exchange has informed me that he will

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[54] Reports of operations, Second Brigade, First Division, Twenty-Fourth Army Corps, *The War of the Rebellion*: A Compilation of the Official Records of the Union and Confederate Armies (Washington, D.C.: U.S. Government Printing Office, 1880-1901) Series I, Vol. XLVII, Part I, Chap. LIX, p. 150, hereinafter cited as Official Records

> deliver 10,000 of our prisoners at he point where the railroad crosses the Northeast River, and I have agreed to receive them at that point....
>
> J. M. Schofield,
> Major-General[55]

The railroad bridge was destroyed, and the "pontoon bridge" was at least partially destroyed by retreating confederate forces. In 1845, James M^cCree used the phrase "Ferry Bridge" in his advertisement for contractors to build a bridge. Its possible, that M^cCree's Ferry Bridge and the "pontoon bridge," identified in Civil War military accounts may be synonymous. Perhaps rather than a timber frame bridge, M^cCree constructed a floating bridge. When advancing Union forces came to the bridge in 1865, perhaps what they observed was an 18-year-old "Ferry Bridge." If the ferry bridge and the pontoon bridge were not one in the same, then M^cCree's bridge must have been destroyed sometime between 1859, when George Averitt purchased the property, and 1865 when Confederate forces retreated north from Wilmington. In this scenario, a temporary Confederate built pontoon bridge must have been placed at the crossing sometime during the War.

In 1880 when Jackson Wood died, the property was inherited by his nephew John E. Wood. Margret Sophia Blossom purchased the land and ferry franchise from John E. Wood in 1882.[56] Sophia's husband Samuel Blossom operated the ferry at the crossing until his death in 1926 when he was 86 years old. During the time of Samuel Blossom's tenure, the ferry crossing was known as Blossom's Ferry. No other bridge was ever constructed there.

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[55] Major General J. M. Schofield to Lieut. General U. S. Grant, Official Records, Series I, Vol. XLVII, Part II, Chap. LIX, pp. 558-559.

[56] John E. Wood to Margret Sophia Blossom, New Hanover County Registry Records, Book VVV, 681.

In the late 1920s, North Carolina embarked on a highway building program that eventually brought an end to the need for the ferry crossing. In 1930, the main highway from Wilmington through Pender County was relocated. A new bridge known as the "Hungry Bluff Bridge" was constructed approximately one mile west and downriver of the historic crossing site. Hungry Bluff Bridge was eventually replaced by the present-day U.S. Highway 117 that bridge crosses the Northeast Cape Fear River at Castle Hayne.

By coincidence, in the late 1980s, Interstate 40 was completed into Wilmington crossing the Northeast Cape Fear only 250 feet west of the original Heron's bridge crossing. Today the "Great Road" leading north from Wilmington crosses the Northeast Cape Fear River on an impressive concrete and steel bridge, enabling everyday motorists to pass the black water river almost without notice.

Wooden Bridges Until the Mid-Nineteenth Century

Simple Beam Bridges

Prehistoric man built the first bridge with materials adapted from the natural environment. A fallen log, or one felled for the purpose of crossing a small stream, was most likely the first wooded beam bridge conceived by man. A more complex arrangement in which logs were laid from stone to stone may have been the first multiple-span bridge with intermediate piers. Thus, a simple wooden beam bridge can be regarded as the first and most common of wooden bridge types.[1]

Simple beam bridges are often used in rural areas and developing countries today. In regions that experience annual flooding, such as the Amazon in South America, beam bridges are often effective. In northern Brazil, in the 1970s, a poorly planned project designed to open vast areas of rain forest to settlers resulted in the hasty construction of hundreds of miles of roads by modern earth moving equipment. Although scores of bridges were constructed, they generally were designed poorly for the conditions, and seldom maintained. As a result, during annual flooding, newly arrived homesteaders frequently found themselves stranded by washed out bridges. The new Brazilian homesteaders found the most practical and expedient solution to bridging streams to be simply placing two or more large diameter logs, sometimes as much as 35-40 feet long, across them. Mud or rock sills were all that was required to hold the beams in place. When the beam bridges were washed out, they were relatively easy to replace with nearby trees. The primary problem with these

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1 Robert Flecter and J. P. Snow, "A History of the Development of Wooden Bridges," *American Society of Civil Engineers Transactions*, Paper No. 1864 (November 1932), 316, hereinafter referred to as Flecter and Snow, Development of Wooden Bridges.

bridges was that they were sometimes dangerous to cross. Often, beam bridges went without floors for months. Drivers of vehicles were required to align their wheels with the beams and drive straight to keep tires from slipping. Beam bridges even proved strong enough to support daily traffic of trucks and buses over shorter spans, although some bus drivers disembarked passengers before crossing them.[2]

The earliest development of more complex wooden bridge designs was never recorded. In most ancient civilizations, the transition from a nomadic existence to more sedentary or community lifestyle spawned the need for more permanent structures. Architecture began to develop and the basics of structural design were established.

Earliest Beginnings of Wooden Bridges

The first structural stone arch was built in Mesopotamia, about 4000 B.C. Although not fully developed for several thousand years, the stone arch form eventually was a prominent feature of bridge design and construction. The first bridge on record was built on the Nile about 2650 B.C. by Menes, the first King of the Egyptians. No details of the bridge are available. The Greeks, although masters of early stone architecture, seem to have built few bridges of wood or stone. Even the Cephissus River, which ran across the most travelled avenue in Athens, had no bridge.[3]

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2 The author has utilized and helped in the construction of such wooden beam bridges in jungle areas of Rondônia, Brasil.

3 Information about ancient bridges is varied and limited. Good secondary sources include: "Bridge," *Collier's Encyclopedia,* (New York: Macmillan Educational Company, 1987), 4, 530-549, hereinafter cited as *Collier's Encyclopedia*, and H. Shirley Smith, *The World's Great Bridges* (New York: Harpers & Brothers, 1953), hereinafter cited as Smith, *The World's Great Bridges*.

The first recorded developments in early wooden bridge design can be traced to the Romans. As they built their empire, Roman armies marched throughout much of the known world in conquest. In order to maintain communication and trade with the outlying portions of their vest empire, thousands of miles of roads were built from Britain and North Europe to North Africa. In conjunction with this vast network of roads, hundreds of wooden bridges were built. The Pons Sublicius is the first Roman bridge of which there is any record. Built in 621 B.C., it was the bridge Horatius Cocles defended against the Etruscans in 598 B.C. It simply is described as a "tree bridge resting on piles." The bridge is said to have been built by priests and maintained for 900 years.[4]

There are no contemporary accounts of how Romans constructed their timber bridges. The first description of a Roman timber bridge was not written until the sixteenth century. The Venetian architect Palladio described and drew the bridge in his classic treatise on *Architecture* based on "Cæsar's Commentaries." Called "Cæsar's Bridge" by Palladio, the bridge is thought to have been designed by the famous Roman architect and engineer, Vitruvius. It was constructed over the Rhine River during the Roman Army's march into Germany in 55 B.C.[5] It was ingenious in its design, and constructed in only ten days. According to Palladio's interpretation, Cæsar's Bridge was constructed with double incline struts that supported a cross-girder on blocks fitted into notches between the struts (Figure 8). The girders were notched in such a way as to hold the support blocks in place. As an

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4 Ibid.

5 Ibid. and see *Andrea Palladio The Four Books of Architecture*, London 1738, translated from Italian, (Reprint New York: Dover Publications, Inc. 1965) Cæsar's Bridge is described in the third book of Palladio Architecture, hereinafter cited as *Andrea Palladio's Architecture*.

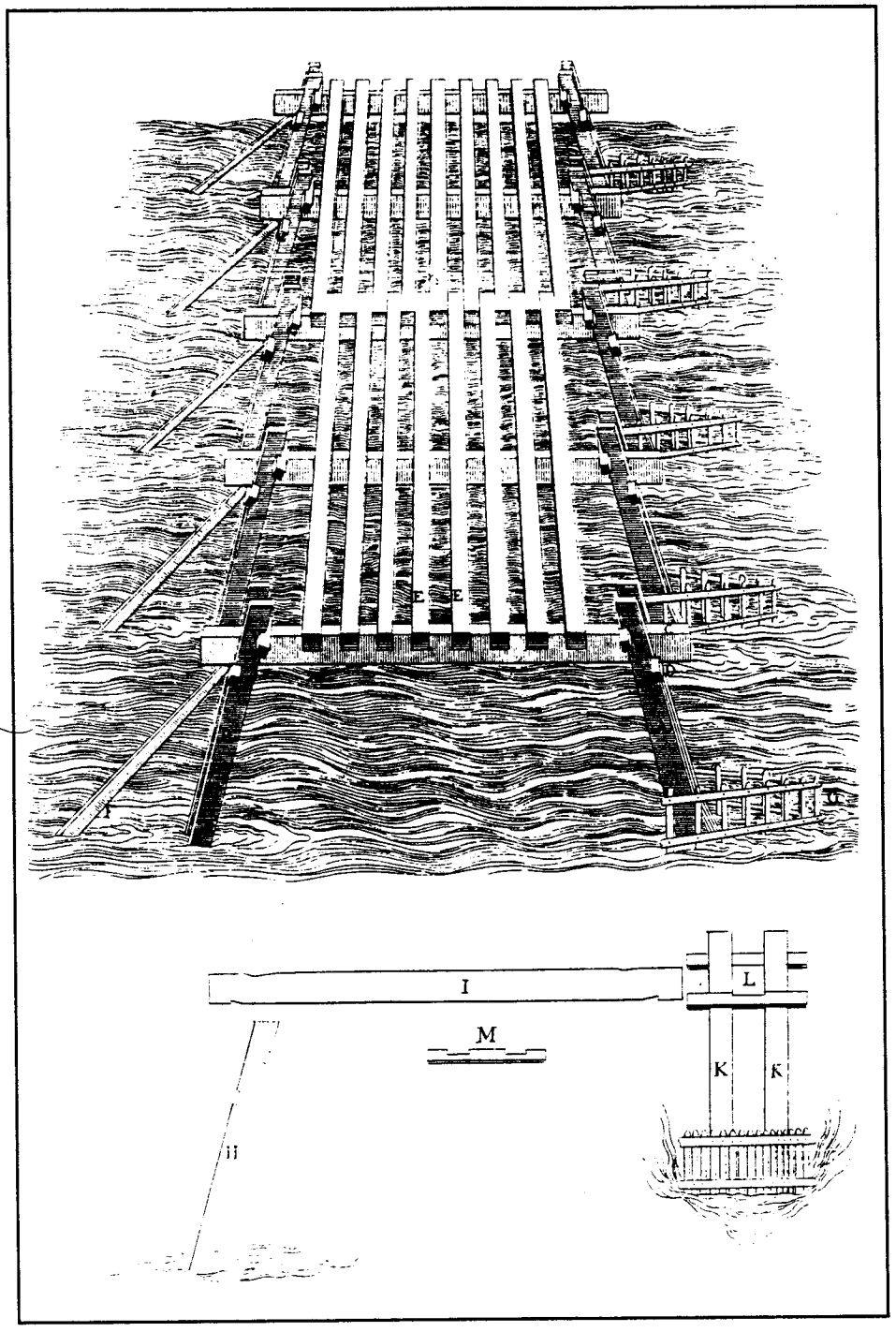

Figure 8. Cæsar's Bridge according to Palladio.

imposing weight was applied, the joints of the bents[6] would be made to fit tighter.[7] Long timber stringers were laid over the girders. The upstream side of the bents were protected from ice breakers and the dynamic effects of the river by V-shaped diversion piles. On the afterside or downstream side of the bents, a timber brace was driven at such angle as to support the bridge against the lateral forces of the river.

In subsequent analysis of Cæsar's Commentaries other architects and scholars have arrived at somewhat different interpretations of construction designs for Cæsar's Bridge than Palladio's (Figure 9 and 10).[8]

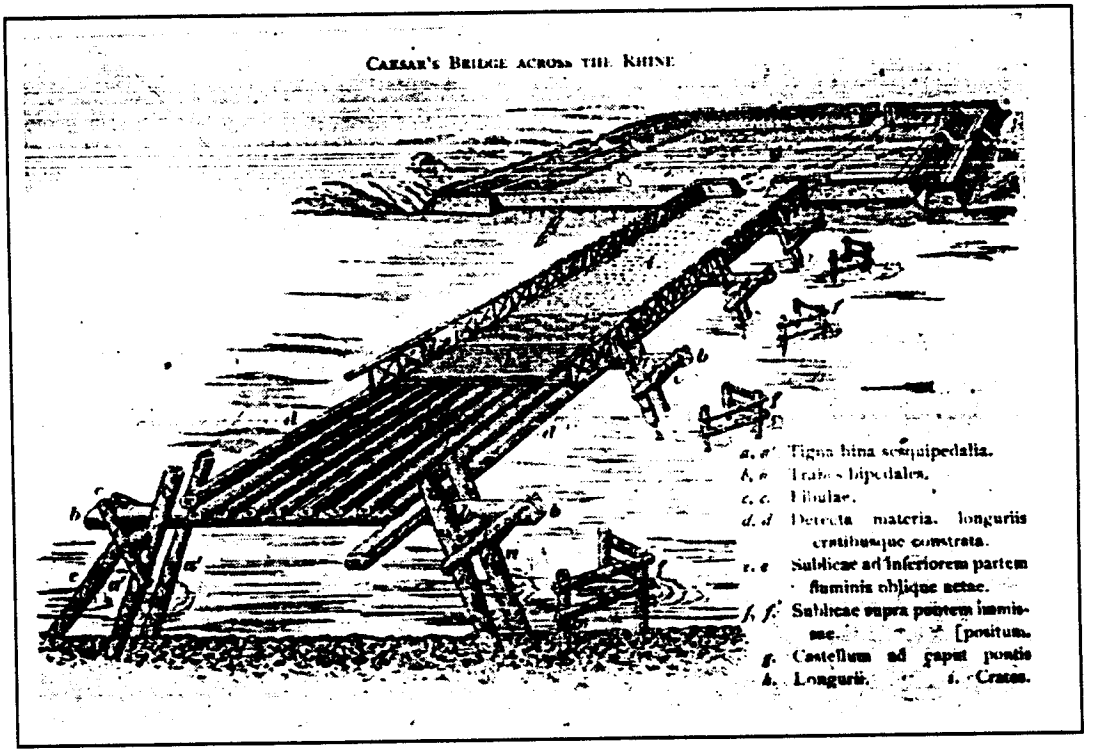

Figure 8. Cæsar's Bridge according to Kelsey.

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[6] A transverse framework design to carry lateral as well as vertical loads.

[7] Flecter and Snow, Development of Wooden Bridges p. 320.

[8] Wilbur J. Watson, *Bridge Architecture*. (New York: William Helburn Inc. 1927), p. 33, and Charles Evan Fowler, *The Coffer-Dam Process for Piers*, (New York: John Wiley and Sons, N. D.), p. 4.

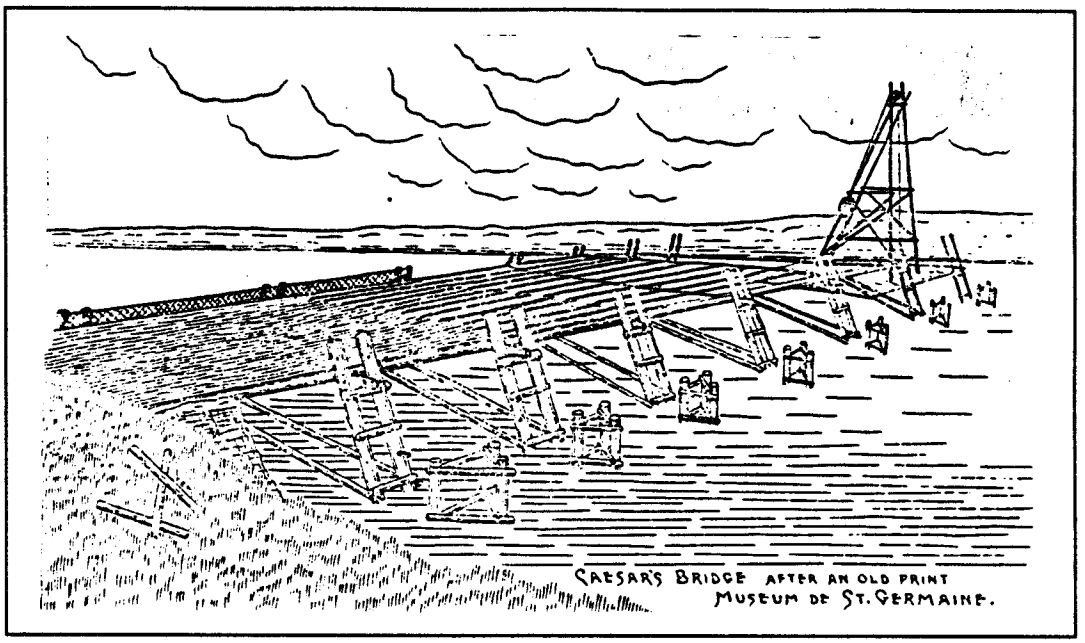

Figure 10. Cæsar's Bridge after an old print, Museum de St. Germaine.

Trajan's Bridge built in A.D. 104 across the Danube in Hungary is noted as one of the most immense works ever undertaken by the Romans. Images of the bridge were discovered on a column from Trajan, although many of the details appear to be out of proportion with recorded descriptions of the bridge. The bridge was built under the direction of Apollodorus of Damascus who was considered the greatest engineer of his time. It is described only in general terms by Dion Cassius as having 20 piers of hewn stone 150 feet high, 60 feet wide, and 50 feet thick. The piers were connected by semicircular timber arches 110 feet long. This would have made the bridge in excess of 3000 feet long (Figure 11).[9] Not until twelve centuries later was this remarkable span length exceeded. Some of the more important

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[9] Flecter and Snow, Development of Wooden Bridges, p. 320. Also see Bridges, *The Encyclopædia Britannica*, A Dictionary of Arts, Sciences, Literature and General Information, Eleventh Edition (Cambridge 1910), and Smith, *The World's Great Bridges*, p. 12-14.

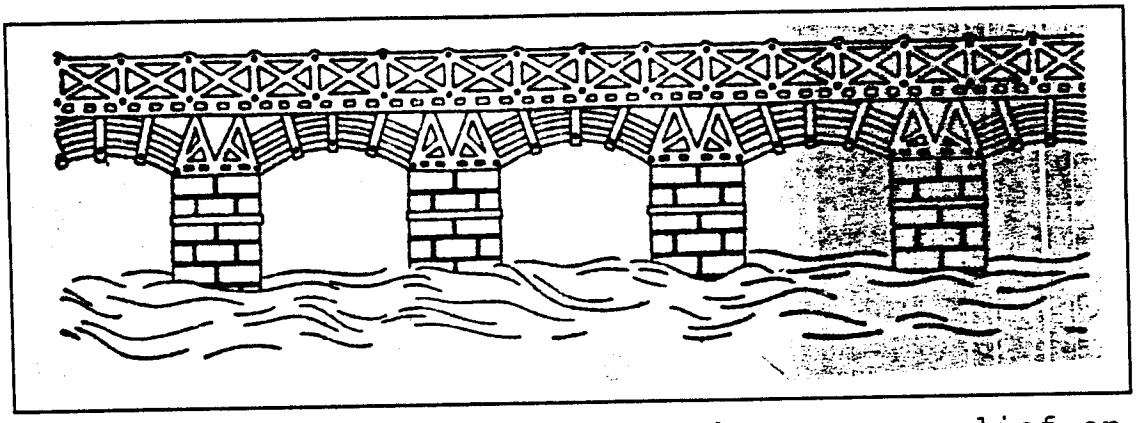

Figure 11. Trajan's Bridge as shown on a relief on Trajan's Column.

bridges initially constructed of wood such as those in Rome eventually were replaced by structures of stone. Many of these prodigious stone bridges survive today.

Early Bridge Engineering

After the fall of the Roman Empire, travel in Europe became disorganized and, in some cases, dangerous because of faulty bridge construction and poor maintenance. During the Middle Ages all of the accumulated knowledge concerning science and engineering, including bridge building, was held in widely scattered religious orders throughout Europe. In the twelfth century, because of a lack of organized central governments, the Church became the leading organization to repair or build bridges and maintain roads. Construction techniques were based on empirical knowledge, probably passed down through stone masons and carpenters from the Roman period. Medieval bridges were constructed mostly of stone and were often built with a variety of unrelated features such as defensive or decorative towers, embattled parapets, chapels, statues,

shops, and dwellings. As a result, during the Middle Ages little advancement in wooden bridge design and construction techniques were witnessed.[10]

During the Renaissance period in Europe few changes were witnessed in bridge construction practices. As during the Middle Ages, public works and development of transportation saw little progress. Although new ideas in bridge design were developed, it took hundreds of years for these concepts to find practical application. The most significant contribution in wooden bridge design during the Renaissance Period is found in Palladio's treatise on *Architecture*. His work not only reintroduced the practices of Roman wooden bridge building, but it also demonstrated three different wooden bridge designs in which wooden trusses first were "invented" by Palladio as practical span types.[11] However, it was not until the eighteenth century that Palladio's trusses received any attention from engineers and builders.

It was during the eighteenth century that the importance of the advancement of roadways and transportation were recognized by both rulers and common people. During the eighteenth century, the "Age of Reason," empirical practices and conventions in bridge design held for centuries were subjected to rationalism and scientific analysis. In 1714, the first treatise on bridge building, *Traite des Ponts,* was written by Hubert Gautier, a French engineer. Perhaps inspired by Gautier's work, Louis XV authorized the Corps des Ponts et Chaussées in 1716 to advance bridge and road building; and in 1747, the first engineering school in the world was founded, the famous "L'Ecole des Ponts et Chaussées" in Paris. The first teacher of the school, the

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[10] *Collier's Encyclopedia*, 4, 533.

[11] *Andreas Palladio's Architecture*, p. 63-73.

engineer Jean Perronet, became known as the "Father of Modern Bridge Building." Perronet's designs resulted in extraordinary advancements in masonry bridge construction. He perfected arched designs and invented the balustraded parapet as well as various types of construction equipment. Perronet's bridge designs were noted primarily for the strength of their slender structural features. Perronet's work in bridge design and construction was a leading influence on engineers in England and Europe.[12]

Although in the eighteenth century, the French built their most noteworthy bridges from stone, they were responsible also for the advancement of wooden bridge design. French revolutionary designs enabled the construction of longer spans than ever before attempted. Wooden bridges such as the *Pont de Choisy Sur La Seine* and the *Pont Louis Pres De Fresingen Sur L'Isar* (Figure 12) were marvels of engineering

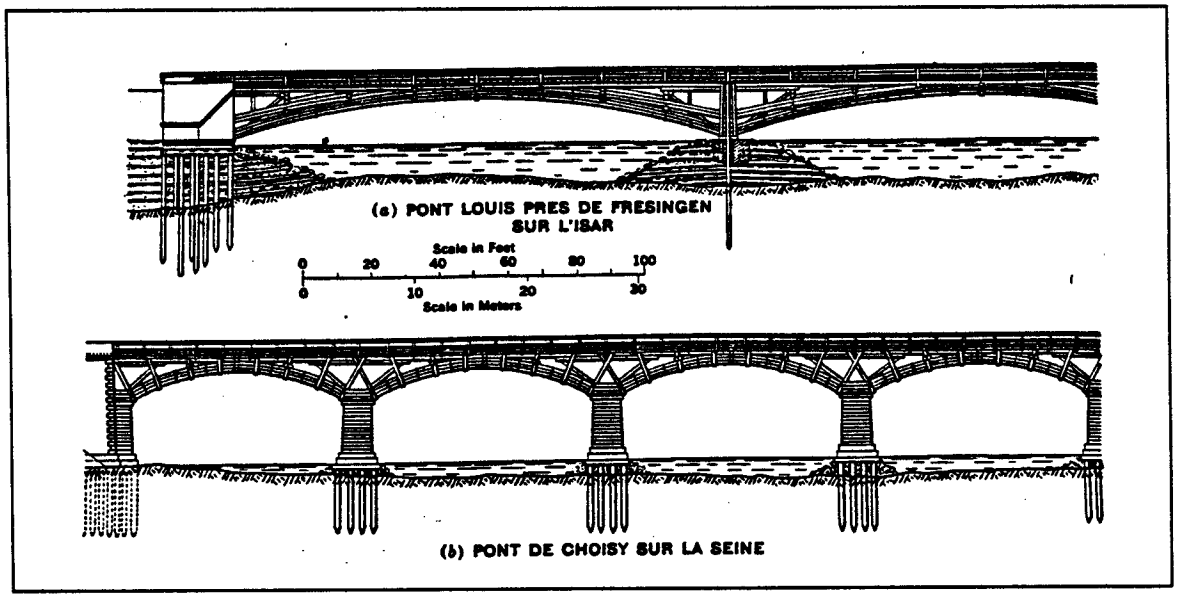

Figure 12. *Pont de Choisy Sur La Seine* and the *Pont Louis Pres De Fresingen Sur L'Isar*.[13]

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[12] *Collier's Encyclopedia*, 4, 534.

[13] Flecter and Snow, *Development of Wooden Bridges*, p. 322.

for the period. They were distinguished from earlier wooden bridges by their level floors supported on low flat arches and radial struts.[14] In most cases French wooden bridge designs made use of stone piers and low parapets. The French arches were not constructed of timbers but of planks clamped together. For shorter bridges, or when long spans were not needed, the French utilized simple pile bents or pile and beam trestles. The second book on bridges, *Theatrum Pontificaiale oder Schau Platz der Brucken und Brucken-Baues,* was written by the German engineer Jacob Leupold ,and it appears to have been printed in 1726. Other articles and books by French and German engineers followed Gautier and Leupolds initial treates, but it was not until 1760 that Stephen Riou wrote the first book written about bridge construction in English, called *Short Principles for the Architecture of Stone Bridges with Practical Observations and a New Geometrical Diagram to determine the Thickness of the Piers to the Height and Base of Any Given Arch.* Riou was a well-educated engineer who traveled extensively in Europe and had gathered his knowledge of bridges from his observations and studies of their design.[15]

John Smeaton was another influential eighteenth century English engineer. His papers and applications of engineering in bridge designs, although not published until a few years after his death in 1792, frequently were referred to by nineteenth century bridge builders.[16]

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[14] Ibid. p. 322.

[15] Llewellyn Nathaniel Edwards, *A Record of History and Evolution of Early American Bridges* (Orone, Maine University Press, 1959), p. 35, hereinafter cited as Edwards, *Early American Bridges.*

[16] Thomas Tredgold, *Elementary Principles of Carpentry; A Treatise...* (Philadelphia: Jesper Harding 1847), herein after cited as Tredgold, *Elementary Principles of Carpentry.*

The dearth of literature in English concerning bridge construction may explain to some degree the continuation of empirical practices in bridge design in America until well into the latter half of the eighteenth century. Although Palladio's sixteenth century work on architecture was available in English as early as 1738, it apparently was not well circulated or received.

Wooden Bridge Construction in America

Most early American bridge construction reflected the versatility and the practical knowledge of early settlers. Bridge structures were designed and built using empirical rules based on practical carpentry experience. Few colonial Americans possessed theoretical knowledge on bridge design. Some American bridge builders may have seen or had knowledge of French and German bridge design and construction devices. It is more likely that builders based their construction knowledge on bridges they had observed in either England or their travels in Europe.

Stone proved to be the most durable material for the construction of bridges by the Romans and in Medieval Europe. However, the expense, time, and lack of engineering know-how resulted in the building of comparatively few stone arch bridges in America. The abundance of wood, and later the improvements of cast iron and steel trusses, further inhibited the development of American masonry bridge building.

The first bridges in the American colonies were simple beam type structures. Most frequently, no doubt, one or more logs were laid over a small stream to provide convenient passage.

In 1672, John Smith of Hadley, Massachusetts, was directed by the local court "to fell a tree across Swift River for a foot bridge, if any such be near at hand."[17] To provide for safer crossings, two or more logs could be laid parallel, then planks or hewn logs could be fastened to the top of the beams for cross members.

Passage, or the inability of passage over streams and small rivers, frequently determined how roads and trails could be laid out. A convenient ford in a stream generally was the simplest route. A narrow expanse over which a beam bridge could be placed was probably chosen as the next best option. In locations where marshes or shallow streams were to be crossed, simple pile bent type bridges were the next most logical structure type. The pile bent bridge consisted of two piles driven a convenient distance apart and jointed together across the top by a girder on which stringers could be supported.

Over wider streams and rivers, the early American settlers, in most cases, would have relied on ferries to transport them and their cargo from one shore to the other. The construction of long bridges over waterways subject to floods, strong tides, wind, and other hazards generally were not undertaken lightly. Since water transport frequently was the most convenient means available, colonists seldom felt the need to undertake the construction of an expensive and relatively difficult bridge project. Hence, major bridge projects generally were undertaken only when traffic was more than ferries could handle, or when a bridge was simply more economical.

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[17] Edwards, *Early American Bridges*, p. 21.

In 1660, "The Great Bridge" was built between Old Cambridge and Brighton across the Charles River only 30 years after the settlement of Boston, Massachusetts. The bridge reportedly was 270 feet long and was supported by 13 piers.[18] Little is known about the construction features of this early bridge; although some sources suggest they were constructed on "cribs of logs filled with stone and sunk in the river hewn timber being laid across it."[19]

Substructures generally were referred to as "piers" in early bridge drawings and records. The term "piers" included bents or trestles; although more often cribs were constructed to support bridge superstructure, particularly in the northern colonies. The cribs could be constructed with floors, so as to be filled in part or entirely with ballast.[20] Cribs were most often used when bottom conditions prevented the driving of piles to anchor the substructure of the bridge. Other methods included piling stones or boulders in intermediate positions across shallow streams to serve as pier abutments. Local conditions determined the nature of the piers or substructure.

End supports for early American bridges varied from simple mud-sills made of timber embedded into the earth, to timber bents, and heavily constructed abutments of wood or stone. Wooden abutments commonly were built in the fashion of a three-sided crib. The front of the abutment faced the direction of the bridge, and side portions or wings were parallel with the bridge alignment. The abutment was anchored by timbers or deadmen deeply embedded into the

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[18] Ibid., p. 24. Flecter and Snow, Development of Wooden Bridges, p. 324. Also see Theodore Cooper, "American Railroad Bridges," *American Society of Civil Engineering, Transactions*, XXI, (July, 1889) 7-17, herein after cited as Cooper, American Railroad Bridges.

[19] David Plowden, *Bridges, The Spans of North America* (New York: The Viking Press 1974), p. 33, herein after cited as Plowden, *Bridges, The Spans of North America*.

[20] Flecter and Snow, Development of Wooden Bridges, p. 324.

shoreline or embankment.[21] Stone masonry was used for abutments and piers in locations where stone was abundant. It also was used in locations where strong currents or ice floes were a problem for bridge support members.[22]

Soft mud bottoms or deep silt were a problem for early bridge builders. Rocks and boulders were used for fill or reinforcement of sediments. Following placement of the fill, a wooden grillage or large raft-like platform could be placed over the fill material to form a more stable foundation. Generally, cribbing would be placed on top of these surfaces and filled with ballast and protected by riprap.

There is little evidence about even the more important bridges in colonial history to suggest details about the mode of their construction. Simple king post or twin post trusses developed by Palladio may have been known to American builders; however, there is no evidence that trusses were utilized until the nineteenth century. Beam type superstructures apparently were built more simply and were adequate to colonial transportation needs.

In the eighteenth century, driving piles to support a bridge was dependent upon the bottom type. Pile supported bridges were often more technically difficult than building crib-type piers. The French designed and utilized early pile drivers in the first half of the eighteenth century.[23] The French pile drivers most frequently were powered by several men hauling and releasing a heavy weight onto the top of the pile in unison (Figure 13). More complex pile driver designs

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21 Edwards, Early American Bridges, p. 24.

22 Ibid.

23 "Recueil de Planches sur Les Sciences, Les Arts Libéraux et Les Arts Méchaniques, Avec Leur Explication," *Encyclopédie ou Dictionnaire Raisonné des Sciences des Arts et des Métiers*, Nouvelle impression en facsimilé de la première édition de 1751-1780, (Stuttgart-Bad Cannstatt, 1967), XXIII, herein after cited as *Encyclopédie ou Dictionnaire Raisonné des Sciences des Arts et des Métiers*.

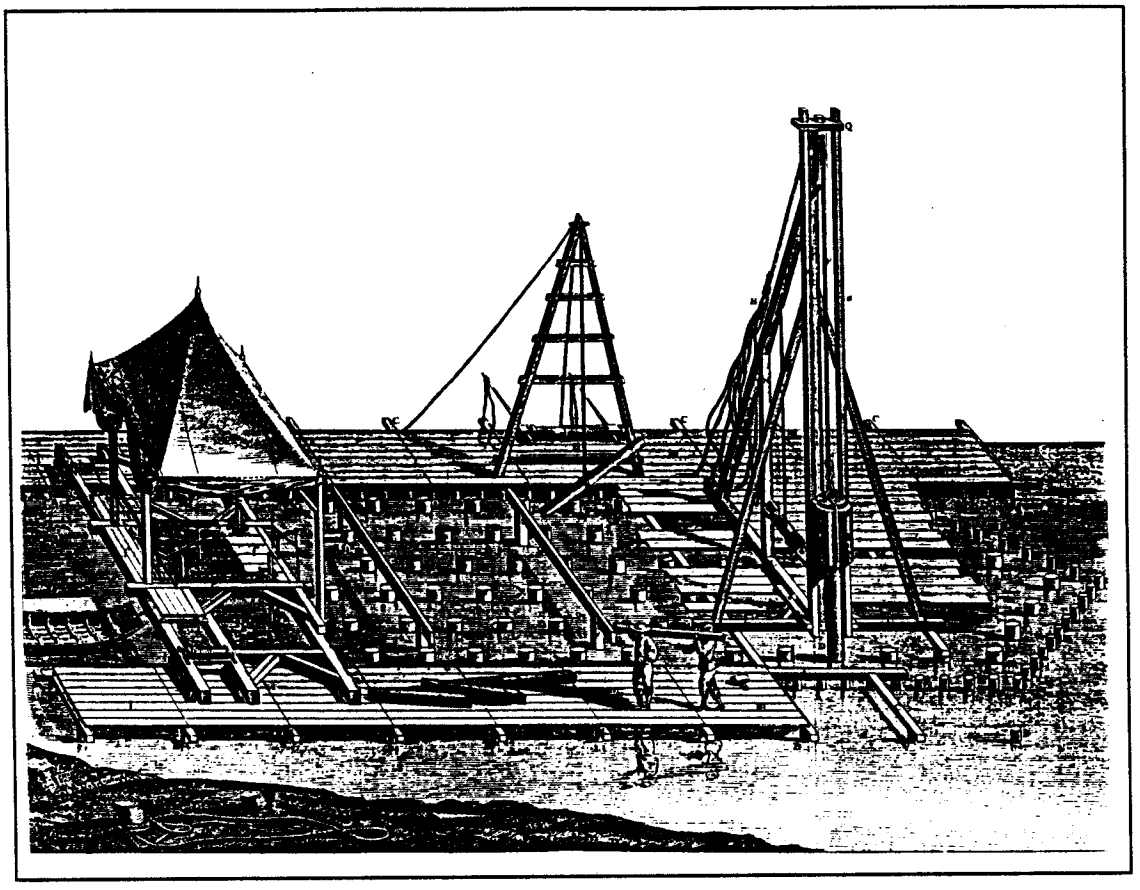

Figure 13. Early French Pile Driver, Manually Operated.

utilized horsepowered or manpowered capstans to lift the pile driver's hammer. Trip levers then were used to release the weights (Figure 14 and 15).

The methods of lifting heavy loads and handling heavy objects were passed down through the ages from one builder to the next. These practices were well understood in the construction of structures on land as early as the Egyptian pyramids. However, lifting, handling and placement of heavy loads over water for constructing bridges required more specialized equipment. Block and tackle served for the most part, but winches and cranes also were necessary in building

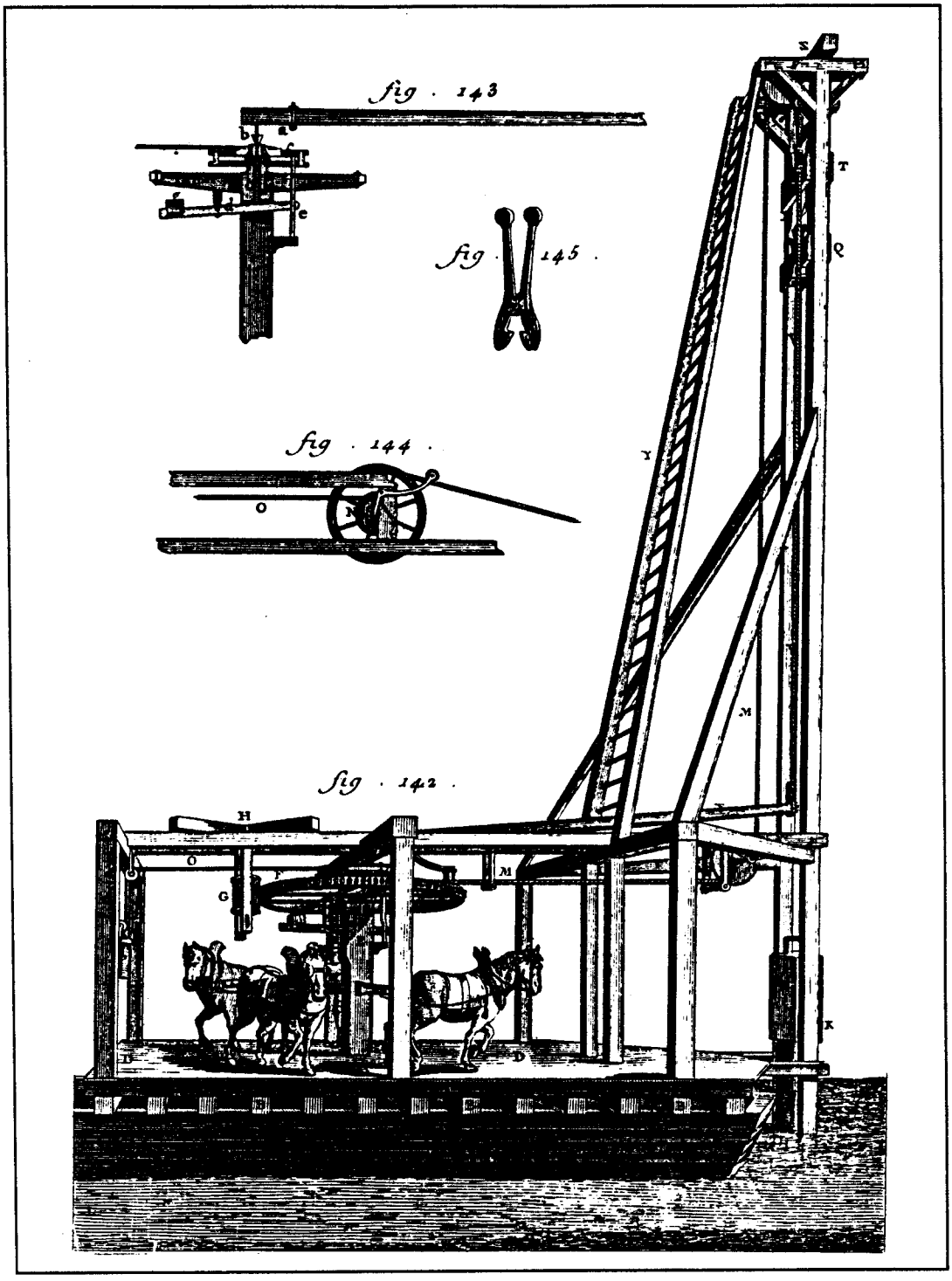

Figure 14. Early French Pile Driver, Powered by Draft Horses.

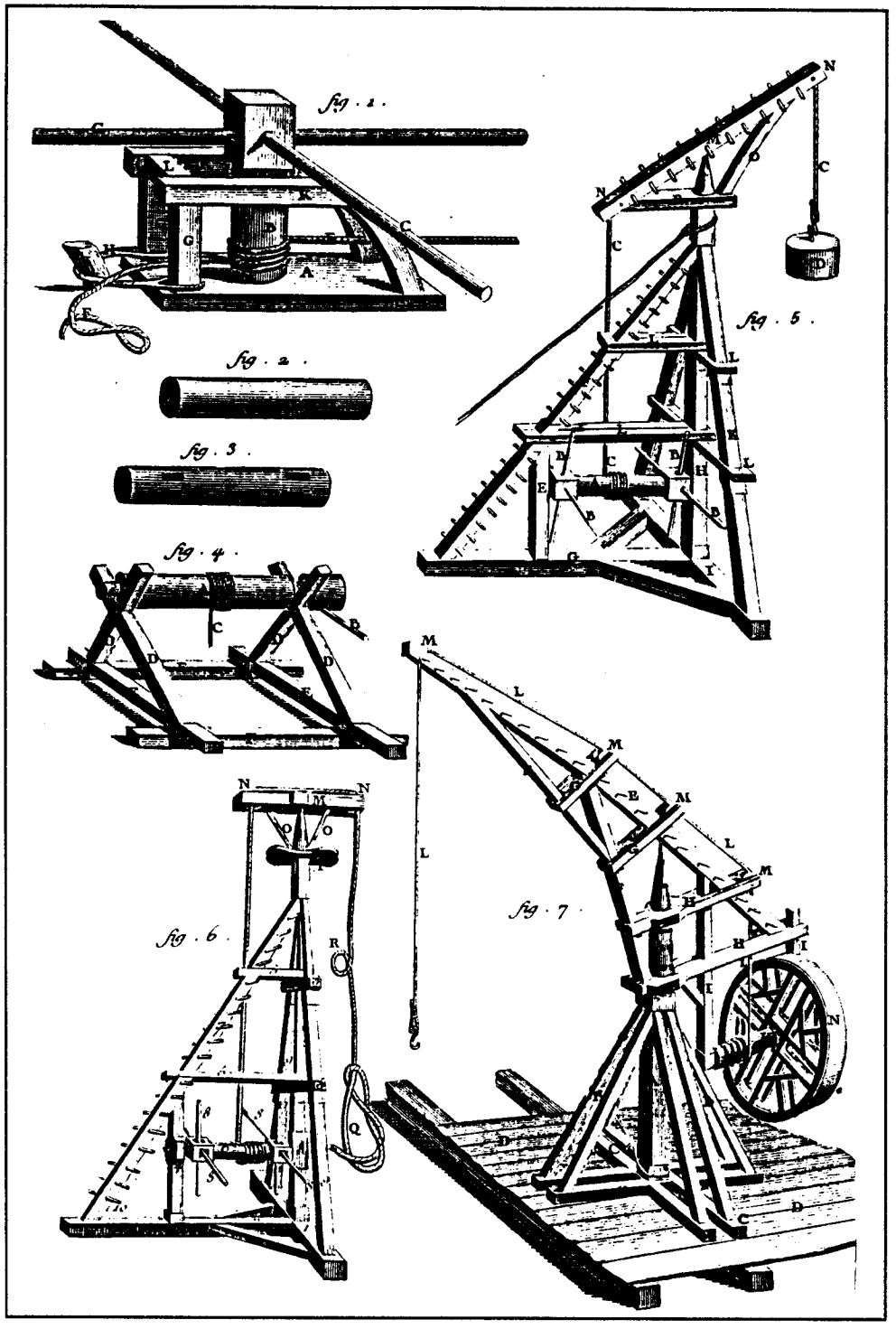

Figure 15. Eighteenth Century French Construction Equipment.

larger more complex bridge structures, such as those in eighteenth century Europe (Figure 16). A wooden crane or lifting apparatus may have been built by Americans based on empirical practices or based on observation of those designed by the French bridge builders in the early eighteenth century.

An engineer by the name of Major Samuel Sewall is said to be the first to have built a pile-trestle bridge, in York, Maine. The interesting story of Sewall's Bridge had its beginnings on 20 January 1742 at a local parish meeting, as reported by George Alexandria Emery in his book *Ancient City of Gorgeana and Modern Town of York (Maine)*:

> Voted, that this parish is willing there should be a bridge built across York river, at or near where Capt. Samuel Sewall keeps a ferry, and that a Committee be chosen to take subscriptions for building the same, and the said committee are directed to prepare materials for to build said bridge as soon as may be...Capt. Nathaniel Donnell, Samuel Sewall, Joseph Holt, Samuel Bragdon, Jr., Samuel Milberry, and Thomas Donnell, were voted to the committee to take subscriptions and prepare materials, etc.[24]

The original bridge committee apparently failed to obtain the required subscription, because many years passed before the bridge was finally constructed. In 1760, a second group that included Samuel Sewall, Jr. was formed and given permission by the town to construct a bridge.[25]

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[24] Emery, *Ancient City of Gorgeana and Modern Town of York*, p. 169.

[25] From an unpublished statement written by Judge David Sewall (ca. 1794) from Jos Sewall's notes, Old York Historical Society, York, Maine, herein after cited as Sewall, unpublished notes, Old York Historical Society.

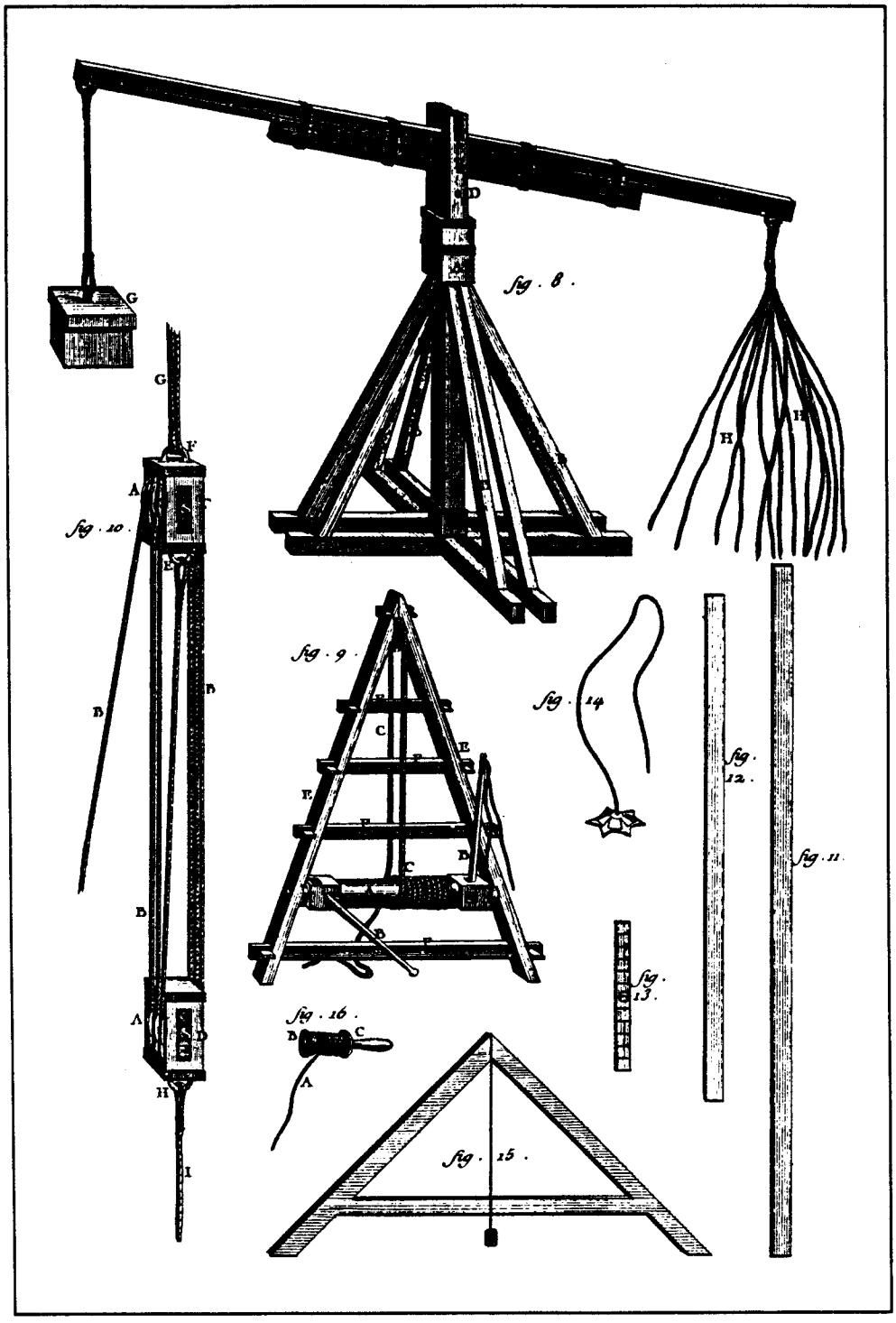

Figure 16. Eighteenth Century French Construction Equipment.

On this occasion, the money was raised, and a unique method of pile bridge construction was invented by Samuel Sewall. Sewall is said to have fashioned iron rods that were used to probe the depth of the bottom sediments until reaching hard clay. He then supervised the prefabrication of pile-trestles on shore in which piles were pre-cut to the proper length. The trestles, consisting of four piles each, were then floated into position at slack tide. The trestle sections were raised upright and driven into place using a (poorly described) mechanism that utilized heavy oak logs to drive the entire trestle section into place (Figure 17).[26] As implausible as it sounds, this is the impractical method Sewall reportedly used in constructing the first pile-trestle bridge in America:

> The piles or posts were of different lengths; the length being determined by probing the bottom of the river or mud with a pointed iron affixed to a long pole, and having ascertained the various depths of the mud in a section, a whole section, containing four piles or posts, was framed, well braced, and the cap sill fastened on. At still tide it was floated to its place, and, by a dint of labor, set upright and guyed. Large and heavy oak logs, the tops or lighter ends of which were secured inland, were then made use of, and the butts raised by tackle to a proper height; and by the striking of detents or latches, the ropes were released, the logs fell with great force upon the caps, and by their impetus this section was driven to the depth desired.[27]

Why Sewall and the builders of the bridge chose to prefabricate the trestles before driving them into the bottom surface is not fully understood. Unless the mud at the bridge site was very soft, the force necessary to drive the

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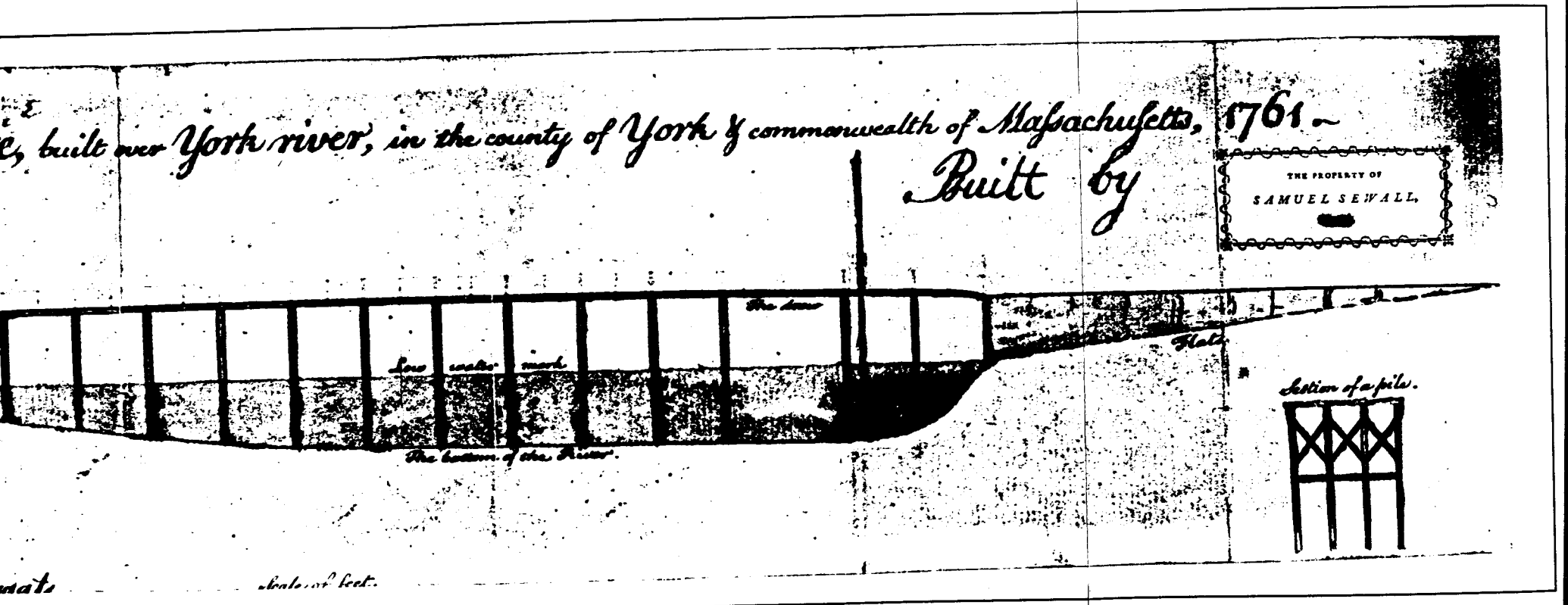
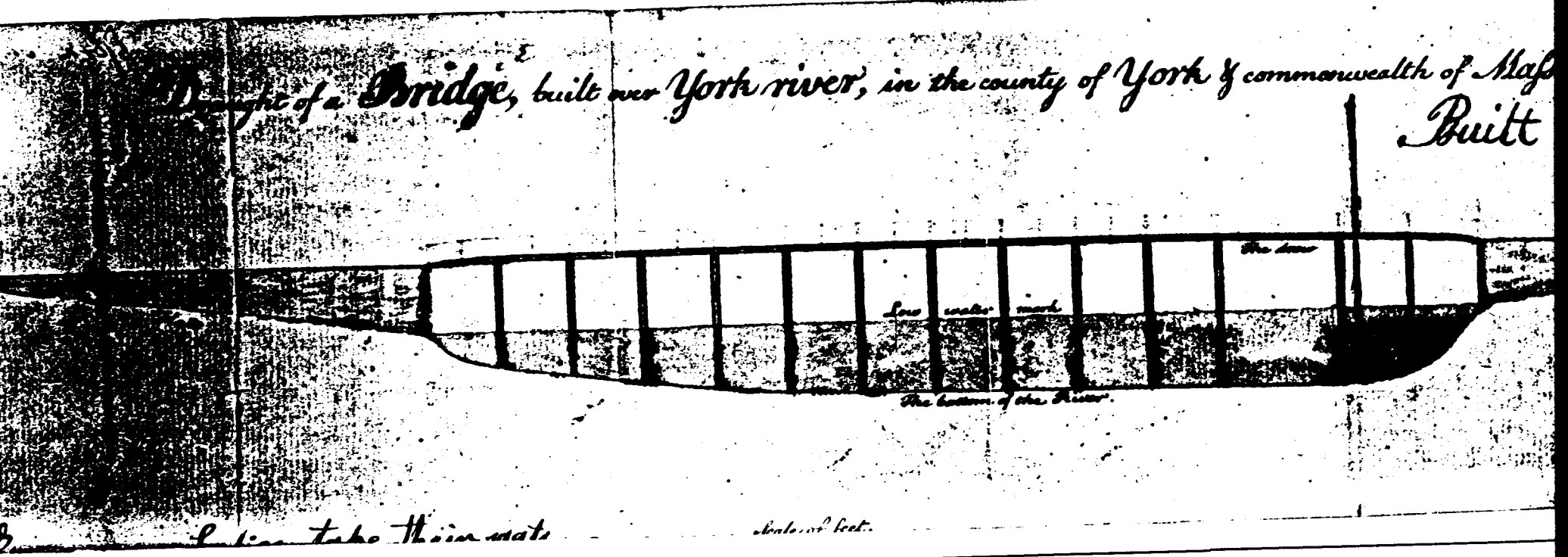
[26] *Draught of a Bridge Built over the York River, in the County of York & Commonwealth of Massachusetts, 1761*, is courtesy of the Old York Historical Society, 140 Lindsay Road, York, Maine.

[27] Emery, *Ancient City of Gorgeana Modern Town of York*, p. 171.



1 Bridge over the York River, York Maine.



ure 16. "Draught" of Sewall's 1761 Bridge over the York River, York Maine.

entire trestle into place would have damaged the structure. The bridge was "two hundred and seventy feet long by twenty-five feet wide exclusive of the wharfs at each end which reached to the channel."[28] Thirteen "piers" were used to cross the river at the low water level.[29] The "wharfs" at each end of the bridge, said to be constructed of field stones and earth,[30] also served as abutments and crossed the "flats" or tidal areas to the "low water mark." Lightly drawn vertical lines in the wharfs leading to the bridge shown in the "Draught of a Bridge," suggest that piles or cribs were utilized in the construction of the on ramps prior to being filled. Although the drawing of the bridge is not of sufficient detail to determine specifics of construction, carpentry practices of the time suggest that the girder, strut and bracing joints probably were mortise-tenon held with treenails.[31] In colonial bridge construction practices in New England, stringers were made from logs dapped at their bearings and hewn on top to provide a uniform surface for flooring. Flooring was made from plank and would have been readily available to Sewall since the second sawmill built in America in 1631 was in Berwick, Maine - located only a few miles north of York.[32]

Because of the success of Sewall's Bridge over the York River, Sewall and company were asked to build a bridge over the Charles River in Boston, which they did in 1785 and 1786. The bridge was reported to have been built in the same manner as the York River Bridge except that the trestles were constructed with seven piles framed together. It reportedly was 1,503 feet long supported by 75 piers.[33]

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[28] Edwards, Early American Bridges, p. 26.
[29] Sewall, unpublished notes, Old York Historical Society.
[30] Edwards, Early American Bridges, p. 26.
[31] Ibid. p. 27.
[32] Sewall, unpublished notes, Old York Historical Society.
[33] Ibid. and Cooper, American Railroad Bridges, XXI, 8.

In post-Revolutionary War America, the 13 states were no longer able to depend upon many of the goods and products that had been acquired in the past from England. As a result, a greater economic interdependency evolved among states. One of the consequences of this greater interstate dependence was the need for better roads and means of transportation. Transportation improvements began slowly, but by the 1830s they not only included new roads but also canal systems and railroad systems.

The increased transportation demands after the Revolution provided the stimulus for improved bridge design and construction. The first notable example was completed in 1785 by Enoch Hale. Hale's Bridge was constructed over the Connecticut River at Bellows Falls, Vermont. The site chosen to build the bridge was across a gorge at the narrowest point of the River. A large island of rock divided the River into two channels and provided Hale with a natural rock pier to support the center of his bridge. The two spans combined to a length of 365 feet. Initially, Hale's plan for a bridge was met with skepticism by local inhabitants. However, after its completion, the bridge was noted as an engineering achievement that opened the Vermont region to trade with Boston and coastal New England.[34]

One of the earliest and most successful bridge builders of this period was Timothy Palmer. Palmer built his bridges with arched trusses and stone abutments. He was responsible for building several major bridges in the northeastern United States in the late eighteenth and early nineteenth century. Palmer insisted upon the need to protect bridges from weather; hence, most of his bridges were covered. By the

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[34] Flecter and Snow, *Development of Wooden Bridges*, p. 324-325.

turn of the century Palmer was the best known bridge builder in America. He was commissioned to build the first permanent bridges over the Potomac River at Georgetown, D.C., the Schuylkill River at Philadelphia, and over the Delaware River at Easton, Pennsylvania.[35]

Palmer's success with wooden trusses was part of a revolution in bridge building in America during the first half of the nineteenth century. Bridges were being designed by trained civil engineers motivated by the economic growth during the American Industrial Revolution. Crossings where traditional pile bent type construction were impractical to utilize were being safely traversed by newly designed wooden truss style bridges. Engineers such as Lewis Wernwag, Theodore Burr, Stephen H. Long, William Howe, and Thomas Pratt each developed more practical wooden truss designs. As a result of these designs, successively longer and longer spans were bridged in the first half of the nineteenth century.

Although the majority of the most noteworthy bridges were built in the northern states, some of these design improvements were making their way south as early as the 1820s. Karl Bernhard, Duke of Saxe-Weimar-Eisenach, commonly known as Prince Bernhard, noted such a bridge over the Cape Fear River near Fayetteville,North Carolina in 1825:

> Not far from Fayetteville, which we reached about nine o'clock in the evening, we crossed the Cape Fear River on a long covered bridge, built on a suspension frame work [a swinging bridge] of which I had seen a very good model in the Patent Office in Washington.[36]

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[35] Ibid p. 325-326.

[36] Susanne H. Freund and Alice B. Keith, "Prince Bernhard's Travels in the Carolinas, December, 1825," *The North Carolina Historical Review*, XXVI (October,, 1949), 453.

The bridge Bernhard observed may have been a design inspired by Timothy Palmer, Theodore Burr, or Lewis Wernwag. However, only Palmer and Burr had patented their bridge design by 1825. Lewis Wernwag's bridge designs were not patented until 1829; although he had already built his famous bridge "The Colossus" over the Schuylkill River at Fairmount, Pennsylvania by 1812.[37]

The revolution in wooden truss bridge design in the early nineteenth century can be traced to successful truss designs of the eighteenth century. The following series of drawings extracted from various sources, including U.S. Patent Records, demonstrates evolution and some of the truss designs of the early nineteenth century (Figures 18-25).[38]

By the mid-nineteenth century the engineering and design of wooden bridges were no longer based on empirical knowledge. Trained civil engineers and experienced contractors built bridges based on established principles of design and construction. In 1847, the civil engineer, Thomas Tredgold published his classic treatise *Elementary Principles of Carpentry.* In Tredgold's book, he clearly relates the principles and guidelines for wooden bridge construction of the time beginning with the design of wooden bridges:

Of the Design of Wooden Bridges

> The principal objects to be attended to in a design for a wooden bridge are 1st, the choice of a proper situation; 2ndly, the width of the roadway; 3rdly, the water-way that ought to be left for the river; and 4thly, the span of arches. Each of these is chiefly determined by local circumstances.

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[37] Flecter and Snow, *Development of Wooden Bridges*, p. 325.

[38] *Encyclopédie ou Dictionnaire Raisonné des Sciences des Arts et des Métiers*, XXIII, Plate XV, and Patents for Inventions, United State Patent Office, 1790 to 1873, Washington, D.C.

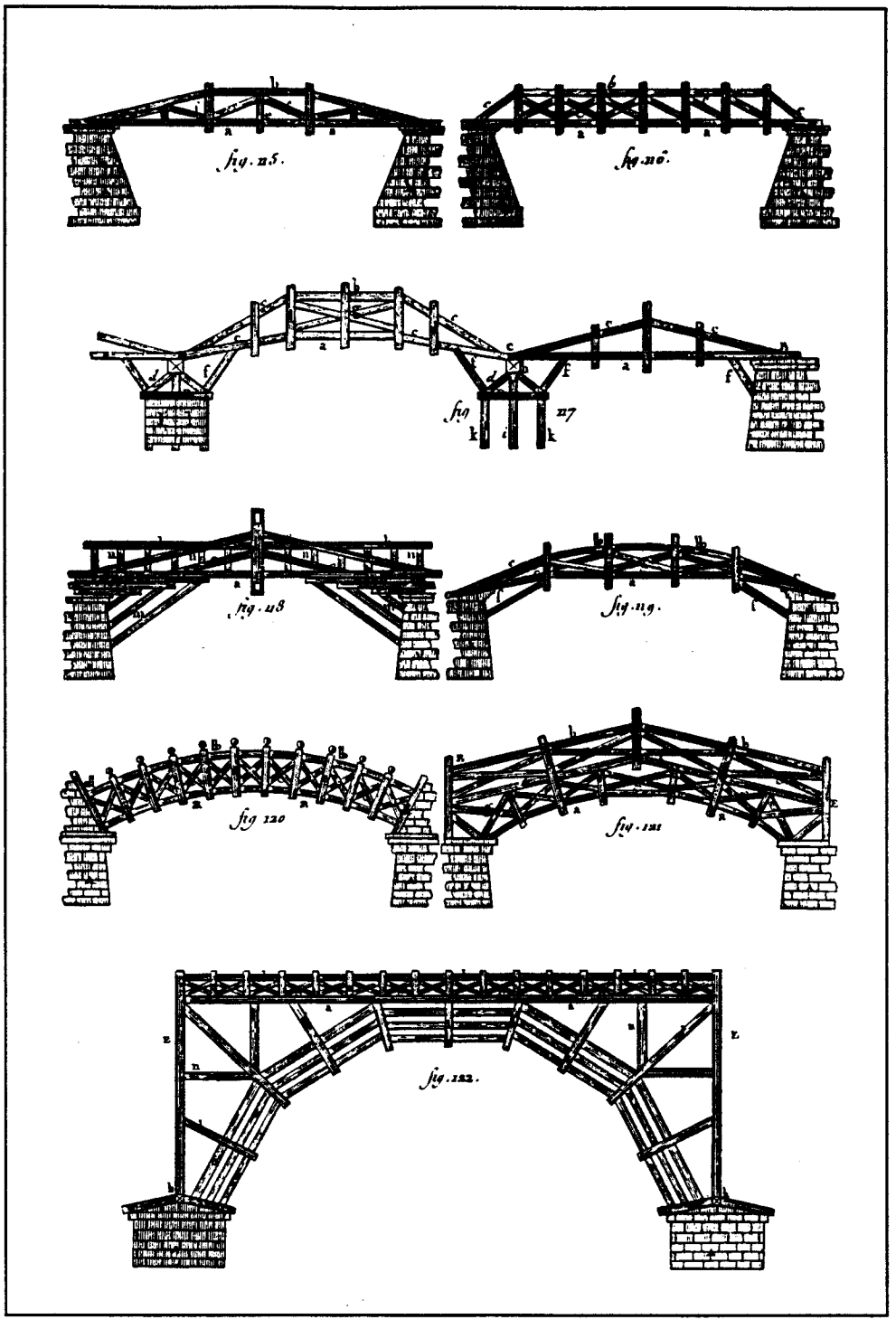

Figure 18. Examples of truss designs from the eighteenth century.

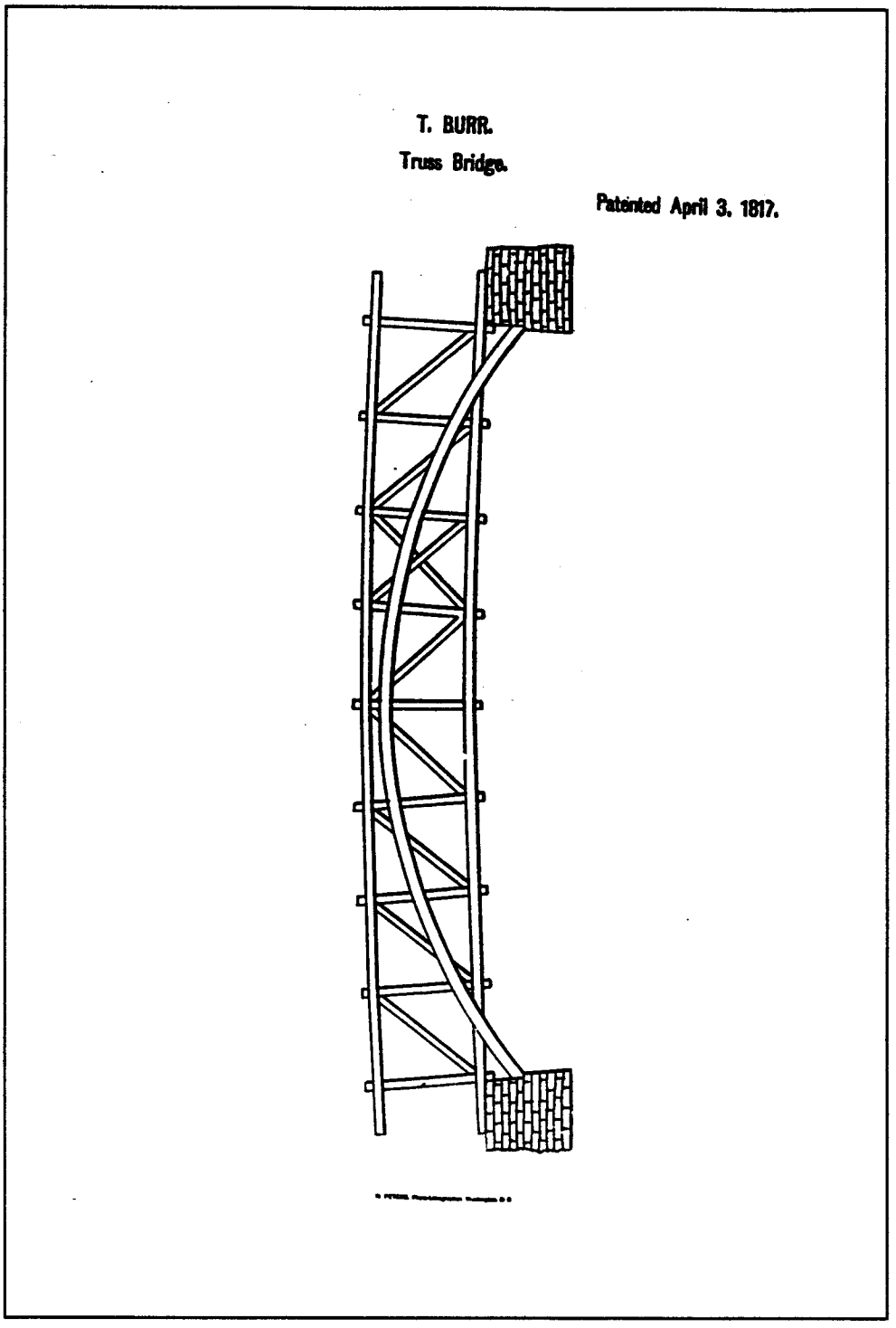

Figure 19. Early nineteenth century truss designed by Theodore Burr, patented 1817.

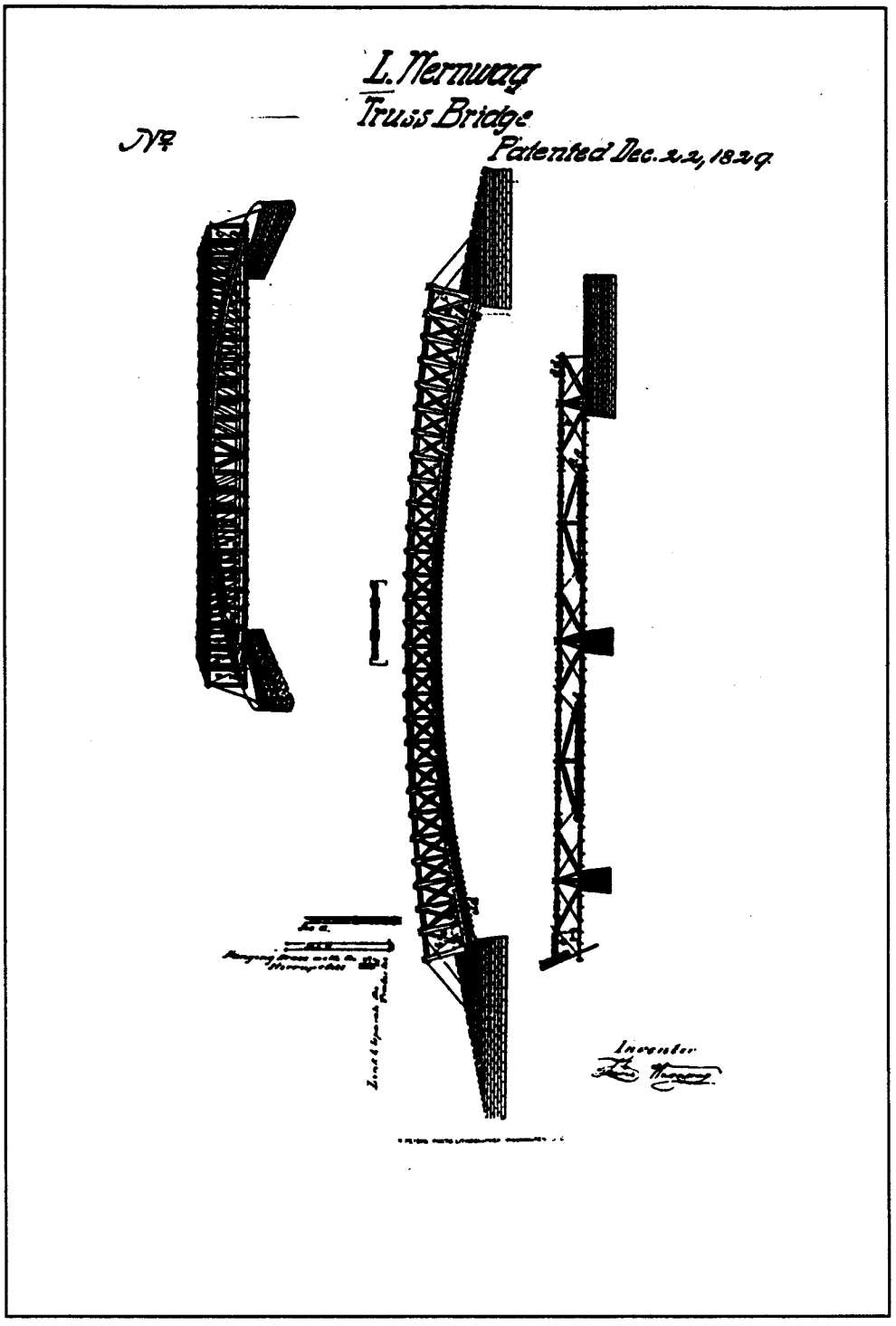

Figure 20. Early nineteenth century trusses designed by Louis Wernwag, patented 1829.

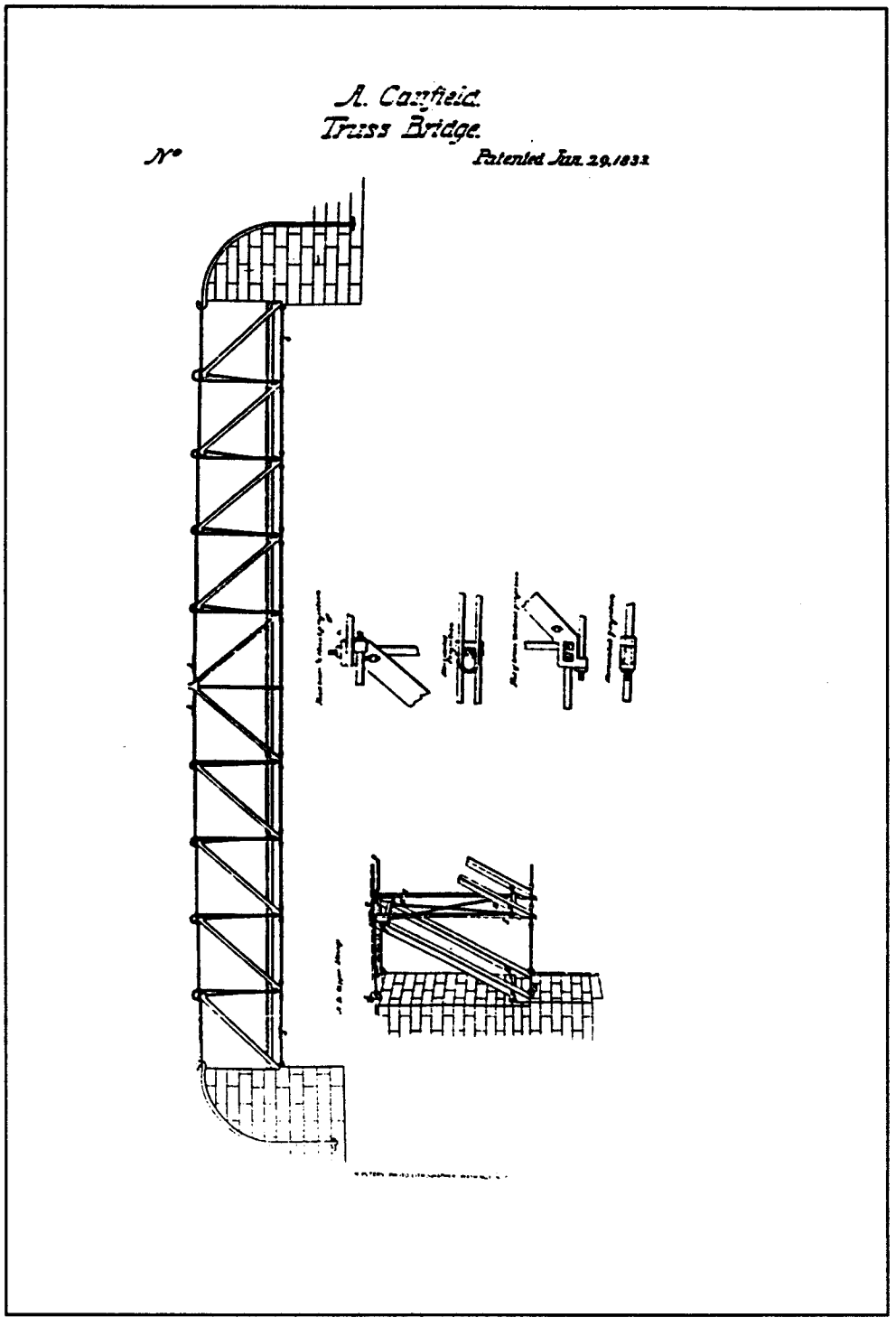

Figure 21. Nineteenth century truss designed by A. Canfield, patented 1833.

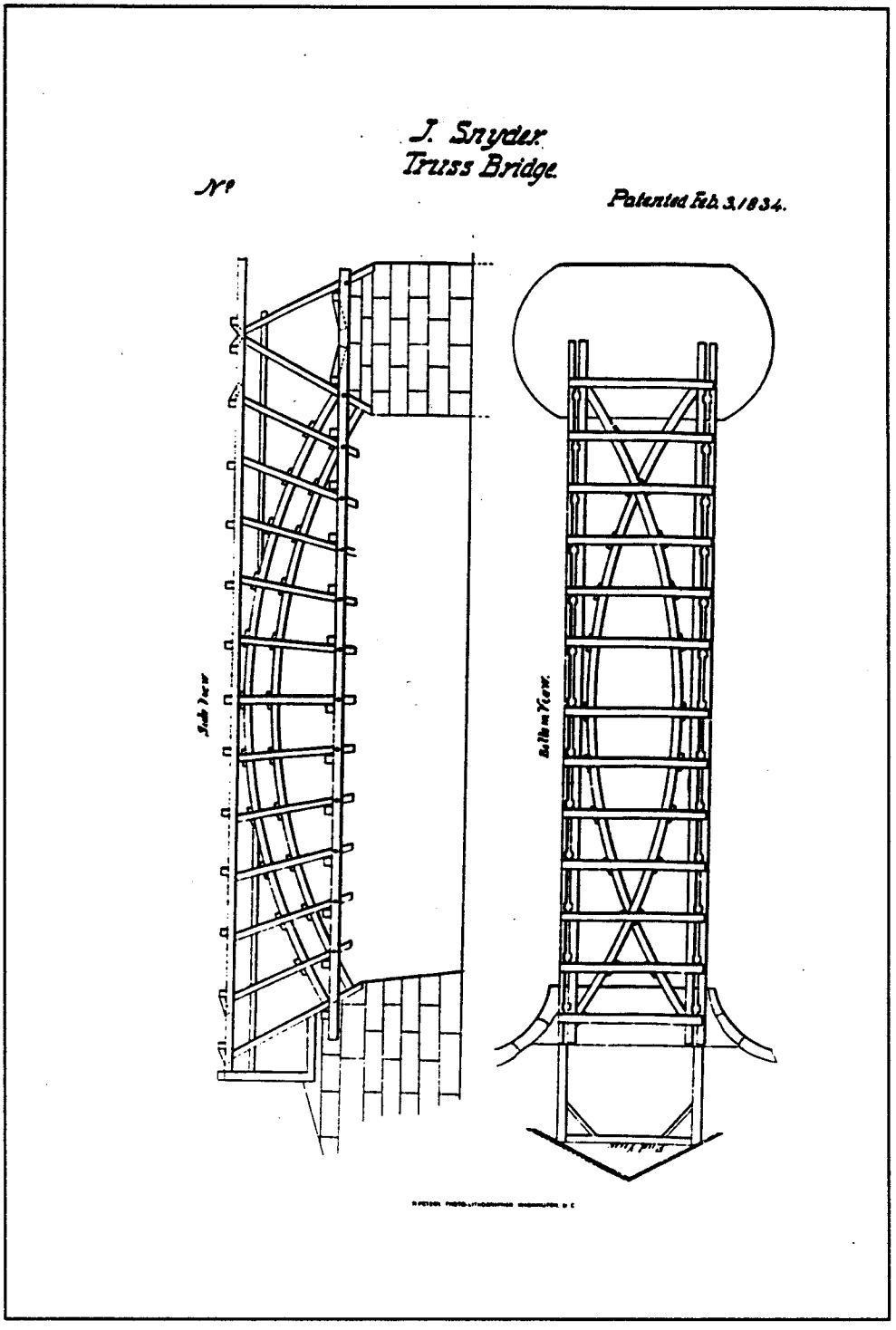

Figure 22. Nineteenth century truss designed by J. Snyder, patented 1834.

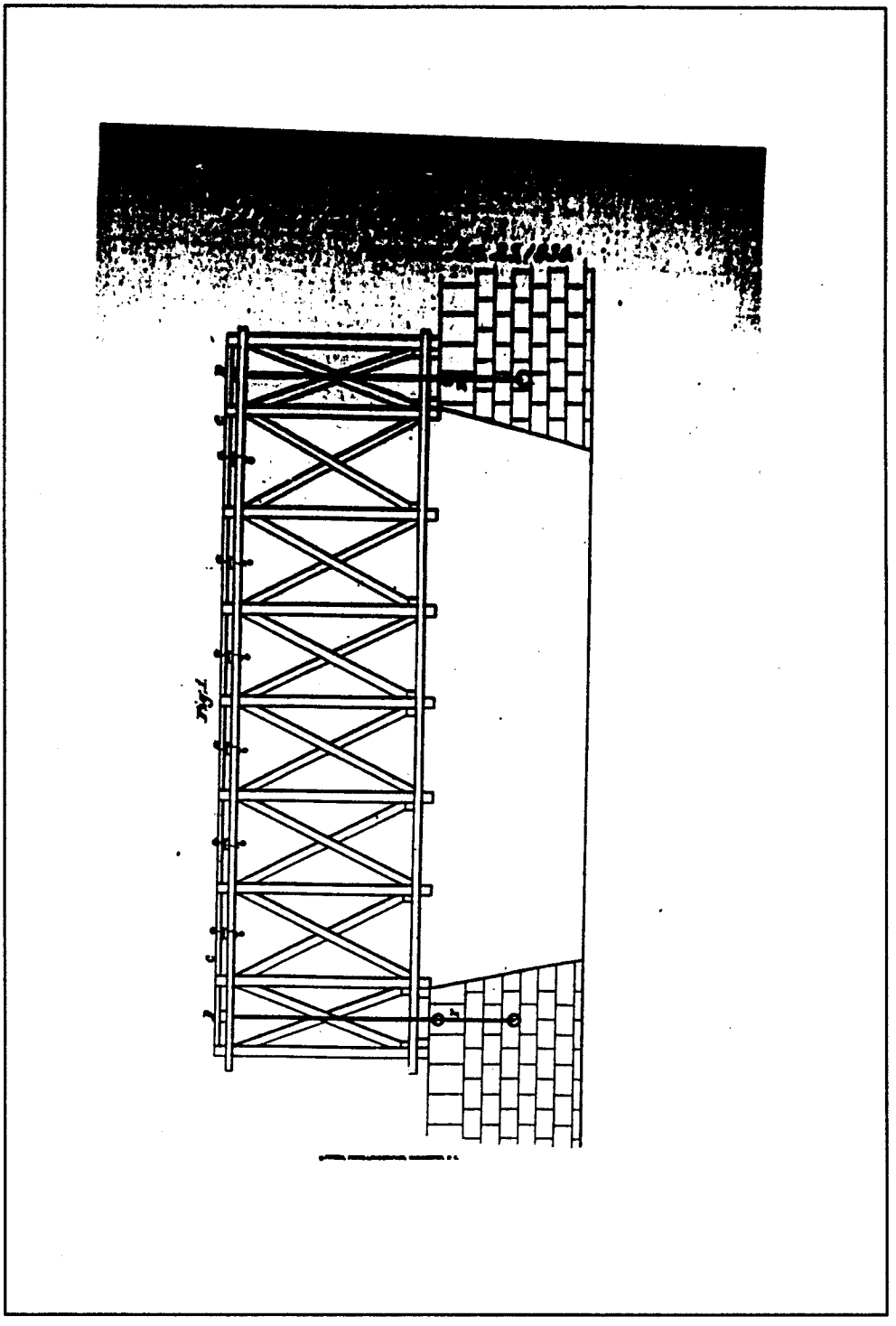

Figure 23. Nineteenth century truss designed by Stephen H. Long, patented 1834.

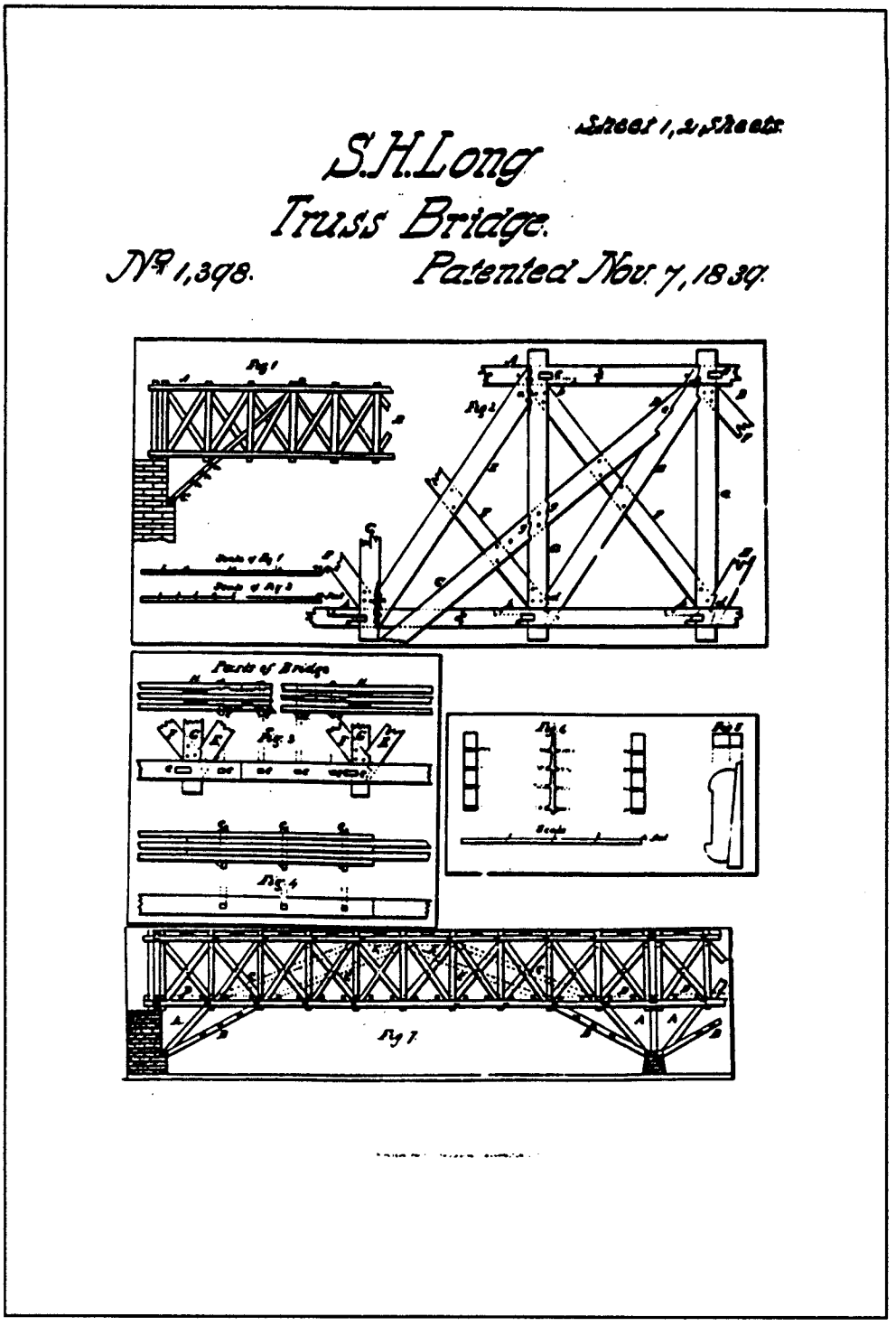

Figure 24. Nineteenth century truss designed by Stephen H. Long, patented 1839.

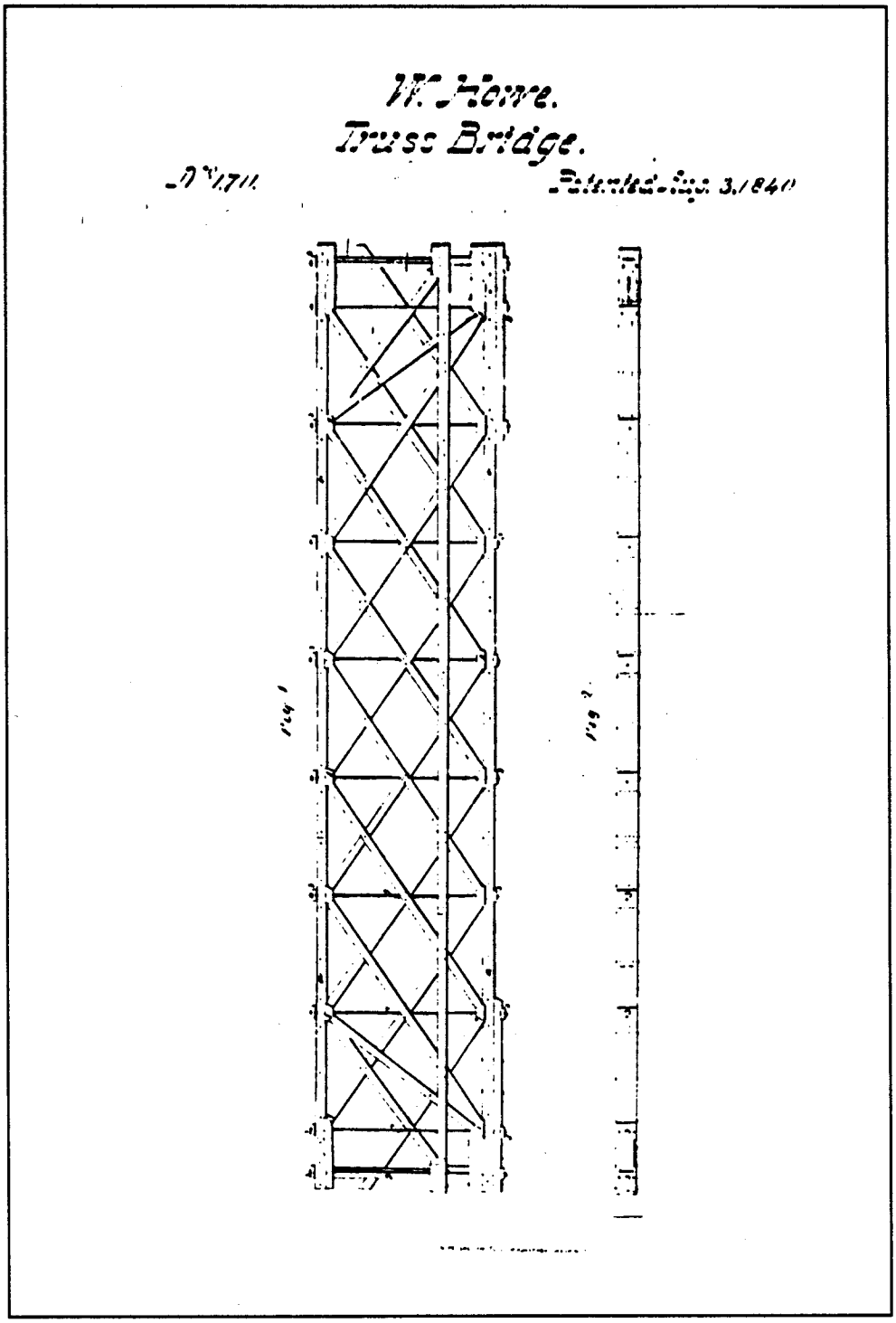

Figure 25. Nineteenth century truss designed by W. Howe, patented 1840.

The principal object in erecting a bridge is to obtain a more easy and ready communication between the opposite banks of a river, a deep ravine, and places of a like nature; and, in general, the situation ought to be that which (is) most convenient for the use of the public. Sometimes, however, it happens that the most convenient situation is not the best adapted for the erection of a bridge. In this case the advantages and disadvantages of other situations should be carefully considered, and the site determined so that the means of communication may be as direct as possible, and the access to the bridge commodious.

This determination will be much facilitated by making a correct plan of the course of the river, and of the roads that are to be connected with the bridge. This plan should be sufficiently extensive to give a correct idea of the nature of the river, and of the changes its bed may have undergone; and also of the directions of the roads.

The bridge should always, if possible, cross the stream at right angles; and it is an advantage, when the course of the river is nearly straight for a considerable distance above the bridge; and, when there is a contraction in the channel at a little distance below the bridge, it renders the effects of floods less dangerous.

The situation being fixed upon, a correct section should be made of the bed of the river, showing the form of the opposite banks, and the depth of water at different seasons of the year. Also on this section should be put the line of the highest and lowest water marks, which should be drawn from the best information to be procured from the observations of the oldest inhabitants of the neighborhood.

The nature of the bed of the river should be carefully examined, particularly in the site of the abutments or piers, by boring, driving in a rod of iron, or other means, and to sufficient depth to be certain of the quality of the ground.

It would also be desirable to have a section, showing the declivity of the bed of the river for a considerable distance above and below the situation of the intended bridge, and also the velocity of the stream at different periods.

The Width of the Road-way

The width of a bridge depends wholly on the situation of the place where it is to be erected. It ought to be wide in proportion to the the importance of the communication to be effected, and according to the population of the place where it is at, or near; but it is desirable that its width should not be greater than its situation requires, because it increases the expense of erection without adding to its utility.

The width of a bridge between the parapets that is intended for wheeled carriages may be from 18 to 45 feet, according to the situation. Where the road is at a distance from any principal town, and has little traffic upon it, the width of the bridge may be from 18 to 20 feet; in more frequented places, from 20 to 22 feet; near to towns, and on great public roads from 25 to 30 feet; and in or near large cities, from 30 to 45 feet.

In private roads and parks they are made from 12 to 20 feet in width; and foot bridges, from 5 to 8 feet.

On the Water-way that ought to be left for the River

The water-way of a bridge should be sufficient to give free passage to the highest floods, and particular regard must be had to this circumstance in fixing the height and width of the arches.

Of the Span of the Arches

The extent of the span is the next subject to be considered; it will be obvious that this is, in some degree, determined by what has been said respecting the quantity of water-way. The span of the arch, however, must also be regulated by the form of the banks, the height of the highest

floods, the depth and rapidity of the river, and the kind and dimensions of the timber that can be procured.

In rivers that are tranquil, of little depth, and not subject to high and rapid floods, the number of piers may be augmented without inconveniences, provided they do not interrupt the navigation of the river, nor contract too much of the water-way.

But if the bridge has to cross a torrent, the least possible number of supports should be placed in the stream. When the banks are not too low, and the width of the river does not exceed 300 feet, the engineer should give the preference to each arch.

Piers

When piers are necessary, either to save expense, or to reduce the span of the arches to a practical extent, to construct them of stone is the best method, as piers of timber very rapidly decay; the timber in a wooden pier being exposed to the alternate action of dryness and moisture, and consequently, in the worst situation in which timber can be placed.

When the timber is used for piers, they may, in simple cases, be constructed by driving a single row of piles for each pier in a line with the current of the river. The piles may be from 10 to 14 inches square, and placed at from 2 to 4 feet distance from one another.

Of the Roadway

As the moisture which passes through the gravel or broken stone soon rots the planking, it is supposed to be better to lay an additional thickness of planking, and no gravel or paving. In that case, the upper planking should lay across the bridge to prevent the feet of horses sliding. It would be easy to renew such a roadway, but I do not see any other advantages it possesses.[39]

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[39] Tredgold, Elementary Principles of Carpentry, p. 111-137.

Tredgold explains in detail various principles in the construction of arches and timber frames for wooden bridges. The arches and wooden frames are demonstrated in detailed drawings (Figure 26). Tredgold also explains the details and the advantages of various wooden joints (Figures 27-29).[40]

Early America Drawbridges

It is not certain when the first drawbridge was built in America. Because bridges over navigable streams were difficult and expensive to build, ferries served as the more common solution to crossing expanses too wide and too deep to ford. Narrow expanses, easily bridged, over deep water, probably were the only instances in the early colonial period when a drawbridge might be preferred to a ferry. Ferries were preferred, until traffic reached a volume in which a bridge was more practical than a ferry. In Colonial America, because of the ease of transporting goods by water, the general need for bridges frequently was long in coming. This situation was true particularly in the southern colonies where all the major centers of commerce were located along important water routes that serviced regions deep into the interior. A drawbridge was therefore not a common site in the colonies.

One of the earliest, mention of a drawbridge in America is one built over the "mill stream" in Boston before 1653. The bridge was noted because it was the scene of an accident. In 1659, when so many people crowded onto the bridge in order to witness the execution of Quakers, it collapsed. There were a

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[40] Ibid.

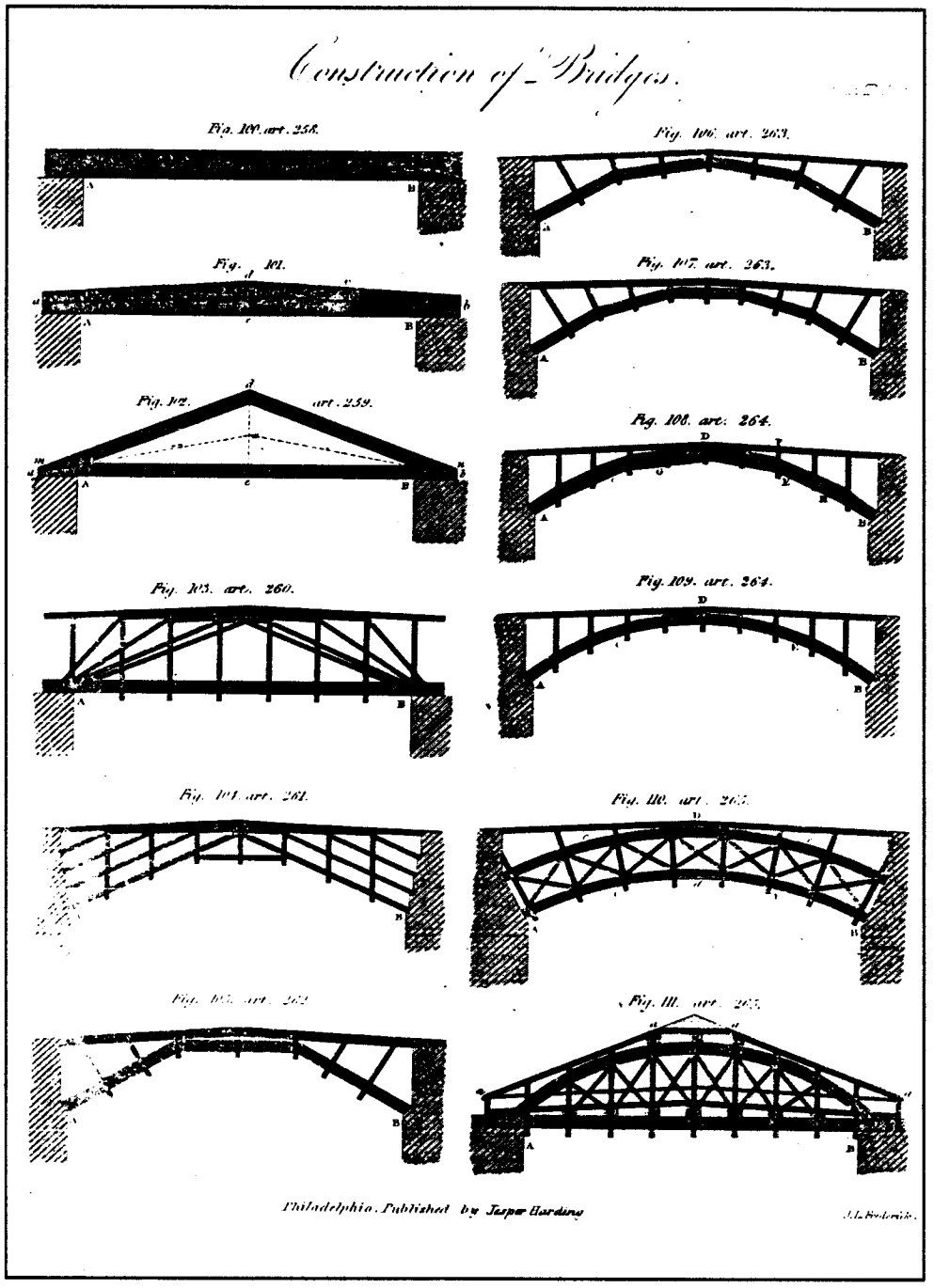

Figure 24. Bridge designs demonstrated by Thomas Tredgold in his classic treatise *Elementary Principles of Carpentry* Published in 1847.

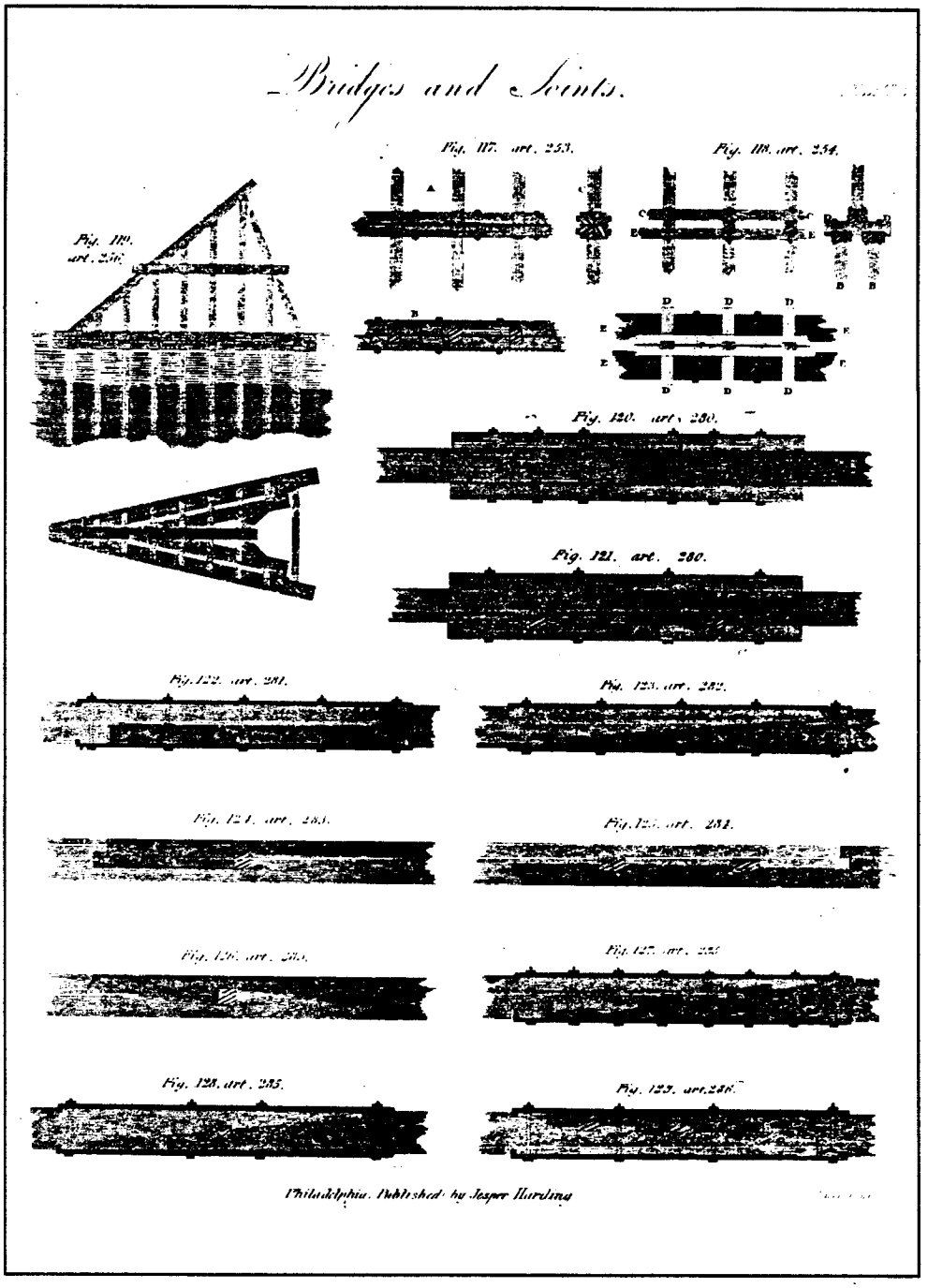

Figure 27. Examples of joints used in the construction of bridges in the nineteenth century.

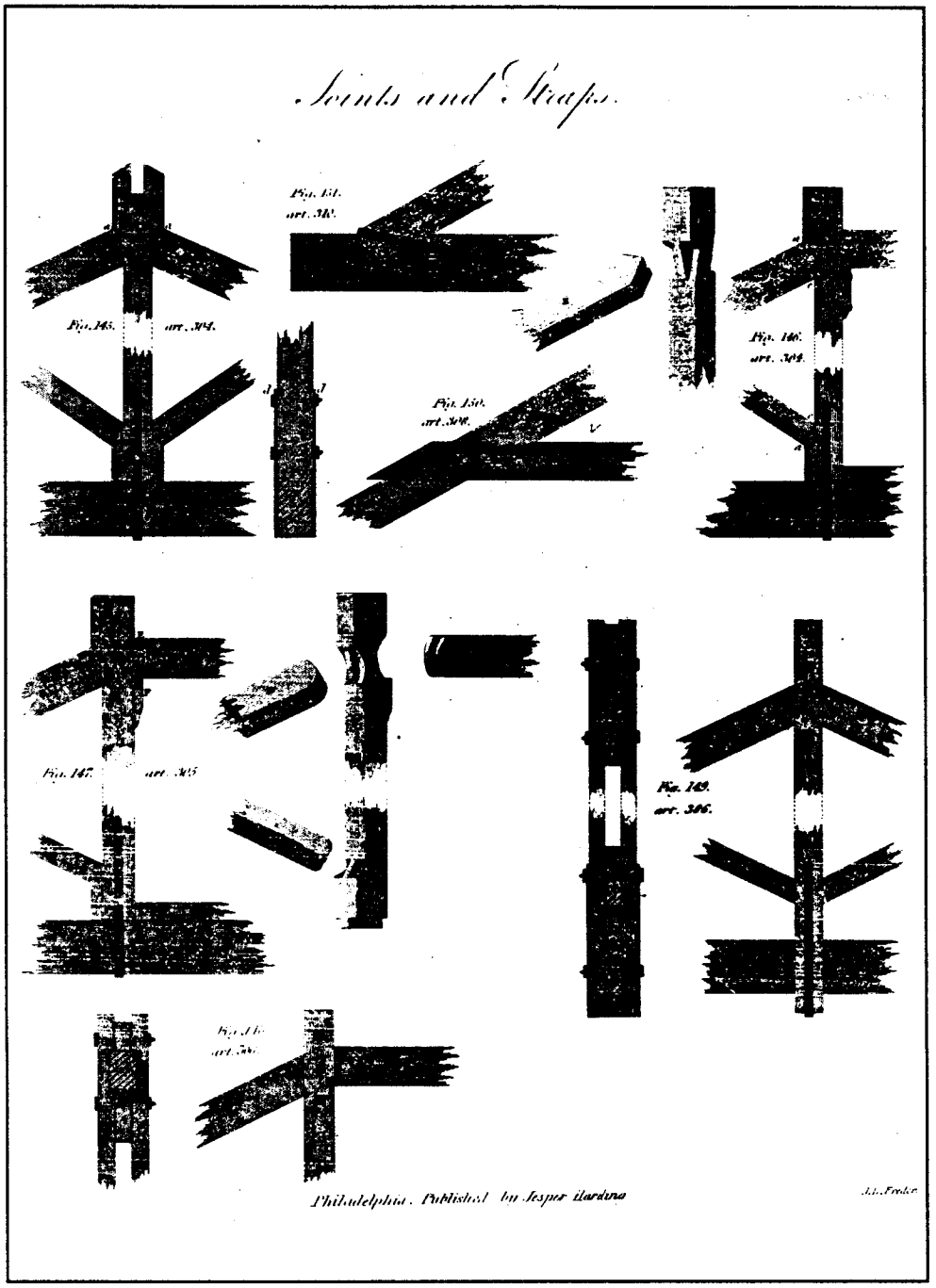

Figure 28. Examples of joints used in the construction of bridges in the nineteenth century.

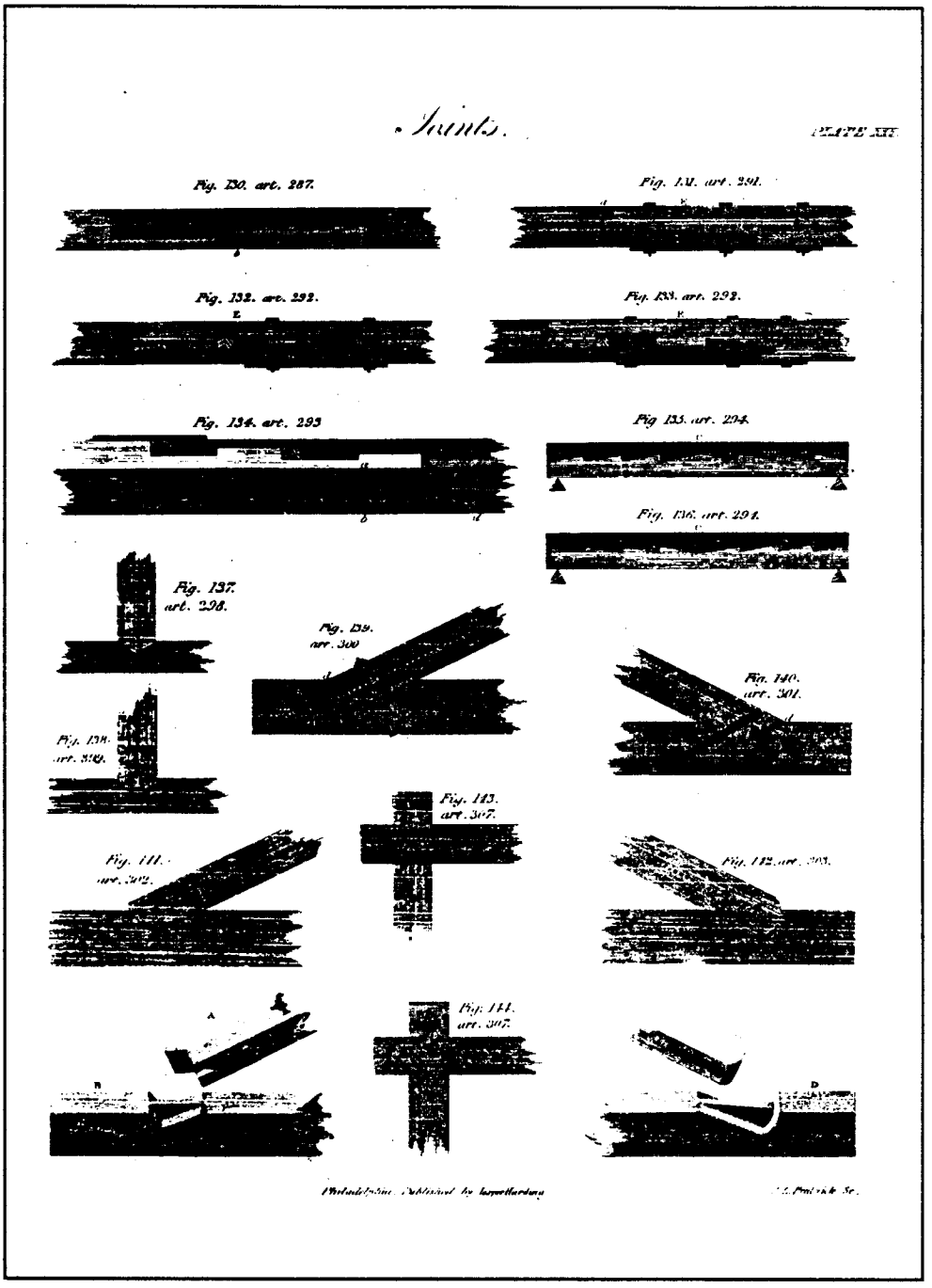

Figure 29. Examples of joints used in the construction of bridges in the nineteenth century.

number of injuries, but it was rebuilt that same year. The manner in which the draw was constructed was not described except to say that it was heavily built.[41]

Although other drawbridges probably were constructed in America in the latter part of the seventeenth and first half of the eighteenth centuries, Sewall's Bridge, at York, Maine, is the first bridge to provide any evidence of the manner in which the draw was constructed. The only specific detail of "the draw" mechanism is shown as a tall unsupported pole or "gallows frame"[42] extending to the bottom of the river on the nearshore side of the deepest part of the river channel (Figure 16). The structure must have supported block and tackle or counter weights design to lift the hinged draw span portion of the bridge to "provide a sufficient way for sloops to pass and repass through the bridge."[43]

Almost all draw mechanisms of early wooden bridges were designed to raise and lower. Other motions would have been more difficult to engineer and probably less practical. As a result, on every drawbridge some sort of framework or gallows was necessary to provide the elevation and or leverage necessary to easily lift the extended draw span. In lifting the draw span a counter weight was the simplest aid to controlling the lift of the span. A "tip-up" designed draw was probably the most common type. It could be made with four stringers at least one third longer than the distance to be spanned. The stringer portion that extended over the opening, or the draw span, would have been designed to be light weight. Sometimes the stringers were selected from

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[41] Andrews, *Journal of a Lady of Quality*. p. 339; also see Boston Record Commissioners, Report, 2 pp. 117, 124, 153, Book of Possessions, 2, 20; Wintrop Papers, Collections, Massachusetts Historical Society, 4th series, VII, 507.

[42] Flecter and Snow, *Development of Wooden Bridges*, p. 349.

[43] Edwards, *Early American Bridges*, p. 27.

crooked trees with large butts which provided the necessary counterweights. The crooked logs could be hewn down as small as possible on the span portion of the stringer and left full size on the crooked end. The stringers were attached at a pivot or trunnion log with rounded ends that functioned as a hinge for the draw span. If the span to be bridged was too wide for a single leaf, two could be used, meeting equidistant in the opening with a sliding toggle mechanism to hold the two leaves in grade under passing loads. Once the draw span was balanced properly, it could be raised by passing rope or chain guys over a sheave attached to a gallows that extended over the bridgeway. When lifting a draw in these bridges, a segment of plank would need to be removed to allow draw stringers to lift.[44]

Early North Carolina Bridges

The first bridges in North Carolina were constructed in the latter part of the seventeenth century by the first inhabitants of the Albemarle region. These earliest bridges would have been for use by nearby inhabitants, since no public roads were established. The first roads or paths probably were established to connect inhabitants with boat landings. Almost all travel over any distance was by water. By the beginning of the eighteenth century, population had increased such that all the inhabitable lands along navigable rivers and creeks were taken.[45] Increased demands for more adequate transportation between settlements and public landings lead courts to appoint surveyors to clear roads for public use.[46] As roads were developed, so were bridges and

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[44] Flecter and Snow, *Development of Wooden Bridges*, p. 349.

[45] Councils Journal: Petitiion of William West 1 August 1717, *Colonial Records*, II, 290.

[46] Colonial Court Records, Minutes of the Court of Common Pleas and Quarter Sessions, Chowan Precinct, March 1682, State Archives and *Colonial Records*, I, 413.

ferries although both were difficult to maintain. Ferries most often were established by individuals who charged a fee for their use; however, bridges were often constructed and maintained at public expense. By 1700, overseers were appointed by the precinct courts to maintain roads and bridges.[47]

The earliest records concerning the regulation of roads and bridges in North Carolina have been lost. The first surviving record of a public law passed in North Carolina concerning roads and bridges dates from near the end of Proprietary control of North Carolina. The 1715 law formalized the existing jurisdiction of the precinct courts over roads and bridges. It also established that all bridges were to be at least ten feet wide, made of strong pieces of wood at least three inches thick, with firm and strong post well secured and fastened.[48]

Four subsequent laws concerning roads and bridges were passed in North Carolina in 1734, 1745, 1756, and 1764. Each of these new laws were attempts by the colonial government to improve travel in the province not only by land but also along rivers and creeks.[49] The most important of these acts for bridges was the 1764 law which ordered:

> ...all Bridges over Deep or navigable Streams shall be made at least Twelve Feet wide, with good sawed Plank, clear of sap, at least Two inches thick, with firm and strong Posts, Rails and Bearers, well secured and fastened; and for that Purpose, the Overseer of the Road to which any of the aforesaid Bridges shall belong, shall and may lawfully cut

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[47] Watson, "Regulation and Administration of of Roads and Bridges in Colonial Eastern North Carolina," 400.

[48] An Act Concerning Roads and Ferries, 1715, *State Records*, XXIII, 46-48.

[49] Watson, "Regulation and Administration of Roads and Bridges in Colonial Eastern North Carolina," 401.

> and take from off the land of any Person next adjacent to such Bridge, such, and, so much Timber only, as shall be necessary for that Use.[50]

The details of construction of early bridges in North Carolina were primarily controlled by the county courts. In some counties bridges could be constructed at the county expense. This normally only transpired if the size of the bridge was larger than could be undertaken by the appointed overseer and the court ruled it was to the county's benefit. In such cases the construction was often advertised and open to bid by contractors. In most cases, bridges over navigable water were required to be high enough to allow the passage of "rafts and periaugers."

In several instances private individuals were granted permission to construct toll bridges along public roads. This was done primarily where longer more expensive bridges were needed, but the cost of construction was more than the county wished to bear. In 1749, Michael Higgins was granted permission to construct a toll bridge on the Trent River at the location of Wicliff's Ferry in Craven County. This was along a favored north-south route to New Bern.[51] In 1752 Caleb Grainger was granted permission to build a bridge over "Smith's Creek" at Smith's Creek Ferry in New Hanover County. This bridge was the first toll bridge along the "Duplin Road" just north of Wilmington. No specifications for the bridges were detailed in the Acts to encourage their construction. They may have been as narrow as ten feet; although their floors were probably at least five to seven feet above the

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[50] An Act to imprower the inferior Courts of the Counties in the Province to order the laying out of Public Roads, and establish and settle ferries; and to appoint where Bridges shall be built, for the use and ease of the inhabitants of this province; and to clear navigable Rivers and Creeks, *State Records*, XXIII, 608-609.

[51] An Act to encourage Persons to settle in the Town of Brunswick on the southwest side of the Cape Fear River, State Records, XXIII, 240.

water.[52] The Smith Creek Bridge became known as the "Little Bridge" and was predecessor to Benjamin Heron's toll bridge over the Northeast Cape Fear River sometimes referred to as "Big Bridge" or "Long Bridge."[53]

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[52] An Act to encourage Caleb Grainger, to Build a Bridge over Smith's Creek near the place by the name of Smith's Creek Ferry, in New Hanover County, *State Records*, XXIII, 385.

[53] Colonel James Kenan to Governor Burke, *State Records*, XV, 535; Extract from the Minutes of New Hanover Superior Court, October Term, 1832, *State Records*, XV, 786; and Annie Walker Burns, *North Carolina Pension Abstracts of Soldiers of the Revolutionary War: War of 1812 and Indian Wars*, VIII, W9745, 6; X, S 30936, 17; XIV, R 5374, 28.

Historical and Archaeological Research

Historical Investigations

Historical research for the Heron's Bridge crossing survey was conducted over the course of a ten-year period between 1982 and 1992. The main portion of the historical research was conducted in 1984 and 1985 at libraries, universities, and archival repositories in Wilmington, Greenville, Raleigh, Chapel Hill, and Durham, North Carolina. Research also was conducted at the National Archives in Washington, D.C. The most informative sources were primary documents and included: Wills and Deed Records held in New Hanover and Pender Counties; Colonial Records of North Carolina and State Records of North Carolina. Pensioners Records of the Revolutionary War; British Revolutionary War Records and Correspondence; and Official Records of the Union and Confederate Armies also were utilized extentively. Historic travel accounts and journals were helpful in understanding human attitudes and circumstances, as well as travel conditions in the south during Americas early history. A practical understanding of early transportation developments including regulation of roads, bridges, and ferries was gleaned from secondary sources. The most recent transportation studies and most helpful sources were found in a series of articles in the *North Carolina Historical Review,* written by Dr. Alan Watson. Earlier studies in the same journal by Charles Christopher Crittenden and F. W. Clonts also were beneficial to understanding the early developments in North Carolina's transportation system.

An important element of the investigation was research into early wooden bridge contruction. Although popular books about well-known bridges and their design and construction

were plentiful, more practical sources on early wooden bridge design and construction were not found. Two secondary works proved to be very helpful in at least explaining the dearth of literature on early bridge construction: *A History of the Development of Wooden Bridges* by Robert Flectcher and J. P. Snow and *A Record of History and Evolution of Early American Bridges* by Llewellyn Nathaniel Edwards. Neither of these works provided much information on wooden bridge construction in colonial America. They did help to identify some seventeenth and eighteenth century sources that clarified some aspects of early wooden bridge building practices in Europe.

Field Investigations

Field investigations were conducted over a one-year period between November 1991 and November 1992. The work was initiated by a visual reconnaissance of both sides of the Northeast Cape Fear River at the historic bridge/ferry crossing. One of the objectives of the reconnaissance was to identify any onshore evidence of a bridge crossing or bridge abutments. As part of the reconnaissance, a topographic map of the north and south sides of the River in the immediate vicinity of the crossing were produced.

In order to help identify the extent and nature of the material scattered on the bottom surface at the bridge/ferry crossing, a side scan sonar and sub-bottom profile survey were conducted. A 500 kHz Klein side scan sonar and a 3.5 kHz subbottom profiler were used to conduct a series of eight survey transects parallel to the course of the river. Three other sonar transects also were conducted across the course of the River in the area of the bridge/ferry crossing.

Positioning for the sonar survey was maintained by using the piers of the Interstate 40 bridge as visual ranges for a series of parallel transects. Evenly spaced range markers were established along the shoreline and were used as event references on the sonar record. The location of Interstate 40 bridge piers and the shoreline range markers were mapped in relation to river and shoreline features using a Lietz theodolite and electronics distance measurer (EDM).

A magnetometer survey of the bridge/ferry crossing also was conducted. A Geometerics 866 proton precession magnetometer with a sensitivity of less than + or - one gamma resolution was use to conduct the survey. The 866 magnetometer comes equipped with a marine sensor, digital read out, and dual channel chart recorder. The primary purpose of the magnetometer survey was to identify any concentrations of ferrous debris (i.e. fasteners or other hardware) that might be related to the bridges or ferries. Positioning for the data collected during the magnetometer survey was maintain with aid of a theodolite and EDM. The theodolite was set up on a datum established along a baseline located on the south shore of the River. Buoys were set at known features on the river bottom and used as reference markers for the magnetometer survey. Angles and distances to the preset reference markers were recorded. Using the theodolite as the center point, a series of radial survey transects were carried out beginning each transect at the north side of the River. A total of 11 magnetometer survey transects were accomplished with 5 degrees (approx 28 feet at the north side) between each transect. The magnetometer was set to record a magnetic change every two seconds. This sample interval resulted in a magnetic reading approximately every 10 feet along each survey transect.

A cross-sectional depth survey was conducted at the approximate location of the bridge/ferry crossing. The results of the survey were considered somewhat inaccurate due to an exaggerated amount of sediment accumulated on the scattered bridge timbers and other debris at the crossing. The survey was conducted shortly after an exceptionally high flood (12 to 15 feet over high tide) that occured on the River in early fall of 1992.

A bottom surface survey was accomplished by divers swimming controlled bottom transects. The purpose of the bottom surface survey was to locate and mark any exposed features that might be related to the bridge/ferry crossing. The bottom survey was controlled by placing a 250-foot-long non-floating reference line on the bottom and parallel to the course of the River. Two divers equipped with lights, would swim the length of the line, examining the bottom surface for a distance of 0 to 10 feet on either side of the reference line. At the completion of each swimming transect, the divers would move one end of the line 15 feet farther and the survey vessel would pickup the other end of the line moving it an equal distance in the same direction. Each time cultural features related to the bridge or ferry crossing were encountered, a marker buoy was affixed to the object so that its relative position on the bottom surface could be recorded. Once the bottom surface survey was completed, the angle and distance to each of the marker buoys was recorded to aid in the preparation of a bottom surface map.

Description of Findings

Historical

Although the existence of Heron's Bridge was well-known to North Carolina historians, its exact location and history have been the subject only of limited researched. Heron's Bridge was built for or by Benjamin Heron between November 1766 and July 1768. Because of Heron's untimely death in June 1770, the bridge came to be associated with the long time tender of the bridge - Henry Buford. In various documents and letters the bridge is referred to as Buford's, Beaufort's, Beauford's, and Blueford's Bridge. The Smith Creek Bridge, one mile north of Wilmington, had been completed for 15 years when Heron's Bridge was built. Since they were on the same road, Smith Creek Bridge was referred to as Little Bridge, and Heron's Bridge over the Northeast Cape Fear River was called Big Bridge, Great Bridge, or Long Bridge by local and regional inhabitants.

The crossing at Heron's Bridge was a focal point of historic activity. Heron's Bridge was a landmark for giving directions or a convenient place for various functions including auctions, militia drills, and other public meetings. The Northeast Cape Fear River at Heron's Bridge also was a natural defensive position, and it was used as such in both the Revolutionary and Civil wars.

In late January 1781, the south end of Heron's Bridge was burned by the British. The fire may have burned only as far as the draw, thereby leaving more than one half the bridge still standing. The bridge apparently was reconstructed shortly after the War. This is based on references to the "bridge" in the present tense in testimony and petitions given in the late 1780s. In 1794, the Deed Of Sale between

William Campbell and John and Elizabeth (Heron) Mackenzie mentioned the "bridge crossing the said river". This further reinforces the notion that Heron's Bridge was rebuilt.

Apparently, William Campbell built an entirely new bridge at the site of Heron's original bridge sometime shortly before 1810. Thus far, there is no historical record of how Campbell's Bridge was constructed. Following William Campbell's death, the property and bridge changed hands three times before 1845, when James F. M^{c}Cree purchased it at public auction. In 1847, McCree succeeded in having another bridge built at the same location. Again, there is no historical record as to the nature of the bridge constructed at the site. M^{c}Cree's use of the phrase "Ferry Bridge," in an advertisement to bidders for the construction of the bridge, may suggest that it was a floating or pontoon type bridge. Later, references to the "pontoon bridge" over the Northeast Cape Fear River at the end of the Civil War provide some support to that supposition.

Field Investigations

Field investigations resulted the positive identification of the location of Heron's Bridge Crossing. The side scan sonar survey clearly identified the location of a single bridge trestle on the bottom surface. Although, no other intact bridge features were identified by the sonar, there was a noticeable increase in bottom surface debris across the River at the bridge/ferry site (Figure 30). Sub-bottom data indicates an 1 to 3 foot accumulation of bottom sediments 60 to 80 feet wide across the River in the location of the bridge crossing. The increase depth of sediment is likely caused by the scatter of bridge related debris across the river at that location. The debris blocks the natural movement of silt and sand down the River. The sub-bottom

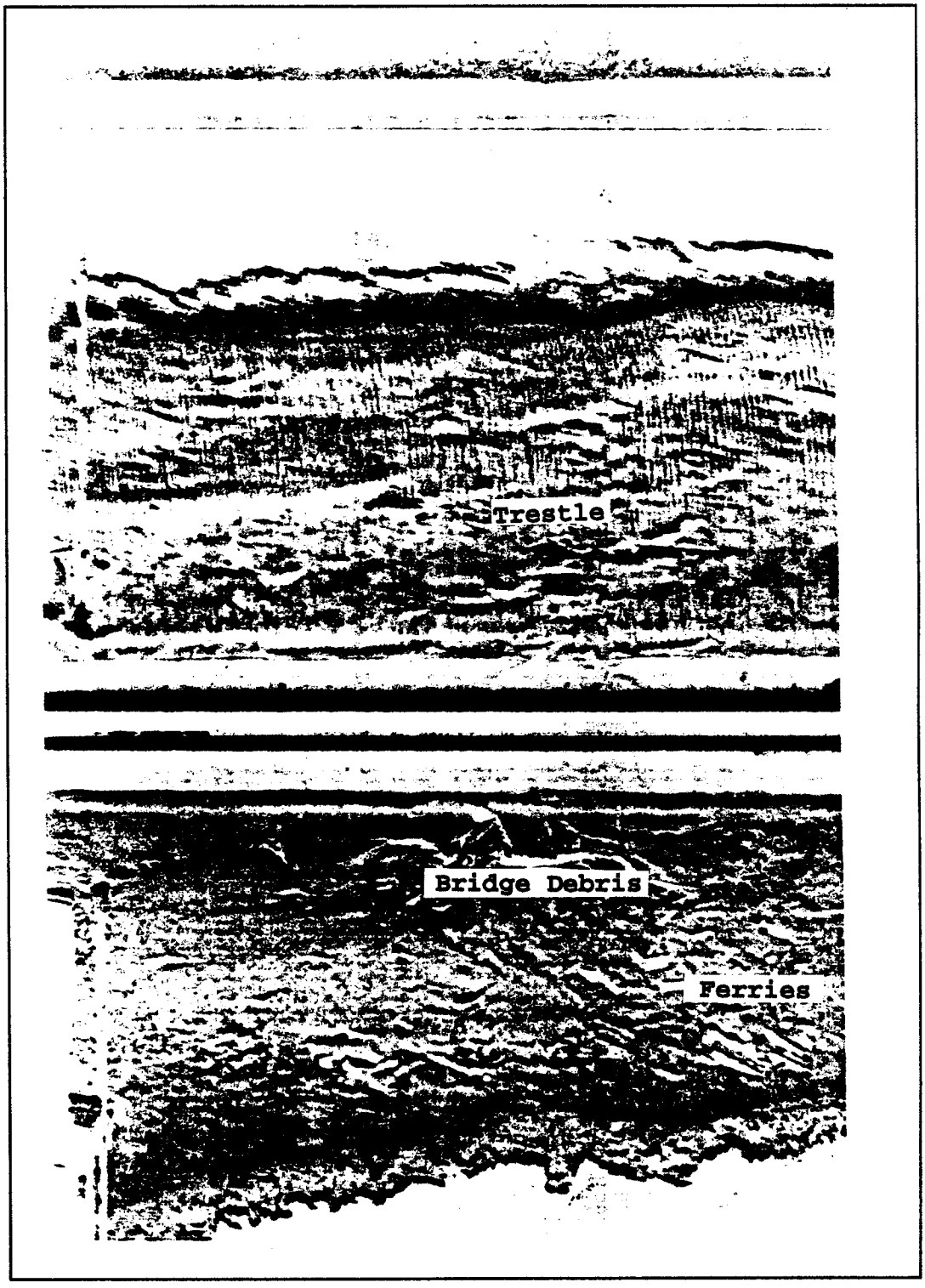

Figure 30. Sonagram Record of Bridge/Ferry Crossing.

profiler did not effectively penetrate the bottom surface in the area of the historic bridge crossing. The poor sub-bottom penetration is attributed to the high organic content of bottom sediments in the area of the bridge/ferry crossing. The high percentage of organic material in the bottom sediments was confirmed by divers during the bottom surface survey.

The magnetometer survey resulted in identification of five magnetic anomalies or targets in the vicinity of crossing site(Figure 31):

Target A--had a dipolar magnetic signature of 40 gammas maximum intensity over five sample intervals. The anomaly was detected along three survey transects.

Target B--had a negative monopolar magnetic signature of 110 gammas maximum intensity over seven sample intervals. The anomaly was detectable over four survey transects.

Target C--had a dipolar magnetic signature of 40 gammas maximum intensity over four sample intervals. The anomaly was detectable over two survey transects.

Target D--had a dipolar magnetic signature of 60 gammas maximum intensity over five sample intervals. The anomaly was detectable over two survey transects.

Target E--had a dipolar magnetic signature of 69 gammas maximum intensity over four sample intervals. The anomaly was detectable on one survey transect.

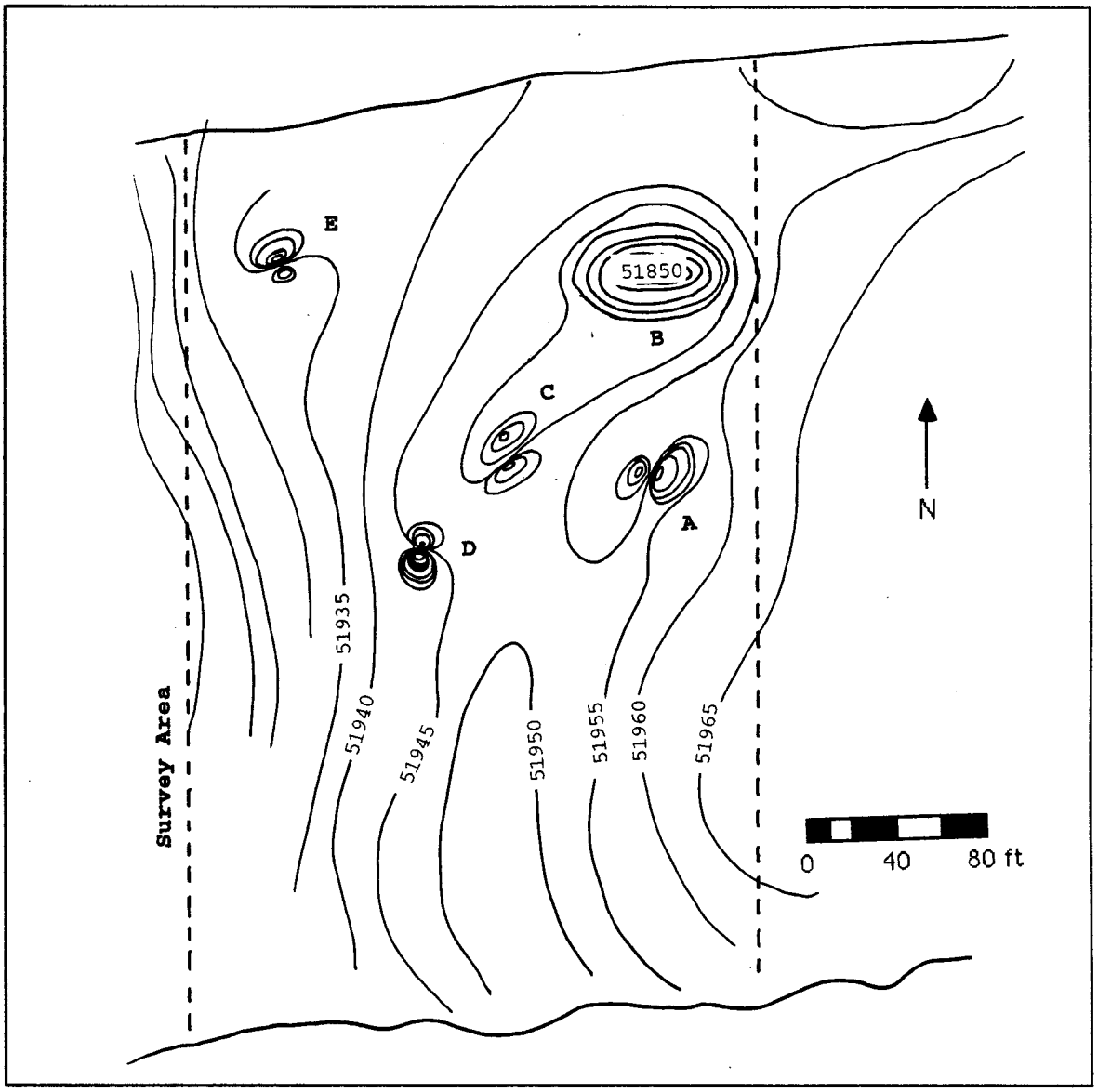

Figure 31. Magnetic Contour Map.

The bottom surface survey of the bridge/ferry crossing resulted in the documentation of the single bridge trestle and the identification of various bridge related timbers. The remains of a sunken vessel and three Civil War frame torpedoes (magnetic Targets A and D) also were identified during the bottom survey.

The partially intact bridge trestle was constructed of five large timbers held together by mortise and tendon joints with single 1-1/2 inch treenails through each joint. A single 10-by-16 inch traverse beam 27 feet 4 inches long formed the top of the trestle. Two 14-by-14 inch piers were mortised into the traverse beam four feet (centered) from each end. From the bottom edge of the traverse beam, one of the piers is 32 feet 7 inches long, and the other is an even 33 feet long. The trasverse beam is braced in the middle by two 6-by-8 inch diagonal support timbers 15 feet long each. The diagonal supports were mortised into the central portion of the bottom of the traverse beam. They were also mortised to the inside face of each support pier, 12 feet below the base of the traverse beam (Figure 32).

Twenty-six feet (centered) below the traverse beam along the inside face of each support pier was a 4-by-12 inch mortise. The mortise is clear evidence that the trestle also was fashioned with a cross support timber nearer the base of the piers. On one of the piers, 26 feet 6 inches (centered) below the traverse beam on the lateral face of the trestle piers was a 4-by-12-by-6 inch deep mortise. On the lateral face of the other pier, 26 feet 6 inches below the traverse beam was also 4-by-12 mortise except that it passed completely through the 14-by-14 inch pier.

A thorough examination of the top and sides of the traverse beam and piers for any evidence of fastener patterns was negative. No remains of treenails or iron fasteners of any kind were found anywhere except at mortise and tendon joints.

The bottom surface survey also identified 15 other exposed and partially exposed timbers of similar size and characteristics to those found in the trestle. Some were the remains of piers, and others included support braces and

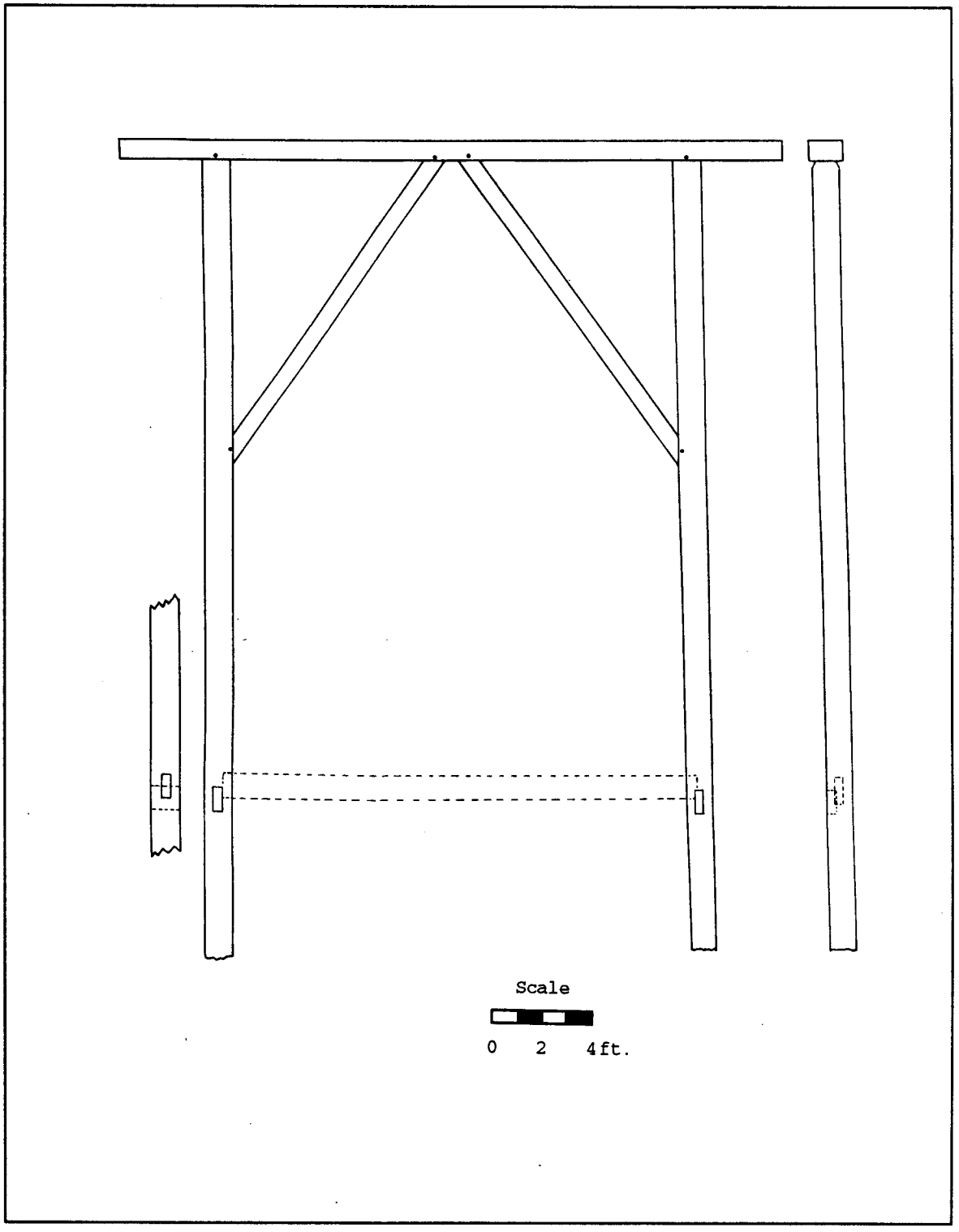

Figure 32. Plan of Bridge Trestle.

traverse beams.(Figure 33). A portion of what appears to be the remains of a crib structure was found buried in bottom surface. The top edge of 4 inch thick timbers jointed at a 90 degree angles were partially exposed in the bottom surface. A pile of large rounded river cobbles or ballast stones 8 inches to 16 inches in diameter were found covering most of the wooden portions of the structure.

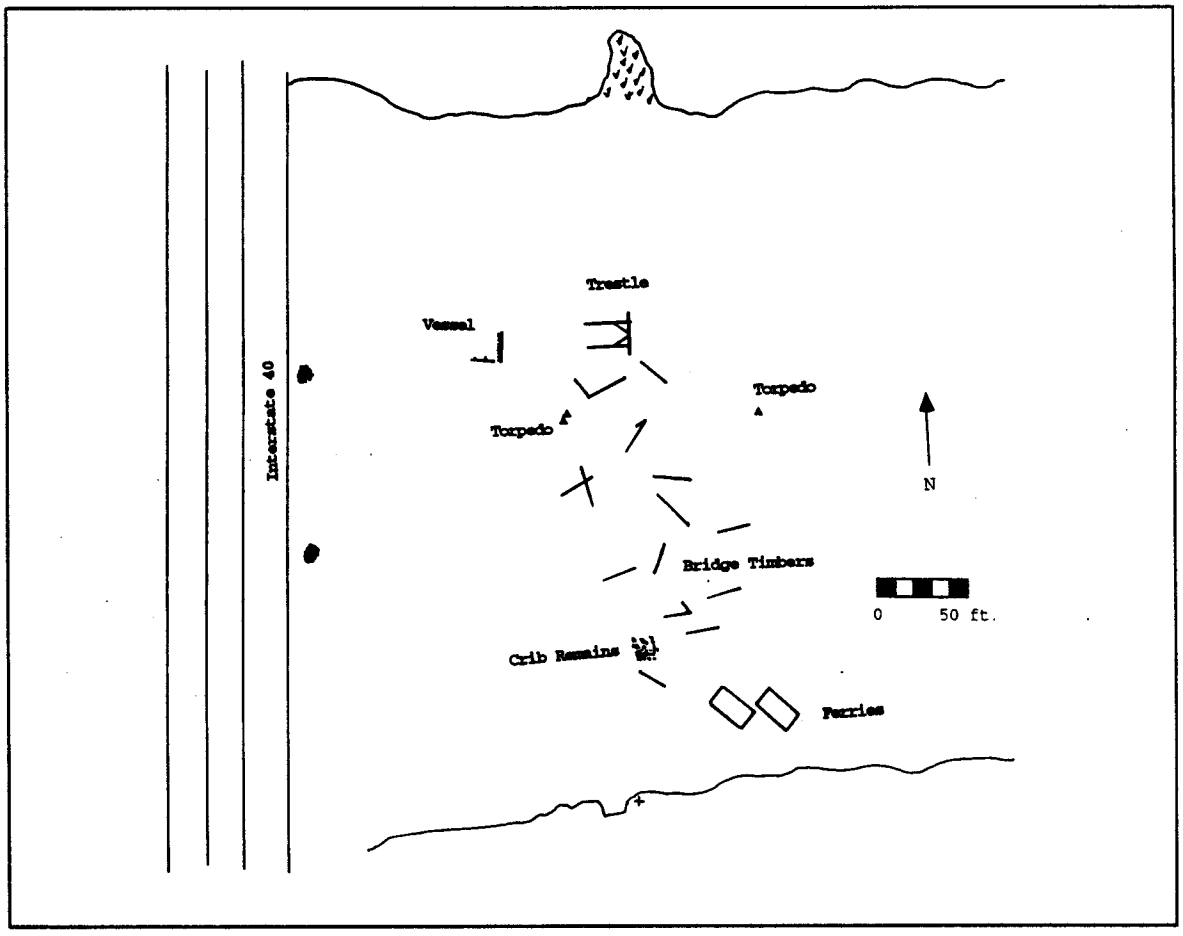

Figure 33. Bottom Surface Map.

The remains of a vessel, possibly a ferry or pontoon were identified during the bottom survey. The vessel remains were almost completely buried making it difficult to identify its type. Exposed were the worn ends of two 4 by 4 inch frames with badly deteriorated exterior planks still attached and

the edge of a single support timber also with some planking. The vessel is located 80 feet downstream of the trestle (Figure 33).

Three Civil War frame torpedoes also were located during the bottom survey. A number of other frame torpedoes have been found by divers at the crossing site in the past several years. One was recovered by East Carolina University's Program in Maritime History and Underwater Research in 1983 (Figure 34). Reportedly, none of the torpedoes recovered from the crossing site contained powder or fuses. All still had lifting eyes still attached as shown in Figure 34. Thus far, all of the torpedoes located at the crossing have been separated widely. Only two were found at the same location (Magnetometer Target D).

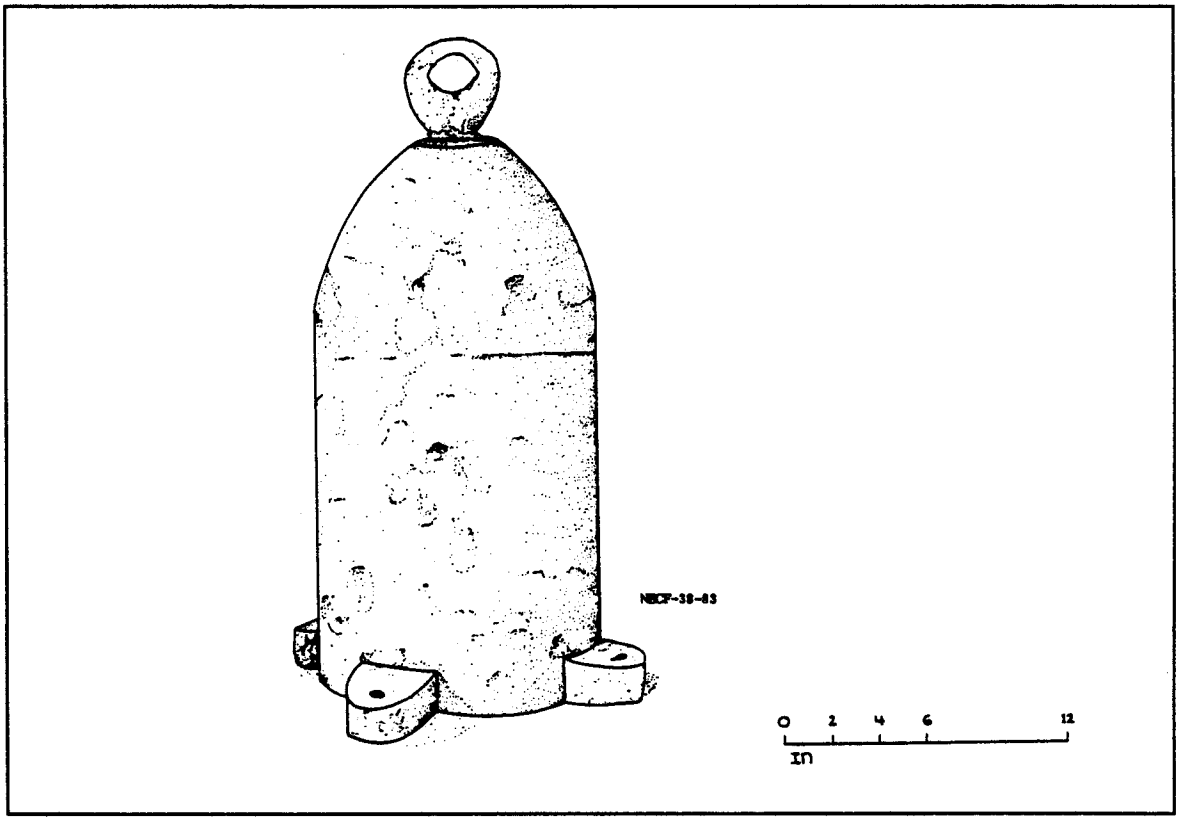

Figure 34. Civil War Frame Torpedo.

Conclusion

There is no definitive proof that the remains of the trestle and scattered timbers identified during this archaeological survey were those of Heron's Bridge. However, the complete lack of iron fasteners in the trestle and other scattered timbers do suggest an early construction date. The size and configuration of the scattered timber remains were consistent with those timbers found in the partially intact trestle. The similarities in the timbers confirm that they were part of the same bridge structure. Even though historical evidence confirms that two other bridge structures were built at the crossing site, no phyical evidence of more than one bridge was identified on the river bottom.

The partially intact trestle provides the best evidence of how the bridge structure was built. The river bottom at the site of the bridge crossing is composed of mostly marl. Only the north side of the river bottom holds any significant amount of river sediment. Because of the hard bottom surface, driving pilings to support the bridge was not an option to the builders. Construction features shown in the trestle suggest that the bridge was built as a free-standing timber framework. This may partially explain the reasoning behind what seems to be an unusually wide bridge for the period. The width was demonstrated by the 27-foot-4 inch length of the traverse beam in the trestle. If the bridge was mostly free standing, more distance between piers would help the bridge withstand lateral forces placed on it by river currents. The structure could not have been entirely free standing, especially with a double leaf draw mechanism in the central portion of the bridge. At minimum, the piers that supported the draw must have been anchored to the bottom with rock filled cribs. The remains of the crib and ballast

stone located in the south central portion of the crossing may be such a support feature. Other evidence of crib support structures may be buried in the accumulation of sediment at the crossing.

The marl bottom would have required that each vertical support feature of the bridge be custom made not only to fit the depth of the water, but the desired height to support a level floor. Although the foot of the piers in the remaining trestle was badly deteriorated, enough of the cut ends remained to suggest a 4-inch difference in their lengths. Other pier timbers scattered on the bottom were not measured because they were only partially exposed (Figures 35).

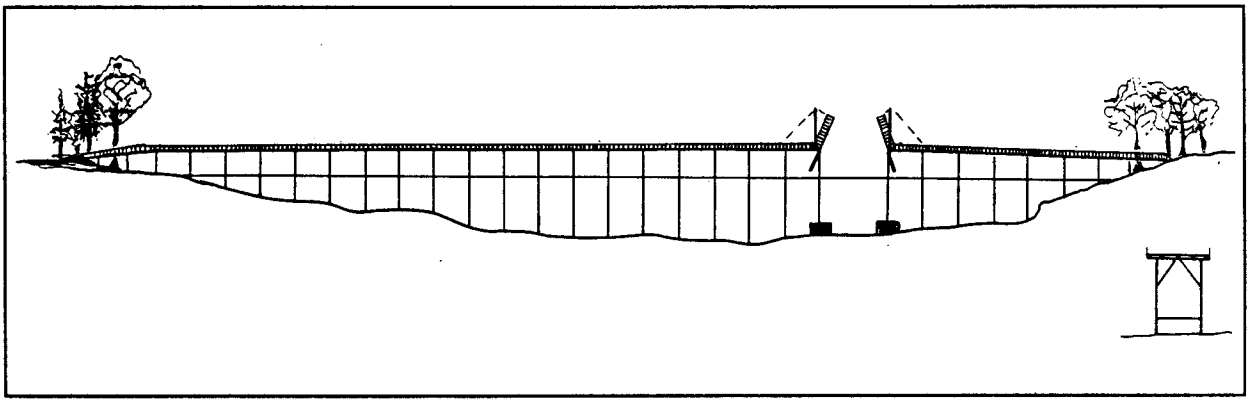

Figure 35. Conceptual Drawing of Heron's Bridge in Profile.

The location of the traverse beam support braces implies that the waterway of the bridge was more than 12 feet above normal high water. The lower support brace mortise joint was located 12 feet below the traverse beam. It does not seem probable that the architect would have designed the bridge for this feature to be underwater. Below the water surface, the support brace would have increased drag and helped to catch floating limbs or trees.

The mortise cuts to the inside face near the foot of the trestle piers suggest that a 4-by-12 inch by 20-foot horizontal cross brace was missing from the trestle. The lateral mortises 6 inches lower and 90 degrees to the inside mortises imply that a 4-by-12 inch horizontal beam ran between trestles. How the builders would have accomplished fastening the timber to the base of the trestle is a mystery. These lower trestle-to-trestle beams somehow must have been attached before the structure was submerged (Figures 33 and 36).

A search for fasteners or a fastener pattern on the top and sides of the traverse beam and piers provided the next mystery. No evidence of fasteners was found. This may mean that the stringer and floors of the bridge were held in place by their own weight. Perhaps stringers were dapped but not fastened to the top of the traverse beam. Individual stringers may have been dapped and staggered in such a way that each one joined at least three trestles. However, there was no physical evidence to support this construction method.

Physical evidence of only one timber framed bridge structure at the crossing raises some interesting questions about the other bridges constructed at the site. Assuming that the trestle and other timbers were from Heron's Bridge, it is possible, that the subsequent bridges constructed over the Northeast Cape Fear River by William Campbell and James M^{c}Cree were floating bridges. The use of the phrase "Ferry Bridge" by M^{c}Cree in his newspaper advertisements at least suggested his intentions to build something other than a pile bent or timber framed structure. The lack of attention in the historical record garnered by Campbell's Bridge and McCree's Bridge during their existence suggests that they lack the grandiose design of Heron's Bridge. One would expect any bridge designed for the deep water crossing site

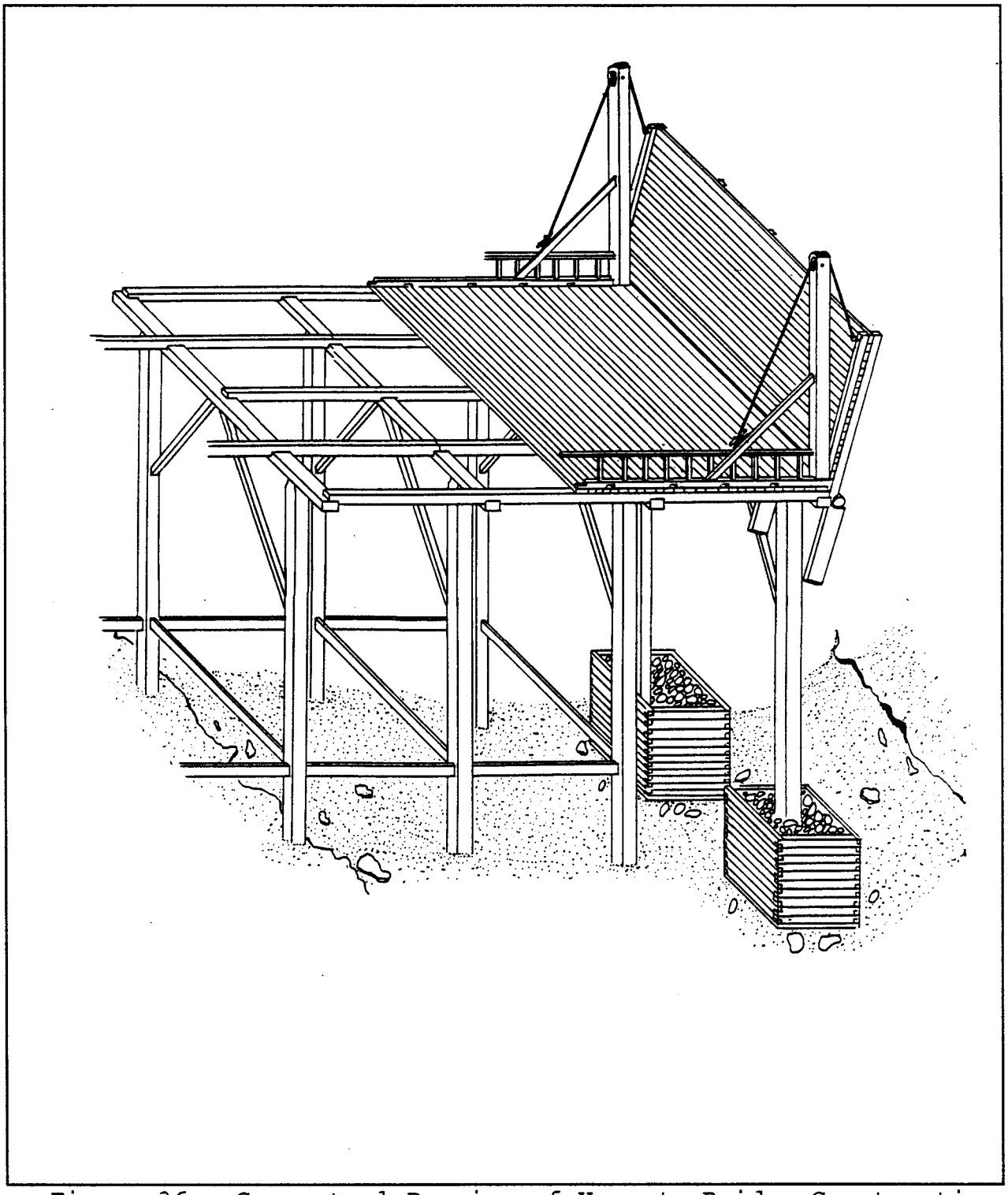

Figure 36. Conceptual Drawing of Heron's Bridge Construction Features.

to allow for the passage of boats and ships. Any draw mechanism, other than a floating type, would require a substantial framework and support structure. Since physical evidence of only one timber framed bridge has been identified on the river bottom, it does not seem likely that Campbell's and McCree's bridges were of timber frame construction.

Recommendations

Heron's Bridge Crossing should be recognized as one of the more important and unique underwater archaeological sites in North Carolina. Heron's Bridge was the first drawbridge constructed in North Carolina. It was probably the second drawbridge built over a major river in Colonial America. Heron's Bridge appears to have been built in a unique manner using a custom-timber-frame type construction technique. Other contemporary wooden bridges generally were pile bent type construction including Sewall's 1761 drawbridge over the York River in Maine. In the eighteenth and nineteenth centuries the crossing site was locally and regionally important not only to transportation but as a defensive position in both the Revolutionary and Civil wars.

A complete historical and underwater archaeological investigation of the site of Heron's Bridge Crossing is recommended. An in-depth historical investigation of individuals associated with the site is needed to help clarify important details concerning events surrounding the crossing site. More research also may identify additional documents concerning bridge construction in Colonial America. Given the amount of bridge timbers and associate features identified during the very brief survey, a thorough archaeological investigation is warranted. Terrestrial testing and underwater excavations and documentation without

a doubt, would provide a much better understanding of how the bridge was constructed. It also would increase our understanding of how the crossing was utilized.

To be eligible for the National Register of the Historic Places, an archaeological site must be significant in American history, architecture, archaeology, engineering, or culture, and possess integrity of location, design, setting, materials, workmanship, feeling, and association. To be considered significant a site must meet one or more of four National Register criteria:

> A. be associated with events that have made a significant contribution to the broad patterns of our history; or
>
> B. be associated with the lives of persons significant in our past;or
>
> C. embody characteristics that are distinctive of a type, period, or method of construction; or that represent the work of a master; or that possess high artistic value; or represent a significant and distinguishable entity whose components may lack individual distinction; or
>
> D. have yielded, or may be likely to yield, information important in prehistory or history.

Based on the limited investigations conducted during this project, Heron's Bridge Crossing Site meets all the criteria for significance on local, State, and to some degree, National levels.

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