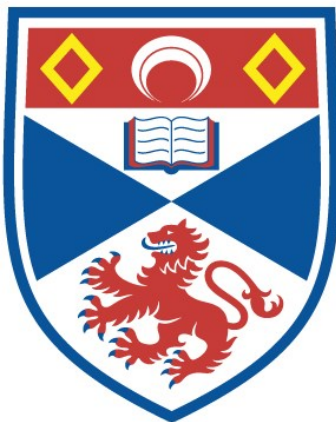


**THE HISTORIC WORKING SMALL CRAFT OF
SOUTH CAROLINA : A GENERAL TYPOLOGY
WITH A STUDY OF ADAPTATIONS OF FLATBOAT
DESIGN**

Mark M. Newell

**A Thesis Submitted for the Degree of PhD
at the
University of St Andrews**



1997

**Full metadata for this item is available in St Andrews
Research Repository
at:**

<http://research-repository.st-andrews.ac.uk/>

Please use this identifier to cite or link to this item:

<http://hdl.handle.net/10023/11135>

This item is protected by original copyright

The Historic Working Small Craft of South Carolina

A General Typology
with a
Study of Adaptations of Flatboat Design



by

Mark M. Newell



A Dissertation Submitted To The
University of St. Andrews
for the Degree of Ph.D.

1996

Declarations

I, Mark M. Newell, hereby certify that this thesis, which is approximately 62,000 words in length, has been written by me, that it is a record of work carried out by me, and that it has not been submitted in any previous application for a higher degree

April 10th, 1996

I was admitted as a research student under Ordinance No. 12, in October, 1989 and as a candidate for the Degree of Ph.D. in October of 1990; the higher degree for which this is a record was carried out in the University of St. Andrews between 1989 and 1994

April 27 96
Date

Signed

In submitting this thesis to the University of St. Andrews, I understand that I am giving permission for it to be made available for use, in accordance with the regulations of the University Library for the time being in force, subject to any copyright vested in the work not being affected thereby. I also understand that the title and abstract will be published, and that a copy of the work may be made and supplied to any bona fide library or research worker.

April 27 96
Date

Signed

I hereby certify that the candidate has fulfilled the conditions of the Resolutions and Regulations appropriate for the Degree of Ph.D. in the University of St. Andrews and that the candidate is qualified to submit this thesis in application for that degree.

2/5/96
Date

Supervisor

Abstract

The following dissertation presents a typology for historic working watercraft of the State of South Carolina, United States of America. The background investigation for this typology addressed research design questions concerning the geographic and ethnic origins of the builders of these craft, the history of transportation growth in the area and other factors which are thought to have influenced basic design, and construction methods. These factors were the environments in which craft operated, the materials and skills available for their construction, and the shapes and weights of typical cargoes they were designed to transport. In addition to archival sources, data was developed by surveying regions of South Carolina where specific types of craft were known to operate. These areas included lower coastal plain riverine environments, abandoned rice plantations, abandoned ferry crossings, historic canals, and marine phosphate mining areas. Where remains of craft were discovered, a survey was conducted to gather sufficient information to determine the basic design, construction, and function of the vessel. Experimental archaeological projects also were undertaken during the last stages of the research to determine if it were possible to gather viable data concerning construction economy, construction sequence, and performance. The projects consisted of the construction of one full scale 'replica' rice plantation barge, one full scale 'reconstruction' of an upland cotton boat, and one large scale model of a plantation chine-girder barge. These projects also constituted an examination of the value of experimental archaeology to this type of research. The work also provided an opportunity to compare the relative values of the construction of replicas using historic techniques and materials, versus 'reconstruction' to visually accurate standards using modern materials. It was determined, given certain factors dictated by funding and labor, that experimental archaeology can indeed contribute worthwhile data for research purposes.

The archival and field data generated by this activity were analyzed and a typology developed. It was determined that at least fourteen specific types of paddled or wind and tide driven watercraft were operated in the study area from the pre-historic period to approximately 1930.

These craft included dugout canoes, dugout-form based plantation craft, flat bottomed sailing vessels, round hulled ocean going sailing vessels, barge-form ferry craft, rice flats and phosphate carriers, extreme length-to-beam ratio mountain river craft, and highly specialized canal craft.

The data also indicate that working environments and cargo form were specific and direct influences on watercraft design. In some cases, such as aboriginal dugout canoes produced prior to European contact, ethnic influences were readily discernible. This proved not to be the case after the contact period.

Archival data clearly indicate that both European and Africans and African Americans were engaged in watercraft construction and operation during the study period. Evidence is presented to show that Europeans sought specific skills among imported Africans ranging from the cultivation of agricultural crops to blacksmithing. Further evidence demonstrates African skills in watercraft construction and operation, especially of dugout canoes and dugout based designs. It is hypothesized that craft of these type are most likely to be representative of the craft produced by this ethnic group in South Carolina. This hypothesis is supported by presentation of archival data showing that these types of craft were the vessels of choice of

African and African American crews. Further evidence is presented to show that widely ranging European boat building skills also are represented in the archaeological record, including English, French and possibly middle European influences. It is further determined that specific identification of the influence of any one ethnic group is made unlikely as a result of the early absorption of ethnic traditions and the training of one group, Africans and African Americans, in the boat-building and carpentry traditions of the dominant European group.

Extensive additional field data is presented on barge-form craft as remains of this type of vessel contributed to the archaeological record in far greater numbers than any other. The preponderance of this form is interpreted as a manifestation of the magnitude of the South Carolina rice industry and the catastrophic nature of its cessation due to the Civil War of 1860-1865.

Two types of construction are identified, one based on plank and frame (as opposed to plank **on** frame) methods, the other method utilizing massive chine-girder logs. Evidence is presented to demonstrate that, while the basic barge or flat design was similar throughout the study area, details of construction including chine-girder shaping, fastening methods, scarphing techniques, and bow/stern to side construction methods varied greatly. This is interpreted as a reflection of the individual skills of the plantation carpenters who were primarily responsible for the building of these craft.

Evidence also is presented for an emerging dating technique based on the nature of construction methods, types of fastenings, and the size of lumber components of barge form craft.

The research also suggests predictive models for determining the likelihood of further remains of specific vessel types ranging from rice culture flats to phosphate barges.

Finally, appendices to this dissertation include 106 illustrations, a glossary of terms, a procedure for barge documentation, tables of conversions for metric measurements to English measurement on barges, and a discussion of weights and measurements for historic period cargoes and containers.

Table of Contents

List of Figures.....	vii
List of Tables.....	ix
Acknowledgments.....	x
Introduction.....	1
South Carolina	
Environmental Background.....	2
Historical Background.....	5
Research Design.....	7
Methodology.....	9
Archival Methods.....	9
Field Methodology.....	10
Typology.....	10
Barge Forms.....	10
Curved Hull forms.....	13
Experimental Methods.....	14
Notes on Methodology	
Measurement.....	15
Nomenclature.....	15
Results.....	16
Archival Data.....	16
General Context.....	16
Barge Forms.....	18
Ferry Craft.....	21
Chine-Girder Barges.....	26
Plank-built Barges.....	29
Canal Craft.....	32
Post-Civil War Industrial Barges.....	41
Mountain Boats.....	42
Pirogues.....	52
Coasting Schooners and Sloops.....	54
Products and containers.....	57
Field Data.....	61
Ferry Craft	
Avant's Ferry.....	61
Pee-Dee River Ferry Flat.....	62
Potatoe Ferry Chine-girder Craft.....	63
Brown's Ferry Craft No. 1.....	64
Brown's Ferry Craft No. 2.....	65
Plantation Flat Boats	
The Conway Narrow Flat.....	66
The Laurel Hill Flat.....	68
Friendfield Plank-built Flat.....	69
The Trent River, North Carolina Barge.....	70
Mepkin Mud Barge.....	71
Post-Civil War Industrial Barges.....	72
The Pon-Pon Phosphate Barge.....	72
South Edisto River Barge.....	73
Biggin Creek Barge.....	75
Coasting Schooners and Sloops	
The Biggin Creek Coasting Schooner.....	76
The Malcolm Boat.....	77
Experimental Research	

The Magnolia Barge	78
The Conway Narrow Flat	82
The Petersburg boat	84
Discussion	96
Context	96
Ethnology	98
Typological analysis	105
Aboriginal Dugouts	106
Historic Period Dugouts	108
Barge Forms	110
Ferry Craft	112
Chine-girder Plantation Flats	113
Plank-built Plantation Flats	116
Post-Civil War Industrial Barges	117
General Industrial Barge Craft after 1893	118
The Pirogue	119
Coasting Schooners and Sloops	119
The Vessel at Brown's Ferry	119
The Mepkin Abbey Vessel	122
The King's Grant Vessel	123
Offshore Sloops	124
Mountain Boats	125
Other Upland Craft	125
Experimental Archaeology	126
The Magnolia Barge Replication	126
The Petersburg boat Reconstruction	128
Vessel Disposal Patterns	129
Conclusions	130
The African Contribution	133
Contributions of Experimental Archaeology	136
Ethnoarchaeology	138
A Typology for Historic working craft of South Carolina	140
References Cited	145
Appendix A	
Figures	168
Appendix B	
Tables of Scantlings and Measurement Conversions	242
Appendix C	
Glossary of Terms	254
Appendix D	
Barge-form Data Gathering Methodology	257

List of Figures, Appendix A

- Figure 1 The four main physiographic provinces of South Carolina.
- Figure 2 Typical vessel site sketch.
- Figure 3 USGS map section with coordinates.
- Figure 4 Typical scantlings table.
- Figure 5 Doar's map of Combahee Plantation.
- Figure 6 Drawing of a "ferry bat."
- Figure 7 Photograph of the Middleburg Chine-girder Barge.
- Figure 8 Plank barge photographed on the Combahee River.
- Figure 9 Flat being used on the Middlesex Canal.
- Figure 10 Original carpenter's plan for an Augusta canal barge.
- Figure 11 Illustration of a "Santee Canal Barge."
- Figure 12 Gibbes' illustration of a Santee Canal "Cotton Box."
- Figure 13 The Atlantic Phosphate Company's Works on the Ashley River.
- Figure 14 Model of Stockholm Tar Boat.
- Figure 15 Stockholm Tar Boats with cargo loaded.
- Figure 16 Artists impression of a Durham Boat.
- Figure 17 Bateau descending the New River.
- Figure 18 James River Tobacco Boat by Tatham.
- Figure 19 Petersburg boats on the Augusta Canal, 1875.
- Figure 20 "Cotton Boats shooting the Rapids above Augusta."
- Figure 21 Small pole boats below Augusta.
- Figure 22 Maxwell's 1900 drawings of a barge.
- Figure 23 Author and Buck Balchin talk Petersburg boat history.
- Figure 24 Freight scales used on Balchin's Petersburg boat.
- Figure 25 Iron Petersburg Pole tip.
- Figure 26 Artist's impression of a pirogue.
- Figure 27 A general view of Charleston harbour.
- Figure 28 Nineteenth century illustration of coastal fishing craft.
- Figure 29 Sacks of rice being loaded.
- Figure 30 A barrel of indigo being prepared for shipment.
- Figure 31 A mid-nineteenth century tobacco sale.
- Figure 32 Diderot's illustration of cotton processing
- Figure 33 Site map of Black River Peg Flat.
- Figure 34 Plan, elevation, and section of Black River Peg Flat.
- Figure 35 Plan, and elevation of the Pee Dee River Flat.
- Figure 36 Reconstruction sketch of Pee Dee River Flat.
- Figure 37 Plan, elevation, and cross section of Potatoe Ferry Craft.
- Figure 38 Site map of Brown's Ferry Crossing on Black River.
- Figure 39 Plan and elevation of Brown's Ferry craft No. 1.
- Figure 40 Plan and elevation of Brown's ferry craft No. 2.
- Figure 41 Ferry Bats.
- Figure 42 Plan and side elevation of Conway Narrow Flat.
- Figure 43 Photograph of lightly indented treenail hole.
- Figure 44 Cross section showing rabbet for planking.
- Figure 45 Fastening patterns at two locations on the keelson.
- Figure 46 Site plan of Laurel Hill Flat.
- Figure 47 Hampton Shuping's impression of Laurel Hill Flat .
- Figure 48 Detail of header log and sheerstrake fastening method
- Figure 49 Site map of Friendfield Flat.
- Figure 50 Semi-liquid mud over Friendfield Flat
- Figure 51 Plan and elevation of Friendfield Flat.
- Figure 52 Photograph of tool marks.

- Figure 53 Preliminary plan and elevation of Trent River Chine-girder Craft.
 Figure 54 Plan drawing of Mepkin Plantation Barge.
 Figure 55 Photograph of larger nails used to fasten corner fillets.
 Figure 56 Reconstruction detail of Pon Pon Phosphate Barge.
 Figure 57 Plan, elevation, and sections of the South Edisto Barge.
 Figure 58 Plan, elevation, and sections of the Biggin Creek Barge.
 Figure 59 Exposed sections of the Malcolm Boat.
 Figure 60 Sandbagging process on exposed structure.
 Figure 61 William Judd's drawing of the Malcolm Boat.
 Figure 62 Interior of excavation.
 Figure 63 William Judd's drawing of the hull reconstruction.
 Figure 64 William Judd's impression of the original vessel.
 Figure 65 Plan and elevation of the Magnolia Barge.
 Figure 66 The completed strongback with top rails.
 Figure 67 Stringer sections prior to assembly.
 Figure 68 Raised supports for the barge ramps.
 Figure 69 First chine strake installed.
 Figure 70 Power augur being used to drill holes for drift pins.
 Figure 71 Header logs installed on ramp supports.
 Figure 72 Last of the ramps planks are installed.
 Figure 73 Author with template for barge knees.
 Figure 74 Author cuts blanks for carving into knees.
 Figure 75 Live oak knees nearing final finishing stages.
 Figure 76 The completed barge.
 Figure 77 Author's reconstruction of a Petersburg boat.
 Figure 78 CAD-CAM system's impression of the Petersburg cross section.
 Figure 79 Models of the Petersburg boat.
 Figure 80 Partially carved stem knee.
 Figure 81 The keel and floor assembly in early stage of construction.
 Figure 82 Pre-cut frames for centre section of vessel.
 Figure 83 Small standard knee of pine supports floor-frame connection.
 Figure 84 Foregripe and stem knee assembly.
 Figure 85 Untrimmed hood ends of the bow planking.
 Figure 86 Close-up view of knees used to anchor floating cant frames.
 Figure 87 View of framing for bow showing floating cant frames.
 Figure 88 Breast hook being installed in bow.
 Figure 89 Author caulks seam with raw cotton fibre.
 Figure 90 Petersburg boat is launched into the Augusta Canal.
 Figure 91 Crew rowing the Petersburg boat.
 Figure 92 The Petersburg boat on the Savannah River.
 Figure 93 Shavings at Petersburg boat construction site.
 Figure 94 Europeanized dugout recorded by Alford.
 Figure 95 Dugout plantation Boat recorded by Harris and author.
 Figure 96 Diagnostic drawing of construction of most barge forms.
 Figure 97 Early lines drawing of the vessel at Brown's Ferry.
 Figure 98 Framing plan of the vessel at Brown's Ferry.
 Figure 99 Hocker's later lines of the vessel at Brown's Ferry.
 Figure 100 Floor plan of the Mepkin Abbey Vessel by Erd.
 Figure 101 Erd's drawing of the Mepkin Abbey wreck mast step.
 Figure 102 Mepkin rudder, sternpost, and knee assembly by Erd.
 Figure 103 Rudder from the Hobcaw wreck, Beard's photomontage.
 Figure 104 Floor plan of the King's Grant vessel by Judd.
 Figure 105 Resident and slave cabin at Carswell Plantation, Georgia.
 Figure 106 Suriname: Bush Negroes heat treating dugout canoe.

List Of Tables, Appendix B

- Table 1 Load comparison of transportation modes.
Table 2 Chronological development of South Carolina canal system.
Table 3 Canal vessel capacities, crew and tolls.
Scantlings: Measurement conversions:
Table 4 Avant's Ferry Craft.
Table 5 Pce Dee River Ferry Flat.
Table 6 Potatoe Ferry Craft.
Table 7 Laurel Hill Flat.
Table 8 Friendfield Plantation Flat.
Table 9 Trent River Flat.
Table 10 Mepkin Plantation Flat.
Table 11 Pon Pon Phosphate Barge.
Table 12 South Edisto Phosphate Barge.
Table 13 Biggin Creek Barge.
Table 14 Brown's Ferry Craft No.1.
Table 15 Brown's Ferry Craft No.2.

Acknowledgments

No work of this nature is ever accomplished without the support, contributions, and encouragement of many good people. I have tried to mention them all below but have doubtless omitted some, for which I ask forgiveness in advance. I should also add that the people mentioned in no way share the errors in fact and omission which may be a part of this dissertation.

Of primary importance to the creation of this work was Jack Frierson of Florence, South Carolina. A descendant of once great cotton barons, Jack was the person who invited me to South Carolina in 1968 and did his best to see that I was captivated by the bittersweet historical romance that is the history of his native state. Jack died in 1971 and in many ways this work is one of his legacies to a homeland always dear to his heart.

Of equal importance are many professional researchers working in the area who lent support to this research. Worthy of mention for their direct support and encouragement are James Michie, a fellow traveler who offered much advice and encouragement, Stanley South who patiently and freely gave criticism and insight, Jay Mills who provided archival research assistance from the Libraries of the University of Florida at Gainesville, Lynn Harris for reading and commenting on parts of this manuscript. Former colleague Deborah Barshafsky used her considerable editing skills to help with the consistency of style and presentation in the final manuscript.

Many other professionals and avocational researchers also have contributed in large and small ways to the completion of the work. Billy Judd of Charleston joined me in the process of discovery of many of these unique craft and freely shared the results of his own research, primarily drawings and construction detail. An avocational recorder of these craft, his own work is richly deserving of future publication. Hampton Shuping of Conway, South Carolina, discovered the vessel at Brown's Ferry in the 1970s. Using recording methods which I provided as a guide, he began recording barges in the Waccamaw River and freely shared this data with me as the work was in its final stages. Both Billy and Hamp are fine examples of the great contribution avocational archaeologists can make to the record.

Fellow small craft researchers Mike Alford of the North Carolina Maritime Museum at Beaufort, Allan Saltus of Louisiana, and Rusty Fleetwood of Savannah Georgia, spent much time on paper and phone discussing aspects of the work of mutual interest. Mike was especially helpful with advice and for sharing data on the Trent River Flat and for facilitating permission to use some of the Trent material in this work. I owe a special debt to Rusty Fleetwood who not only shared his historical knowledge but also allowed himself to be inveigled into several boat building ventures as part of the research. Ms. Danielle Seward generously lent her services to photograph the building of the Petersburg boat, Ms. Britt Nickels did underwater photography of the Ingram Vessel for me and the Petersburg Project.

The interest and advice of a number of other archaeologists also did much to direct and form the results of the research. Peter Marsden and Damian Goodburn, both of the Museum of London, offered valuable advice on comparative studies and research sources in Europe. Martin Dean, Colin Martin, and Robert Prescott of the Scottish Institute of Maritime Studies also offered guidance and access to their libraries and those of the University of St. Andrews where useful information was found. Judy and Martin Dean also made an even greater contribution to this work by housing and feeding the author during research in Scotland. Bruce Terrell of Richmond, Virginia, generously provided background history and research data on Virginia batteaux from his East Carolina University Master's Thesis. Judy Wood,

with the United States Army Corps of Engineers in Savannah, Georgia, also freely gave advice based on her own research into small craft in Georgia and on the Savannah River. Her enthusiasm for the process of discovery added much enjoyment to the work. Fred Hocker, of Texas A&M offered insights into the vessel found at Brown's Ferry. Leland Ferguson of the University of South Carolina's Anthropology Department generously provided time and insights into aspects of West African influences in small craft construction. Dr. Patrick Malone of the Western Civilization Department of Brown University provided major support for the work in the form of encouragement and a recommendation for a Research Fellowship at the John Carter Brown Library. The Library, and its excellent staff, assisted me greatly in finding materials relative to this area of study.

Tony Carr, a good friend and North Augusta, SC surveyor, gave me free reign of his office and blueprint machine, a considerable gift of support.

Clive, Susan, Helen, and Mark Findlay of Sunbury near London, England, know only too well the burdens of entertaining and feeding in-laws for weeks on end...they became my second family during long research sojourns in England and never failed to make the start of each new visit seem like a homecoming.

Lastly, a very special debt of gratitude is due to my immediate family, Christine, Lindsey, Nick, and Rachel, who have in many ways paid much that this work might come to fruition. They alone know how much more lies between the lines within these covers.

Mark M. Newell
1996



IMAGING SERVICES NORTH

Boston Spa, Wetherby

West Yorkshire, LS23 7BQ

www.bl.uk

**CONTAINS
PULLOUTS**

Introduction

Numerous studies have been published on the history of the State of South Carolina in North America and the State's process of colonization, exploitation, frontier patterning, and the transition of its colonial society to a major world economic power by the nineteenth century (Lewis 1984 for frontier patterning, Weir 1983 for Colonial history, Jones, L.P. 1985 for general history, Easterby 1949 for a general history reference and Sass 1956 for South Carolina's Lowcountry are recommended). This dissertation examines one long neglected aspect of this process, that of the evolution of local water transportation in the State. It presents a typology for the historic working craft of the region of what is now the State of South Carolina and develops some understanding of the environmental, economic, social, and ethnic influences that may have contributed to the particular forms of these vessels and the functions they performed.

The dissertation covers a period of approximately 200 years, from 1670 to 1870, with a few exceptions, and deals with vessels powered by hand, tidal forces, and wind. The study represents the largest survey of small craft sites and related archaeological sites ever to have been conducted in the brief history of professional underwater archaeology in the State. While not every vessel and site visited is included in the text below, all sites contributed to the conclusions resulting from the study.

The intention is to provide a basis for specific lines of inquiry which may be developed by future researchers. Environmental, ethnic, and economic factors influencing the design and function of specific types of water craft are presented. The work by no means claims to be a definitive or totally complete study, due to the scope and geographic range of the sites identified. There are still large areas of South Carolina which have yet to be surveyed and predictive modeling based on the current research would indicate that significant numbers of water craft are yet to be discovered.

The information presented here was gathered from 1983 to 1993, being organized into a dissertation format starting in 1989. Prior to 1983 there was a complete absence of any professional, systematic research program on historic small craft in the South Carolina region of the United States. There were, therefore, no published texts covering history or field data specific to the topic (other than one scientific article) on which to base the start of the research program. It was decided that the work would be based on two main research areas, archival sources and field data. While conducted concurrently, the general procedure

involved identifying specific types of craft in the archival record, followed by the conduct of surveys of the areas mentioned in the documentary sources for archaeological evidence of the craft. In almost every case, archaeological evidence was found.

A third research avenue was introduced toward the end of the program, that of experimental archaeology. Three projects were undertaken, the building of two full scale historic craft and the construction of one large scale model. The full scale projects were designed to develop new information about one craft on which a great deal of archaeological evidence existed, rice plantation barges, and another for which no archaeological evidence existed, Petersburg cotton boats. The third, the model, was designed to develop information about a type of craft for which full scale lumber was no longer available, the chine-girder type of plantation barge. These projects also constituted an examination of the merits of experimental archaeology where historic vessels are concerned.

Once sufficient information was gathered and synthesized, it was organized into the following dissertation. A brief overview is given of the environment of South Carolina and its general history, along with direction to some of the many other published works which offer the reader in depth information on local history. This is followed by a research design for the dissertation and then a methodology. The results of this work are presented as an historical background for working small craft in the region as represented by the archival record, and then as a section of archaeological field data gathered from sites ranging from the Trent River in North Carolina to the Savannah River in Georgia. A section then follows in which the principal findings of the archival research, field research, and experimental archaeological projects are discussed. This leads to the Conclusions section in which a typology for small craft in the region is presented.

South Carolina: Environmental Background

The various aspects of South Carolina's environment did much to recommend the area to English aristocratic entrepreneurs who saw an opportunity to acquire vast tracts of land on which agricultural exports could be produced for the European market. Voyages of exploration to West Africa prior to this time had identified tobacco, cotton, rice and indigo as crops which thrived in these low latitudes of 32° to 35° north (Matthews 1966:18-52). In an original "Prospectus" for South

Carolina these products were listed as potential export crops, clearly setting the foundation for the transfer of this agricultural knowledge and the Africans who held it to Carolina's plantations via the slave trade (Dethloff 1988:6-9).

Of immediate interest to potential planters was the fertile coastal plain of the new Colony. The rich alluvial deposits and mild climate were coupled with an extensive riverine system. This area offered an ideal setting for a plantation based economy with a ready made transportation system to and from major ports. The challenge facing early Colonists with land grants from the Lords Proprietors was little more than the organized collection of the region's natural products in exportable quantities and the adaptation of West African agricultural products to mass production systems.

The principal area of interest of this paper will be this lower coastal plain province, and to a much lesser extent the Sandhill, Piedmont, and Blue Ridge Mountain provinces of the state (Fig.1).

The four general physiographic provinces of the State are formed of Upper and Middle Eocene Age deposits (mountain province) and Miocene, Pliocene, and Holocene age deposits (Piedmont and coastal plan) overlaying major beds of Late Cretaceous, Early Cretaceous deposits under which are found Pre-Triassic Age bedrocks (Barry 1980:16).

The coastal plain province has been largely formed by shifting shore lines caused by continental land tilting and fluctuations in sea level. These left a series of coastal terraces marked by wave-built bays featuring bars at their entrances, a factor having a subsequent influence on coastal vessel design. The area extends from these coastal bays to the fall line in the approximate centre of the State.

The Piedmont Province extends from the fall line to the foothills of the mountains. The area represents the change from the unconsolidated sedimentary deposits of the coastal plain to the igneous and metamorphic rocks of the Piedmont. The terrain has rolling, low hills which change in nature towards the north to ridges with a northeast-southwest orientation. The Carolina Slate Belt, a layer of slate running from Virginia to Georgia, creates low wide valleys where rivers tend to be shallow and fast running, another factor influencing vessel design in this region. In depth discussions of the State's geology can be found in Carolina Geological Society 1979, Cooke 1936 and Johnson 1971.

The Blue Ridge Mountain Province in the extreme western part of the State consists of ancient mountains weathered to little more than rounded domes of decayed rock forming a mantle over the bedrock. The area is high in mineral

resources ranging from precious metals to granite and clay. The mountain range is not high and considerable humidity results in run-off which contributes to erosion and provides the source waters for the State's three main river systems.

The three main river systems of the state are the Savannah System, the Saluda-Broad-Wateree-Congaree and Santee System, and the Black-Lynches-Pee Dee-Waccamaw System. These systems, along with the Edisto River, create a riverine transportation network which actually extends far to the west. Smaller rivers and interconnecting creeks are so numerous that few historic agricultural operations in the state were further than five miles from a navigable river (Mills 1826:46).

South Carolina's climate was mentioned prominently in early writings designed to encourage emigration to the Colony:

"...it is very healthful; our Summer is not so hot as in other places to the Eastward in the same Latitude...Our Northerly Winds, in Summer, cool the Air...Our Sky is generally serene and clear...The winter has several Fitts of sharp Weather..." (Lefler 1967:93).

The temperate climate is indeed similar to that of the temperate zone of Africa and, when combined with topographic and hydrographic features, is one of the factors contributing to the combination of agricultural products which forged the early success of the Colony.

The State's low latitudes of between 32° and 35° and an elevation mostly below 304.8m (1,000ft), added to the affects of the Gulf Stream to produce this mild, humid climate (Barry 1980:3).

In general, lower temperatures prevail in the inland portions of the State as a result of higher elevations and latitudes among other factors. Higher temperatures prevail along the southern coast. Average temperatures in the central part of the state range from 33° to 34° C in July to a low of 23° to -5° C in January. This results in extended growing periods for cultivated crops the average period of frost free weather ranging from 200 days inland to 280 days on the lower coastal plain (Barry 1980:4). Rainfall is heaviest in two areas of the state, the mountain Province and the lower coastal plain ranging from 203cm (80in) in the former to 106cm (41in) in the latter.

While agricultural experimentation began very early in South Carolina's history, the first commercial activity in the Colony depended upon the natural assets of the area. Export of animal pelts, either through trapping or trading with Indians, was

perhaps the only exception to activity which was primarily based on the rich natural supply of timber which produced naval stores.

The mountainous Province of the Colony was dominant in pitch pine and shortleaf pine (*Pinus echinata*) and various oaks (*Quercus alba*, *Q. rubra*, *Q. velutina* and *Q. prinus*), all woods of some utility.

Similarly the Piedmont Province provided oaks, pines, including longleaf pine, (*Pinus palustris*), as well as useful flood plain forest trees such as water oak (*Quercus nigra*), pond cypress (*Taxodium ascendens*), ash (*Fraxinus americana*) and hickory (*Carya* spp.).

The Sandhill Province produced both longleaf pine and loblolly pine (*Pinus taeda*). The lower coastal plain produced some of the most desirable woods for naval stores including live oak (*Quercus virginiana*), bald cypress *Taxodium distichum*) and other minor woods of similar utility. Live oak was found to be such a desirable wood for ship building that a substantial industry developed around harvesting it (Wood, V.S. 1981). The sand dune variety, common to the lower coastal plain of South Carolina, Georgia, Florida and the Gulf states, is named *Quercus maritime* as a result (Wood, V.S. 1981:3). This variety is now a protected species and extremely difficult to obtain for ship building purposes. In 1992, the author initiated "The Historic Ships Supply Program" with the South Carolina Department of Highways and Transportation in order to claim live oak cut as a result of road building and construction programs. In two years the program was able to provide the reconstruction needs of the United States Navy's flagship the historic *USS Constitution* for live oak through the year 2025 (Newell 1993c:8).

Historical Background

This brief historical background is provided in order to give a temporal context in general to the information presented, and specifically for the results of archival research on water transportation presented below. Unless otherwise cited, this section is based on the historical works referenced above.

Plans for the Colonization of the area of North America's eastern seaboard now known as the State of South Carolina were developed as early as the 1620s. After several explorations and abortive attempts, most notably by the Spanish in 1566 (South 1979:25-27 and South et al 1988:1-2), a viable Colony was established by the English in 1670.

For at least 12,000 years prior to this date (Goodyear et al in Goodyear and Hanson 1989:19-52), the area was occupied by aboriginals of diverse cultures, all

loosely categorized as "Indians" by the early European explorers. Extensive studies have been conducted on these pre-historic cultures by excellent researchers such as Tommy Charles, Albert Goodyear, Ken Sassaman, and others. The best source book for the large number of research volumes by these authors is Derting et al 1991. Doubtless to support the doctrine of effective use, the numbers of aboriginals in the area may well have been underestimated by the Europeans. In any event, the combined effects of disease, war, and finally mass relocation reduced these numbers to insignificance by the mid-nineteenth century.

As noted above, early explorations in West Africa had already identified various crops which could have been developed as marketable staples in the Province. Early efforts to develop such crops were combined with immediate exploitation of natural resources for naval stores and trade with the aboriginals for pelts. A particularly useful source for information on this aspect of area history is McDowell, Jr. 1970.

By 1680 a township had been established at Charles Towne, moved from a nearby swamp to a neck of land between the Ashley and Cooper rivers, so named for the Earl of Shaftsbury, leader of a group of "Lords Proprietors" acting under a grant from Charles II. Some years later, rice was introduced as an experimental staple crop (Doar 1936:51). Authors differ as to the actual nature of this introduction, but all agree that by 1690 it was an established crop and that by 1700 normally available ships could not cope with the export volume.

The Proprietor form of Government ended in 1719 when the Colonists sought a more direct voice in management of the Colony. The ensuing years saw a rapid growth in the plantation economy based on export of rice, indigo, tobacco and naval stores and other products. Clowse 1981 provides a good overview of the growth in such exports for the period 1717-1767.

During this same period, the Colony's riverine system was used to expand the western frontier to the Appalachians. By the late eighteenth century, the colonists again were seeking a more direct role in the management of their affairs, leading to the American Revolution. Kurtz and Hutson 1973 provide an insightful view of the causes of the revolution, known locally as the War for Independence.

The revolution devastated South Carolina's plantation economy (Orvin 1973:147), resulted in the loss of important markets for indigo (Porcher 1970:7), and diminished plantation profits (Phillips 1908:38). This led to innovative efforts to improve internal transportation, most notably, the construction of the Santee Canal (Crowson 1971:7).

The ante bellum period led to South Carolina's greatest economic success, based primarily on the exports of rice and short staple, or upland cotton. The same desire for self determination that led to the revolt against the Lords Proprietors in 1719 and the British Government in 1775 resulted in a rift over States Rights between a confederation of Southern states in favour of secession from the United States of America, and Northern states in favour of loyalty to a central, Federal Government. The result was a civil war, officially designated as the War Between the States. Volumes on the war are legion and widely available. Commager 1950, Davis and Wiley 1984, and Morgan and Basoco 1971 are among the author's favourites.

The war brought an almost sudden and catastrophic end to agricultural and other economic activity in South Carolina. Few plantations survived the aftermath of Northern victory. South Carolina in particular, where the first shots of the war were fired, was to remain an economically backward state well into the twentieth century. Early attempts to revive the economy after the civil war involved export of phosphates and lumber. The plantation system, the foundation of the economic infrastructure, essentially vanished, taking with it the dependent trades, industry and transportation networks that brought so much vitality to South Carolina life.

Research Design

At the commencement of the research program for this dissertation, it was determined that no formal study of vessel form and function had been conducted in South Carolina. The absence of any wide ranging studies of this type results in the formation of a research design which ranges in inquiry from extremely broad and general questions to minute, but no less valuable, details of craft construction. The intention was to construct a practical research design which would result in a structured investigation from which a foundation could be developed on which future research could be based, rather than one which attempts to produce a definitive and final work.

It was decided therefore that two simple, principal hypotheses should be tested: that the combination of archival evidence and the archaeological record can be used to create a typology of regional craft, and; that the vernacular craft of South Carolina were constructed in forms that were directly related both to the environment in which they operated and the physical characteristics of the cargo they carried.

These hypotheses can be tested by studying the form and function of these craft, and by studying relationships between the design of the various craft and the cargoes they carried and the relationship of these craft to the environment in which they operated. Questions (and answers) concerning ethnicity and opportunities for middle range ethnoarchaeological and experimental archaeological research were left to be considered later, in light of data on the social organization of the various groups owning, building and operating various types of small working craft which was expected to emerge during in the research program.

This paper will first document from archival sources why certain geographic, economic, and demographic factors gave rise to the development of a water borne transportation system in South Carolina. It will show how this system and its various craft resulted from the lifestyles of the population in activities ranging from agricultural production to transportation.

This will be followed by an examination of existing vessel remains in archaeological contexts and their working environments. The data will aid in the understanding of design, construction methods and materials over the most active historic times, from the early Colonial period to the early twentieth century.

Other sub-hypotheses will be tested in the course of the dissertation. For example: Can an examination of construction techniques yield data revealing the ethnography of vernacular craft builders? English shipwrights and carpenters were the first in South Carolina to build vessels (Goldenberg 1976:64), but slave apprentices in shipyards (Goldenberg 1976:63) and carpenters on plantations later formed the majority of craftsmen by the early nineteenth Century (Scott 1984:364). This may have created an opportunity for African regional wood construction techniques to be introduced into South Carolina. This hypothesis may be tested by comparing extant and historical vernacular craft construction techniques in those areas of the African continent from which slaves were exported to the Carolinas with those techniques suggested by sites examined in South Carolina.

Additional questions concern the nature of cargoes. Can the archival record provide reliable indications of weights, volumes, and sizes of typical cargoes? There also are questions designed to aid further study and analysis of area small craft. These include determination of diagnostic features such as tool marks. Can tool marks be found on eroded craft? Can they provide reliable indications as to the date and nature of construction? Are there other features of construction which tend to determine temporal periods of construction?

Methodology

Archival Methods

The South's slave based plantation economy generated an immense amount of both documentary and manuscript material, much of which is still held in private hands, repositories, and libraries. The wealth of material is due in the main to certain special needs of the plantation system. The system originally was based on the premise that wealth could result from the export of locally produced crops and products to an overseas market in England. The commerce with England generated written records ranging from reports of Colonial Governors to requests for slave blankets from plantation managers to their absentee planter-investors.

Sources reviewed and/or used for this study included privately held original papers in England, original manuscripts held at archives in England's Public Records Office, The National Maritime Museum, The South Carolina Historical Society, The South Carolina Department of Archives and History, The Caroliniana Library of the University of South Carolina, The South Carolina Institute of Archaeology and Anthropology (hereinafter SCIAA), The Manuscript Division of the Library of Florida State University, The Southern Historical Collection at the University of North Carolina and the Duke University Library.

These documents were scanned for specific references to those issues raised in the research design. Such references proved to be rare, and especially so in the case of those vessels which were so familiar and commonplace in the lives of South Carolinians that they were never deemed worthy of mention in written records.

The two archives of limited value to this study were at the offices SCIAA. They were the State Site File Inventory, and the files of the Sport Diver Archaeology Management Program. These files were surveyed for reports of vessel remains. The reports were evaluated for type, accessibility, and integrity of remains. Sites or sport diver locations that indicated a potential for contributing to the goals of the study were then scheduled for site visits. Due to the limited number of underwater files on record, and the lack of reporting of finds by sport divers, few vessels were located by these means.

Field Methodology

Typology

Field methodology evolved from a combination of early assumptions and the realities revealed by the early archival portion of the research. Archival sources indicated a sizable field resource on which no formal studies had ever been conducted. The number of sites, or probable sites, to be visited and their geographic range over the State presented a logistical problem which severely tested the practicality of the research design. It was decided that an attempt to record all these craft in great detail, and in person, would be impractical. Instead it was felt that preliminary surveys of sites would generate sufficient data for the stated purposes of the research. Also, it was decided that a small portion of the sites should be surveyed by knowledgeable sport divers and avocational archaeologists, and this data incorporated into the study. As a result, the author provided vessel recording procedures and guidelines to Mr. Hampton Shuping of Conway, South Carolina, and to Mr. William Judd of James Island, South Carolina. Mr. Shuping consequently did an excellent job of recording several barges off Laurel Hill Plantation in the Waccamaw River. Mr. Judd, a trained draughtsman, needed little guidance in recording techniques and examples of his high quality work are seen and credited below. In all other cases, the field surveys, data, and original drawings presented are the work of the author.

A review of the archival results indicated a preponderance of barge form sites at Ferry crossings, on abandoned rice plantations, and marine phosphate mining fields. It was felt that these vessels in particular might yield more data of value to ethnographic study and vernacular building techniques due to the potentially greater data base. Effort was consequently concentrated on these sites.

Other vessel sites were essentially limited to sufficient investigation to determine vessel type, hull configuration, context, variations of construction techniques within the type, and analysis of associated diagnostic artifacts, if any.

Barge Forms

The many common features of these craft provided a ready basis for organized data gathering. A basic field measurement form was therefore devised for this group of craft. Provision was then made for additional data that related to the specific function of the craft.

Prior to data gathering each site was first recorded by a general site plan including major permanent landmarks in relation to the vessel remains, and a site sketch (Fig. 2). Floats were then affixed to each corner of the vessel, and each float located on the site map either by vectors taken with a Brunton compass or with a transit.

These data were transferred to an enlarged section of a United States Geodetic Survey (USGS) map for the area with Universal Transverse Mercator (UTM) coordinates given for the vessel or the nearest landmark feature (Fig. 3).

Data to be gathered from each vessel were then collected in a programmatic procedure commencing with "gross" or overall measurements, and terminating in collection of as much minute construction detail as circumstance permitted (Appendix B: Barge Form Data Gathering Methods). In many cases one or a combination of circumstances prevented field recording to the ideal extent. These usually ranged from lack of time to changing site conditions (tide) or factors such as the partial burial of sections of the hull. In this way, if data gathering was terminated for one of these reasons, sufficient information would have been gathered to support basic determinations as to vessel type and function. In most cases data gathering was non-invasive and designed to disturb the vessel's equilibrium with its environmental context as little as possible. It was felt that this approach was justified in as much as the purpose of this investigation was identification and preliminary recording of as many different vessel types as possible.

Overall measurements of each vessel were first recorded, these comprising of length, width, and depth. Next, the profile of the ramp, or rake of the bow, was recorded by taking depths at 0.10m (3.97in) intervals, measured from a tape tacked along the gunwhale.

In the case of flats constructed with planking, a table was made assigning numbers to each plank with the sheerstrake as plank number one. Only one side and one end (bow or stern) were recorded if the planking schemes matched for counterparts. The thickness, and depth of each plank was then recorded. Scarphs or butt joints along each strake were noted as to type, plank number, and distance point from bow as measured along the tape tacked to the gunwhale. If scarphed, measurements were taken to note depth of edges and the scarph table. These measurements also then described the type of scarph, shiplap or otherwise. Depending upon construction technique, the end grain of bow or side planking was

usually visible. In either case, the grain was noted as an indication of the conversion of the timber from the original log.

Chine-girder flats or barges were recorded according to a standardized table for the most commonly encountered features. These were width of gunwhale, outside depth to turn of bilge, inside depth to top of shelf, depth of shelf, depth of planking rabbet, width of planking rabbet, and width of base. A standard moulding gauge was then used to recover the curvature of the chine at a pre-selected point where more detailed cross section measurements were taken, if conditions allowed.

Interior features of each craft were then noted commencing with bow construction features, location, and dimensions being recorded for internal members which either strengthened the assembly or to which exterior planking was attached. These structural elements were called knees irrespective of actual shape in order to differentiate them from similar structural pieces on the bottom of the craft.

Recording then progressed to the inner sides of each craft where data were recorded on the various methods of internal support for the strakes. Simple measurements were taken where four sided battens were encountered; more complex measurements being made where shaped knees were used. If time allowed, curvatures were recorded by taking offsets from a level placed across the gunwhales of the craft; if not, minimum measurements were made from which the curve could be re-constructed with reasonable accuracy.

Details of bottom features were then taken, noting athwart ship or longitudinal planking plans, position, and dimensions of keelson timbers, and the pattern of fasteners used to attach the keelsons to the planking. Special note was made of the nature of the structural support of the side planking to the bottom planking and whether sides and bottoms were butted or lapped. Other internal features were then recorded ranging from presence/absence of ceiling planking and athwart ship gunwhale to gunwhale supports. Corner supports were documented as the last step of internal recording. Final structural detail usually taken was the position and nature of rowlocks or thole pins, particularly at the ends of the craft, as these designated a stern. Particular attention was paid to the fabrication of the rowlock as a possible indicator of age.

Particular attention was paid to types of fasteners used in these craft as it was felt that these would provide good indicators of both age and craftsmanship. Notations were made as to where and how treenails were used and finishing treatments for them. Nails were noted as to type and manufacture. Drift pins also were recorded as to the length and diameter where they were used.

If unknown woods were encountered (other than cypress, live oak, and pine), samples were taken for future analysis. Samples also were recovered, where possible, of caulking materials for analysis.

Measurement technique differed according to the nature of the recording environment and the condition of the vessel under study. In many cases, vessels were submerged, partially destroyed, and timbers severely reduced from original dimensions by erosion. In such cases, metric measurements were taken since this system provided the easiest way of obtaining and recording a mean measurement. In some cases, the vessel remains were in a complete condition. Timbers were often in an excellent state of preservation with minimal, if any, erosion or rot, and in a favourable recording environment. In these cases measurements were made in English inches and feet, presumed to be reasonably close to the system of measurement used during actual construction. The English measurement system meant making choices between the shipwright's system of inches, and eighths, or the more practical inches and tenths (of inches). Neither system was adopted in favour of decimal feet and tenths (of feet) in order to provide easy conversion to metric measurement. In such cases, a table of scantlings was prepared giving measurements in both systems (Fig. 4). Where metric measurements were taken, they reflect the actual measurement of the timber. It will be seen in the text that the English conversion often gives a measurement close to one that might normally be expected, a quarter of an inch or three eighths of an inch, or four feet as examples. These were possibly the actual original measurements, erosion, and other factors producing the measurement recorded.

Curved Hull forms.

When this research program began, a search was made for expertise in the recording of small craft in the region. It was found that there was a severe lack of such expertise available in the southeastern United States. As a result, the author participated in various projects to design, field test and publish recording techniques for small craft, especially those with curved hull forms. One of the best results of this participation was a publication subsequently used for this type of recording in this study, *"Boats: A Manual for their Documentation,"* produced by the American Small Craft Association (Lipke, et al 1993). Also useful for larger forms was *"Guidelines for Recording Historic Ships,"* published by the National Park Service (Anderson 1988). Other volumes which were consulted included *"Lofting,"* by

Allan Vaitses (Vaitses 1980) and "*Working Boats of Britain*" by Eric McKee (McKee 1983).

Experimental Methods

It was expected that data gathering in the field would not answer certain questions posed in the research design. Unlike the study of ship remains, examination of sunken barge remains reveals little about the actual construction process. Unlike Doar's description (Doar 1936:34) of the building process for the chine-girder barges, no accounts of the construction process were found for plank-built barges. While a certain amount of information can be revealed by analysis of the structure, it was felt that the subject would be illuminated further by actual construction of a flat on a local plantation. This activity was planned for the end of the study period, when field data would be developed and the construction process analyzed with the greatest amount of background knowledge. Construction drawings for a flat were made by the author incorporating various features found on flats in the field. While not all of these were necessary for actual construction of the craft, some were incorporated simply to test construction methods.

The barge was built using local ship's carpenters and avocational ship builder/historian William Fleetwood of Savannah. A combination of historic and modern methods were used, each step of the process being documented by still, and video photography. Notes were made in particular on divergence of modern and historic methods and the reason why the builders employed them. Notes and photographs also were made of the type of tool marks left by typical tools of the historic period such as shipwright's adzes, draw knives, axes, etc.

The one craft of which no archaeological evidence has been found so far is the mountain boat. Good archival evidence of these craft was found in regions from New York state to Georgia. This led to this type of craft being chosen as the second craft for experimental study. The most complete archival evidence found in the study region was for the type known as "Petersburg boats" operating on the upper Savannah River. Construction drawings were prepared using this evidence. The lack of some detail was overcome by testing the new design on a CAD-CAM system which compared the drawings to the known performance characteristics of the original vessels. Also, elements such as the strake layout were tested first on solid planking models. A complete construction model of the vessel on 1:10 scale also was built to further test aspects of the construction for which no archival

evidence existed. After the model building phase, the full sized craft was built, the process being documented in the same manner as the flat.

Both experimental projects also were used as an opportunity to gather oral histories from local carpenters and ship's carpenters and residents with ancestral connections to the various trades associated with the two craft. Full discussion of these projects appears below.

Notes on Methodology:

Additional notes on measurement

The English maritime system of measurement of feet, inches, and eighths is most probably the system used for the construction of most of the historic small craft built on South Carolina plantations and shipyards. When such vessels are found to be in good condition they are usually recorded using this system. This procedure then produces data which more readily reveals features and patterns significant in the analysis of the structure. In most cases encountered for this study, however, erosion of timbers was so extensive that the system becomes meaningless. In such cases, speed and accuracy was served by recording in decimal feet or the metric system. In the case of the flat at Conway, for example, the metric system was used. Conversion tables giving the nearest equivalent in feet and tenths was then made for analytical purposes. In reporting the results of the research it was decided that **all** measurements would be expressed in metric equivalents for clarity. Formulas for these calculations were taken from Horton et al, 1973.

Nomenclature

The formal study of small flatboats, keelboats, and barges is still in its infancy in the Southeastern United States. One of the first formal research reports on the subject was given by the author at the Society of Historic Archaeology in Boston in 1985. One researcher, Mr. Michael Alford, began recording small craft in the 1960s, and another, Mr. Alan Saltus, was studying the craft in the Mississippi River region just prior to 1985. A research program was started after 1985 by Mr. Mark Wilde-Ramsing in North Carolina. A common problem observed by all these researchers is that of nomenclature for various structural members of these craft. Due to the traditional ship building orientation of most researchers, a tendency exists to use the terms of this tradition, "keelson" for the longitudinal timbers that are used to strengthen the bottom of cross planked craft, for example. In the

archival record this same timber has been called a "sill, reelson, stringer and footer." The word keelson is given to the timber which clamps floor timbers of a ship to the keel, and clearly the timber called a keelson in the following text only partially fulfills such a function in the craft under discussion. The question of a standard nomenclature is now being debated and will hopefully result in agreement in the near future. In the meantime, traditional ship terms are used. A glossary is provided as an appendix for those readers not familiar with these terms (Appendix C).

Results

Archival Data

General Context

The development of a local transportation system in support of export and import trading from North America to European markets forms a significant, if little researched, role in the growth and maintenance of the great trans-oceanic lifeline so important to the economies of England, its American Colonies, and the later independent American States. In the broad view, the trans-oceanic trades, which developed from the expansion of Dutch maritime trade prior to the late sixteenth century (Israel 1989:1-3), depended upon the creation of viable merchant fleets and the navies needed to both protect them and keep sea lanes open. It is equally true that this system would have had no purpose without the development of small inland and coastal small craft which connected coastal seaports with sources of products and markets for finished goods. Merchant vessels of 300 tons and above, and military vessels from Ships of the Line to small sloops, have been the subject of extensive study. This dissertation presents some examples of the wide range of vernacular local craft which were developed to transport raw products and import goods to and from North American coastal seaports. These largely ignored "inland fleets" played a vital role in the exploitation process of the Colonies, and later States, where riverine networks were a feature of the topography.

The study of wooden vessels as indicators of mankind's response to given environments, of the growth of technological invention and expertise, and of socio-economic growth is well advanced in many areas of the world. Various studies have documented the development of vessels from the major maritime traditions of Europe (McKee 1983, McGrail 1982 etc.), and North America (Chapelle 1951) to the vernacular traditions of other world areas such as Africa (O'Neil 1991), and Greece (Damianidis 1989).

Many of these studies focus on the functional design and working history of an area's various craft, as opposed to offering an overview of the process of introduction and refinement of various types of the craft, the relationship between their design, function, and environment, the ethnic origins of the builders and their socio-economic context. This is usually because these factors are obscured by many centuries of assimilation and evolution of tradition.

The span of South Carolina's maritime and waterway traditions, from 1670 to approximately 1870, followed by the rapid transition to rail, and later interstate road systems, was comparatively brief. As a result, vernacular inland craft developed from indigenous and foreign traditions were discovered to be easier to identify and locate in archaeological contexts. (Newell 1984:32).

The importance of various types of craft and of ship-building skills becomes apparent at a very early stage in the archival record of the area. Even before colonists gained a solid foothold in North America, "inducements" in the form of glowing accounts based on the observations of early explorers included mention of the need for ship builders and watercraft (Land 1969:14-15).

Quoting from Taylor, 1936, editor of the writings of Richard Hakluyt the Elder, we find in Land:

"Since great waste Wood be there, of Oake, Cedar, Pine, Wall-nuts, and sundry other sorts, many of our waste people may be employed in making Ships, Hoies, Busses and Boats..."(Land 1969:13).

"Sorts of Men Which Are to be Passed in This Voyage.... Shipwrights, to make barges and boats, and bigger vessels, if need be, to run along the coast and to pierce the great Bayes and Inlets," (Land 1969:14).

From this period, in the early seventeenth century, to the catastrophic end of its major transportation systems in 1865, the archival record contains many accounts which help toward the compilation of a list of watercraft types.

No formal archival study of the vernacular craft of the historic rice growing region of the east coast of North America has been before attempted. This is surprising in view of the once significant maritime tradition of the area, and the relative clarity with which it can be viewed. One major ethnic group, the English, settled and exploited the area. They, and their cultural heirs after the War for

Independence, dominated the settlement and development process, imposing their own considerable maritime traditions in terms of design and construction of small and large ships. To a much lesser extent, the traditions of smaller indigenous and European immigrant groups such as Indians, French Huguenots, and Germans, may have impacted these central traditions. Only one other group, West Africans, may claim to have had a major influence on the introduction and development of small craft design. Though without a large ocean-going vessel tradition, West Africans nevertheless had a well entrenched small craft tradition ranging from small dugouts to large riverine and coastal craft (Matthews 1966, Rodney 1970, Smith, R. 1970, Smith, J.F. 1985:62, and Vlach 1979). As a group, they enjoyed unusual latitude and freedom in traveling in small craft during the Colonial period (Weir 1983:188), and their rich watercraft traditions were still strong in the early twentieth century (Dabbs 1970 various photographs).

The early explorations and colonization attempts of the French and Spanish (South 1979) failed, in this author's opinion, in part for the lack of an "exploitation plan" based on the exploration and acquisition of territory using the boat and local waterways as the primary tools. These same tools later enabled the process of exploitation, facilitating the movement of natural products, and later export crops down waterways to coastal ports, and finally to foreign markets.

From 1670 to well into the nineteenth century, the locally built wooden boat was more than the prosaic means of transportation on South Carolina waterways,- it was as well the one tool, more than any other, that enabled the English to colonize this area of North America and develop it into the richest economic center of the Colonial and ante bellum periods (Richards 1859:722).

Barge Forms

The barge form craft documented in the study region to date by the author were built by two distinct methods; plank-on-frame construction and chine-girder construction. Plank-on-frame is somewhat similar to European ship construction in that planks are attached to internal supports such as keelsons, lodging, hanging, and standard knees and cross braces. The important difference is that these framing elements are not first assembled to create a form to which the planking is then attached as in most ship construction (ancient shell-first method excepted). It has been observed that these same framing elements assume less importance in many planked plantation barges of later periods (post 1860s) where structural strength is derived primarily from the planking itself.

The origin of the barge form in South Carolina does not appear to have been recorded. It is known that "flat bottomed pull boats" were in use in the Colonies as early as 1638 (Bunker 1979:6), but no similar record has come to light in South Carolina. As colonists expanded west and north from Charles Towne landing, and later Charleston late in the seventeenth century, they most probably used ship built craft based on European designs. The barge or flat would logically have come into use as demand increased for a type of craft to move raw materials and products to and from the developing plantation system and to connect the less well developed network of post roads on the lower coastal plain in the form of ferries where rivers had to be crossed. The factors generating the flat bottomed, wide beam and shallow draft design were doubtless numerous. Uppermost among them would have been the traditional responses of the Colonists to such a transportation problem, the designs operating in similar environments in Europe. The design also is one of two logical progressions of the practice of splitting a log canoe and inserting planks to achieve a wider beam, the other being the pirogue (see archival results section below). An earlier derivation is supposed to have been the lumber rafts fashioned by Colonists to steer lumber to coastal ports (Alford, Michael, personal communication 1991).

Wide beamed, flat bottomed, wedge ended craft would have been a logical design response to environments that called for heavy load bearing vessels operating in relatively calm waters where constant on and off loading had to be achieved with ease and efficiency.

By the close of the seventeenth century, the plantation system had become well established in South Carolina, primarily as a result of the success of upland rice cultivation (Doar 1936:51-53). There is no evidence to date that flat boats were part of the plantation craft by this time. There are indications that tidally irrigated rice fields were being introduced into South Carolina by 1720 (Carpenter 1973:15). By the 1730s widespread interest was developing in the lowlands cultivation of rice (Smith, H.A.M. 1988:59) with plantations irrigated and fertilized by tidally influenced river water flowing through an intricate canal system (Fig. 5). It was in this environment that the basic barge design was especially suitable, amply demonstrated by the large number of these craft still to be found submerged in the State's plantation canal systems (Newell 1986:2).

The earliest recorded barge in a plantation context dates to the late Colonial period. It is known that the upland method of rice cultivation began to lose popularity as a result of soil depletion in the mid-eighteenth century and lack of

water course control (Heywood 1937:14). Therefore it is reasonable to assume that these craft came into wide use during the latter half of the eighteenth century when river fed canal irrigation systems gained popularity. Archival accounts of the use of barges or flats date to the ante bellum period when rice plantations were reaching periods of greatest production. It is on these accounts that much of our current knowledge is based.

Archival research tells us that both plank-built and chine-girder barges were used on local plantations (Clifton 1978:90-91 and Doar 1936:34). This is confirmed by the remains of both plank and chine-log forms observed in the field. Practice varied as to whether these craft were made on the plantation, were purchased, or whether an off-plantation carpenter was called in to do the work (Linder 1993:8). According to Kemble (Scott 1984:62), two plantation carpenters skilled in the construction of vessels were allowed to build and sell craft in their leisure time, and a sale to a local planter is recorded. This may be a reflection of the ability of larger plantations to afford their own craftsmen as opposed to numerous smaller plantations which hired services ranging from coopers to millers (Newell, Mark, personal communication to Errante, James, 1990). Some plantations added ship-building to their income producing activities (Zierden et al 1985:34). While it is known from these archival accounts that slaves were the craftsmen producing these vessels, there is no direct evidence that these skills were imported with them. To the contrary, many white shipwrights in early colonial shipyards protested the training of slaves in ship-building skills as the practice threatened their livelihoods. Significantly, this practice expanded once shipwrights began to purchase and train their own slaves (Easterby 1954:541,547-550)

Barge designs continued to be used long after the decline of the rice plantation. Ferries continued in use to the present time, the last wooden ferry boat to be used at Brown's Ferry on the Black River was transferred to Cat Island, Georgetown County, for use there when the former ferry was replaced with a bridge. This ferry vessel sank and was abandoned at Cat Island in 1987.

Many plantations, undergoing the transitions documented by Prunty (Prunty 1955:459-491), were reconstituted into large land tracts early in the twentieth century after being parceled out as share-cropper tracts. These renewed plantations were used as duck hunting clubs by wealthy industrialists and others who found the abandoned rice fields ideal duck habitats. This necessitated the restoration and upkeep of the major river bank dikes. The new owners resorted to the same vessel found suitable for the purpose by the original planters, the flat.

Wooden hulled industrial barges also continued to be made after the demise of the plantation system. These large craft were used for a variety of purposes from carrying lumber to raw phosphate mined from coastal plain deposits. These were often made at upriver shipyards, such as the ones at Conway and Bucksport on the Waccamaw River which opened to meet increased demand for such large barges in the latter part of the nineteenth century (Newell 1992d:16).

Large construction projects such as the Pinopolis Dam in 1930 were responsible for the continued construction of some wooden industrial barges. These were used to float heavy equipment and fill materials around the construction site. In a significant change in traditional design, these huge barges were built with a vertical stern which was strengthened to withstand pushing forces from a tugboat. Smaller versions also were built to this same design. After the construction project was completed in 1936, these barges were used locally and then abandoned in area creeks away from main navigation routes (Newell 1986:35).

• *Ferry Craft*

The development, operation, and decline of South Carolina's ferry system is another major facet of early transportation in the State that offers a fertile field for further research. Little is known about the early years of the system, but it is reasonable to assume that as a system of postroads began to trace their way across the South Carolina lowlands soon after colonization, there would have been an early need for ferries. The subsequent growth of ferry locations, predictably enough, follows the expansion of agriculture and trade into the hinterland.

Possibly one of the earliest post roads in the State was the route from Charleston north to Georgetown which provided the only route to the northern colonies. Henry Mouzon's map of 1775 (Mouzon 1775) shows a total of fourteen ferries, many of them on this route. By the time the Robert Mills map of 1825 (Mills 1980) was drafted, this number had increased to 107.

That ferries existed in earlier times is amply indicated in the archival record. When founding the colony, the Lords Proprietors were well aware that there would be a widespread need for ferries. In 1687 they ordered:

"You are to consider a convenient place for a ferry *upon every navigable river*, and having pitched upon a place convenient to you are to order to be set out 1000 acres which whosoever takes up shall be obliged to keep a ferry for the ferrying over of men and horses at

such price as shall be agreed upon by the Grand Council..." (Salley 1920:152 Emphasis added).

Later ferries are indicated in newspaper accounts and advertisements which cite Hobcaw Ferry in 1735, a ferry on the Santee River in 1736 and another Santee Ferry in 1744 (Nylund 1989:58). Early ferries were often privately operated in addition to those authorized by the legislature. They were outlawed within a mile of a public ferry in 1744 when the legislature became more involved in the regulation of public ferries, setting licensing periods and establishing fees and road and ferry slip maintenance standards.

The condition of the roads and state of road transportation at the time made for short journeys after which passengers, horses, and equipment needed rest. This gave rise to the need for taverns at intervals of five to fifteen miles (McIver 1967:33). Ferries also were logical locations for these taverns giving rise to occupational and spatial patterns worthy of further investigation. The ferries were often operated by individuals who owned the adjacent land, or by ferry companies which owned both the ferry and two to three taverns along route either side of the ferry. This gave rise to complexes which typically included the ferry craft, ferry docks, a tavern, stables, and a plantation which served as the source of food and labour. In at least some cases, the company also operated the stage coaches which traveled between taverns (McIver 1967:34).

Congestion of traffic and long waits for ferry service appear to be normal, efficient service perhaps not being in the best interests of the ferry operators who also owned the local tavern. Whatever the reason, it was sometimes necessary to camp for several days, giving some indication as to the volume of traffic with which low country ferries had to contend.

In account by Nexsen B. Johnson, quoting historical notes by J.D. O'Bryan, we read:

"Murray's Ferry on the Santee River...was abandoned in 1863 when the Northeastern Railroad was built. The ferry had existed for one hundred and twenty-two years and was used constantly by wagons laden with commodities bound for Charleston. At one time on a hill just before entering the swamp and at the point where the road crossed Santee Road, there was tavern, a race track, and other buildings. When the water in Santee River was high, travelers

would sometimes have to camp a week or more before they could get across. The swamp here was about five miles wide and even in the best of times, travelers had to camp for days because the ferry was slow and the traffic jammed," (Johnson 1969:39).

The rights to operate a ferry and charge fees were granted by the South Carolina Legislature, usually for periods of seven, ten, to 14 years. Grants of rights were recorded in the Statutes at Large and so provide reliable dates of origination and ownership. The fee listing also provides an indication of the type of traffic considered typical.

The Statutes at Large granting rights to Richard Gallevan on the Little Pee Dee River at Elvise's Landing in 1795 states:

"...he [Gallevan] and they [heirs and assigns] are hereby entitled to demand and receive the following rates - for every wagon and team, or other four wheeled carriage, one dollar; for every chair and horse or other two wheeled carriage, fifty cents; for every man and horse, seven cents; for every head of cattle, hogs, or sheep ferried or swam, two cents," (Harrelson 1973:28).

When Joshua Barfield was given similar rights at Barfield's Mills Ferry for a crossing on his own plantation, the ferriage rights given were:

"...for every foot passenger, four cents; for every man and horse, seven cents; for every led horse, four cents; for every head of black cattle, two cents; for every head of hogs, sheep and goats, two cents; for every carriage upon two wheels, with rider or riders horse or horses in gears or harness, twenty five cents; for every carriage on four wheels, and the riders, and horses therewith, fifty cents; and for every hogshead of tobacco rolled, with the horses and driver, twenty five cents," (Benton 1973:25).

The temporal range of the South Carolina ferry was long indeed. Two early ferries of record are Strawberry Ferry on the Cooper River approved by Act of the Legislature in 1705, and an unnamed ferry on the Santee River in 1709 (Easterby 1954:27). The last ferry to operate in South Carolina was the South Island Ferry

which operated on cables across the Intra Coastal waterway in 1977. The same ferry craft utilized at South Island was previously used at Brown's Ferry prior to construction of a bridge in 1954.

Few archival records of the construction of ferry craft in South Carolina have yet to come to light. The flat was the single most suitable design for ferries and it appears that they may have been converted to ferry use in many instances. The South Carolina Gazette advertised for sale in September 1750..."a new large flat boat such as for a ferry..." at Pon Pon, on the Edisto River

An early reference to the construction of plank-built ferries appears well before the height of the chine-log era, in 1760. Issuing orders to his Director of Carpenters on July 21, 1760, at Oswego, New York, General Jeffrey Amherst writes:

"Thirty feet long by twelve feet wide, her waste (sic) to be two feet deep, the Bottom to be made of Timber hew'd five Inches thick and as broad as they'll work; the joints to be made close enough to be Caulked, about six floor timbers, Six Inches Square to be let into the bottom two Inches; the Sides to be made of Pine, if to be had, She must be flamed off, fore and aft, that Cattle may be easily got in and out, the Blocks on which she is built to be high enough to be Caulked underneath.

To John Skilling Director of Carpenters, at the Great Falls.

you are to proceed with the Six Carpenters whom I send with this to the Seneca River, and build a Scow there according to the above dimensions; Capt. Gray of Gage's Regiment will give you a Sergeant, & twelve men as a Guard and to Assist you. You will make all the Expedition you can in finishing this Scow, and You will Apply to Capt. Prevost at the Great Falls, for anything You may want and report anything extraordinary that may happen to him - These Carpenters to take seven days Provisions with them." (Amherst, General, Public Records Office, Amherst Papers 1757-1863).

Not all ferries documented in this study were of plank-built designs. Two, the Pee Dee Ferry Craft and the Potatoe Ferry Craft were constructed using chine-girders. Two more, the Trent River Craft and the Avant's Ferry Craft, also are chine-girder vessels assumed to have been used as ferries due to context.

The method of operation for the flat boat type of ferry appears to have changed little over the period of operation. The ferry slip provided a shallow gradient onto which the ferry could drop its apron or loading ramp to allow passenger and wheel vehicles access. Once on board the apron was raised and, in shallow and calm waters, the ferry flat was poled across the river. In deeper rivers, a rope stretched across the river. Provision was made for this to be raised and lowered to allow river traffic to pass the ferry. In operation, the rope was raised and the ferry crew would snag the line with a "ferry bat", a club shaped wooden tool with a notch in the head which would be used to gain a purchase on the rope (Gilmore 1879:46) (Fig. 6). The crew would then pull the ferry craft along the rope. A later modification to this process might have been the addition of stanchions to one side of the ferry in which pulley wheels were set. The rope would then be passed through the stanchions, firmly securing the craft to the rope, an advantage in areas of high current.

Gilmore's historic account of ferry bats was confirmed with the discovery by the author of a number of these tools in the Black River at Brown's Ferry in 1985. The use of the ferry bat evidently continued into modern times. During the 1985 investigation of the ferry site, a number of local residents came to the ferry to observe the activities, providing an opportunity for recording oral histories. After being shown one of the recovered ferry bats, Lamar Ferguson, a crewman on the ferry during the 1940s told the author:

"These were the tools we all used to carry the ferry across the river - if we dropped one over board it was easy to make another from a piece of hickory or live oak - nothing else would stand up to the work. We would carve them with an axe and a cutlass and make a heavy head on them to stand the wear from the rope. We'd cut a notch in the head and after a while the rope would wear it out smooth. When the ferry was ready to go, me and another man would go out to end of the ferry and hook on to the line with our bats. Then we would twist the bat real hard so it wouldn't slip on the line and then we'd begin to walk back to the bank - walkin' the

ferry along under our feet. When we got to the end we'd let go the rope and do the whole thing again. It'd take us 'bout four walks to get the ferry across and a few minutes in calm water. Took longer when the current was runnin' but it wasn't no never mind as we was younguns in those days and could do it all day long." (Ferguson, Lamar, transcript of author's recording of personal communication July, 1985).

Chine-Girder Barges

"Split Log," or what we now call "chine-girder" flats, may have been one of the most enduring, and intriguing water craft designs introduced into South Carolina for use as ferry craft and flats. The use of a single large log for the side and chine of a flat appears very early in European history, the practise apparently being abandoned in Medieval times long before it could have been exported to the North American colonies. Yet these craft appear in a multitude of subtle variations of design throughout South Carolina and Georgia.

These vessels were basically flat, rectangular platforms of shallow draft, and minimal freeboard, propelled by hand or tide, and designed to operate in the relatively calmer waters of South Carolina rivers, most often as ferries. The presently known archaeological record consists mostly of these same designs found in rice plantation contexts where the archival record shows they were used on large and small irrigation canals for a variety of purposes (Clifton 1978:82-83, Doar, 1936:34). Used concurrently with plank-built craft they were called barges, flats, and lighters. They were the major vessel type on South Carolina rice plantations and a classic example of the way in which function and environment dictated design.

The ancient European method of chine-girder construction may have been re-invented in Colonial America. Vessels of this type appear to have a single split log which serves as the two principal structural elements. The log, usually of extreme diameter and length, is split, and carved to form each side of the flat as described by Doar below. The base of the log is carved to include the "chine" of the vessel, the point where the hull shape changes from the bottom of the vessel to the side, hence the name "chine-girder."

The first known mention of historic craft converted from cypress logs is in 1702 (Lefler 1967:103), and the latest account dates to the nineteenth century (Doar 1936:45).

How and when the process of adaptation of the large cypress tree to chine-girder barge use was invented is not known. The cypress was already in use by aboriginals for dug-out construction by the burn and scrape method (Fig. 16 in Hulton 1984:118), and it can be hypothesized that the expanded dugout and chine-girder barge of the historic period were both African-European adaptations of these aboriginal craft (Vlach 1979:97). As early as the seventeenth century, Lawson describes the use of cypress for vessel construction (Lefler 1967:103). It seems more likely that this reference is to ship-hulled periaguas. The earliest rice plantations (Heywood 1937:8) utilized a method of reservoir irrigation. Even though these plantations used rice fields dug from lowland swamps, they may not have used canal systems large enough to accommodate flats. It can only be said with certainty that flats were utilized on river edge, tidally irrigated rice fields. The process of tidal irrigation may have been introduced late in the seventeenth century (Littlefield 1981:101) or early in the eighteenth century (Hetrick 1979:7), and certainly by 1737 (Smith, H.A.M. 1988a:37) and 1738 (Rogers 1970:332). The upland reservoir system, plagued by lack of water and depleted fertility, appears to have been abandoned in favour of tidal irrigation by mid-century. Tidal irrigation changed the hydraulic dynamics of the rice plantation and more intimately connected the operation with the nearby river (Doar 1936:8). This dependence may have naturally led to the adaptation of flats from ferries to rice canal use.

Doar's book (Doar 1936:34) gives the best description in print of the construction process for chine-girder flats:

"The carpenters went into the swamps, felled great cypresses, measuring 3 and 4 feet at the butts, split them open by boring augur holes the whole length, then hewed them into sides from 30 to 40 feet long with slanted ends, brought them home by water and constructed the huge flats or lighters for harvesting the rice and *smaller ones for ferrying hands across the river, for carrying seed rice, mud for breaks and other light work.*" (emphasis added).

The construction process took place upside down, the completed barge then being pushed into the water and tipped over (Doar, 1936:34):

"These flats were made bottom upward, so that the planks could be put on, and when finished they were pushed into the water and

turned over. To do this they had an ingenious method, which was to take the flat out to the river, carry it to a deep place, fasten one end to the bank, at right angles to it, anchor or tie the other end in the stream to another flat, then throw mud on one side the whole length until that side sank and the other rose. The force of the tide would then catch and whirl it over. It was then baled and flooring put in and the head and foot timbers.”

The resultant craft had solid wooden sides, pine cross planking fastened to rabbets in the side logs, keelsons, and thwarts and knees to provide additional structural integrity.

Doar's comment about the use of smaller flats for light work may be significant. The vessel examined at Conway is drastically narrower than any other plank or chine-girder built flat documented to date in South Carolina (Newell 1986:5). This is the first evidence for two significantly different sizes of this type of flat, a 1:9 side to length ratio compared to the common 1:3 ratio of other recorded flats. The Wachesaw and Richmond Hill Plantations, both in the general area of the original discovery, operated rice fields on Richmond Island on the opposite side of the Waccamaw river (Michie 1990:53). The smaller flats of the type described by Doar may well have been used in this area. Large chine-girder flats have been located in the river off both plantations.

Only one historic photograph of a chine-girder vessel has been found to date. The photograph is a copy of an original made on a glass plate negative (Hill, Mackie, personal communication 1991), indicating a date of origination of no earlier than 1848, when glass negatives were introduced (Williams 1970:53). It depicts a chine-girder barge in the main canal of Middleburg Plantation on the East Branch of the Cooper River. Significant features of this vessel include a built-up splash board, thole pins for side sweeps, and a large carved rowlock for the stern sweep (Fig. 7).

Plank-built Flats

The plank-built flat appears to have been constructed in South Carolina concurrently with the chine-log flat. It also appears to have been used on plantations which also built chine-log flats, although why both construction methods were employed at the same time is not known. It might be expected that plank-built barges would have been a later response to diminishing availability of large lumber sizes. The expansion of tidally irrigated plantations in the early to mid-eighteenth century increased the acreage of swampland cleared for rice cultivation, perhaps with a resultant increase in the availability of large swamp cypress. For this reason the norm of adaptation of smaller lumber sizes when forest depletion reduced availability of larger sizes did not occur. The reason we see chine-log methods employed alongside plank-built methods is not therefore readily apparent. Chine-log construction would have been more labour intensive than plank-built, but the method might have been more suited to the traditional West African skills of the slaves who built them (Doar 1936:97-107). Plank-built barges also tend to be smaller in overall length than chine-log craft. A plank barge built to the lengths observed in chine-logs would have required far more internal support framing to have the same strength, a possible reason for both why they have not been seen in these longer lengths, and why chine-girders are seen concurrently. Given a life of five to ten years, the barge at Friendfield documented below also is an indication that plank barges were in use at a time when chine-log flats also were being made.

Accounts of plank construction elsewhere in North America pre-date the use of chine-logs on nineteenth century rice plantations (see archival data on ferries above) further indicating that one design did not precede the other.

Records of a Savannah River plantation give an account of construction of a plank-built flat that reveals much about the skills of plantation carpenters and how the flats were used (Clifton 1978:82-83). In July 2, 1851 letter to his employer, Gowrie plantation overseer K. Washington Skinner writes to Charles Manigault:

"I have just seen...the new flat that Billy Cooper is building. Billy is now caulking & pitching the seams. I will launch her in a day or two, he has not put the Deck Boards on yet, nor the hatches. The Hatches are made. I write to you immediately to inform you that you had better not have the Deck & Hatches put on or fastened until after Harvest, as you may well know that it is a very slow work to

stow sheaf Rice under deck, through those hatches, & then the most difficult & retarding part comes when the gang unloads the flat, the rice is so much packed under deck, that pulling it out reduces it to straw...Finally the flat with the Deck will not carry near as much sheaf rice as it will open. The new flat is strong & the materials are pretty good - but the joints are roughly made. You will want to put two boards on each side of the whole length of the flat for the hands to walk on to push the flat."

The use of decking on flats was not common based on the evidence gathered, rather, they were left open, and boards were rested at the gunwhales and on centre cross braces or spalls (Fig. 8).

Flats constantly needed repair to keep them work worthy and water tight. They were usually repaired and re-caulked on an annual basis (Heywood 1937:16)

Not all this work was done on the plantation. This same source gives an equally revealing account of flat construction in a letter from Skinner to the Gowrie Plantation factor, Robert Habersham & Son in Savannah (Clifton, 1978:86-87).

"It is customary for plantation carpenters to repair and calk [sic] the Flats of each plantation, in general, but as I wished to get those two Flats of Mr. Chs Manigault's repaired and calked [sic] in a superior manner, I was induced to send them to you, and you had the kindness to employ Messrs. Papot & Jones to do the work, in a workmanlike manner, and of course, at a moderate price. They began the work by taking in hand the larger Flat, the dimensions of which are as follows, Viz.: -Length 45 feet, width 12 feet, Depth 4 ft. The two rakes were calked[sic] and payed and two pieces of Reelsons 6ft long 5x 5 were put in one of them, the two seams of each side making four altogether, the decks at each end 12 feet and the gangway (seams of which) were also calked[sic] and payed, which is all they did to her... The dimensions of the smaller Flat are:-Length 40 feet 8 inches, Width 9 feet 5 in., Depth 3 feet. Both rakes, and one seam on each side (making two) were calked[sic] and payed. One piece of timber pine 20 feet long and 10 inches wide was put on one side, in the other side two pieces of timber were put in one of which was 21 feet 5 inches long, and 8 inches wide, the

other and last piece was 11 feet long and 10 inches wide. The old & decayed pieces of each side were cut out and the above named pieces worked in, the seams of which were calked[sic] and payed. Two small rowe-locks, and two small oars were furnished to the smaller flat..."

Skinner wrote the letter to complain about the quality, and cost of the workmanship which he judged to be below the standards of the plantation. In so doing we learn that the plantation used large barges of at least two sizes with decked ends and random width planking.

The Civil War probably ended barge construction on South Carolina plantations, even though some attempted to operate after the freedom of the slave work force. Use of the design continued however in the form of ferry craft, two of which were documented at Brown's Ferry on the Black River for this study (see Field Data section below). These appear to have been built in the latter quarter of the nineteenth century.

Some of the last large wooden industrial barges to be built in the state came from the carpentry shops of the Santee-Cooper Public Service Authority. Charged with the task of creating a hydro-electric project in the Santee Basin, this organization built the Pinopolis Dam just above the head-waters of the Cooper River in 1930. A fleet of barges were built on the Cooper for the purpose of transporting fill and machinery for the dam. These ranged from small 6.7m (22ft) barges of simple construction to the large machinery carrying flats of over 12.2m (40ft). Both types were push barges with vertical transom sterns.

A revival of the "plantation barge" may have occurred at this time when the abandoned rice fields became popular duck-hunting preserves. This widespread adaptation of the plantations ensured continued survival of the dike system until well after the second World War. Upkeep of the dikes generated a new need for craft suited to this purpose. The planked-up flat was again the design of choice.

In the late 1940s such a flat, called a mud barge, was constructed on the banks of the abandoned rice mill canal at Mepkin Plantation, then a hunting preserve maintained by the Baruch family.

The recently completed Pinopolis Dam had greatly increased the water flow of the Cooper River (at the expense of the Santee River) with the result that sections of the main riverside dike of Mepkin Plantation had begun to erode. In response, Santee Cooper dispatched a team of its own carpenters to the plantation to build a

barge to carry new fill to the eroding dikes (Mr. Grant Tinker, Santee-Cooper Public Service Authority, personal communication, 1991).

One of the carpenters, Mr. Grover Sutherland, recounted the construction process to the author of this dissertation:

"We took a load of the biggest lumber we could get cut down to the old rice mill. The canal behind the mill had one of the old plantation rice barges sunk it. We pulled the old barge out and built the new one *almost exactly the same way*. After it was built we used it to repair the dikes around the plantation." (Newell 1983:4, emphasis added).

The barge was rediscovered in 1983 by Cistercian Monks who had acquired the plantation for the establishment of an abbey. Santee-Cooper Public Service Authority provided manpower and equipment for the recovery of the barge which was then recorded by the author for this study.

The "Mepkin Mud Barge" was probably the last barge built on the storied rice plantations of the Cooper River.

Canal Craft

The history of American canal craft begins in South Carolina. The first true North American canal, an artificial waterway connecting two bodies of water by raising and lowering purpose-built canal craft from one level to another, was built in the state between 1793 and 1800. Earlier canals, such as the Potowmack, were in fact navigational aids which enabled river craft to circumvent shoal areas and falls (Garrett 1987:716).

The development of the Santee Canal between the Santee and Cooper rivers in 1793 gave rise to the construction of several classes of craft designed specifically to operate on the canal. An extensive discussion of the history of the canal is presented by the author in Simmons and Newell 1989:9-31. In essence, South Carolina's post-Revolutionary War years were marked by efforts to recover from the economic depression that followed the years of conflict with the forces of England. A direct impact on the fortunes of the State was the damage and disruption caused to the Plantation system by the war. Plantations lost labour forces, animal stock and equipment (Orvin 1973:14). An indirect, but equally serious, impact was the loss

of British markets for the products the plantations produced, rice, naval stores, and indigo (Orvin 1973:147).

Leading figures in South Carolina society began to work for the revitalization of the plantation system. In 1785, the State's "delivery system" between major plantations and Charleston, the major port of the era, became a focus of this activity (South Carolina Gazette November 12, 1785). Prior to the War, South Carolina's burgeoning plantation system relied on natural waterways and a variety of water craft (Newell 1986:1) to deliver cargoes to Charleston and return imported supplies and finished goods.

The vessels designed to negotiate river systems were ill-designed to survive the ocean voyages from coastal estuaries to Charleston. The rivers themselves meandered over indirect routes which added to the time and expense involved in delivering a cargo to Charleston.

The Santee River and its upland tributaries were prime examples of this problem. The river provided a coastal route to Charleston for much of central upland South Carolina and waterways which even extended into North Carolina. In 1785 a group of entrepreneurs, merchants, and plantation owners met in Charleston to seek a legislative charter to incorporate the Santee Canal Company (Porcher 1970 Appendix).

Inland Navigation had been introduced into England by the Earl of Bridgewater in the 1760s (Rolt 1973:29-30), and by this time canal technology had been developed to a high level of sophistication. Efforts to import the technology into North America had been on-going for some time, Benjamin Franklin being a prime proponent (Ringwalt 1966:41-42).

The canal project being proposed by the Santee Canal Company was the single most ambitious effort of the era. The Santee Canal, by contrast to previous projects, was to be a true canal, 35.4km (22 mile)long, joining the Santee River to the headwaters of the Cooper River by a series of rises and falls connected by a five mile summit.

The stockholder make-up of the Canal company, bankers, planters, merchants, (Jaher 1982:350), and even early industrialists (Cowan 1987:6) supports the generally accepted view at the time that "great economic advantage" (Crowson 1971:7) would be gained from the operation of the canal.

The project followed the height of England's grand era of canals in the late eighteenth century and the artificial waterways were eagerly adopted by America.

Future economic growth depended heavily on reliable and cheap transportation systems. Early in the nineteenth century, canals were seen as the answer (Table 1).

Table 1: Load Comparisons Of Transportation Modes

Mode	Load (tons)
Average Pack-horse load	1/8
Stage wagon, soft road	5/8
Stage wagon, surfaced road	2
Barge on river	30
Barge on canal	50
Wagon on rails	8

Source: Rolt 1973:1

A contemporary of Santee Canal engineer Colonel Senf, Dr. Charles Drayton, made frequent visits to the canal construction project. On May 6, 1794, he wrote of the Santee canal boats... "Boats carry 18 tons or 720 bushels of corn, or 200 barrels of flour, or 35 h[ogsheads] of tobacco, navigated by one boy and 4 men. This is the same amount of work as 18 wagons, 36 men, and 90 horses." (Drayton 1794). Drayton would seem to be referring to the larger flats which were to travel the canal since his 18 ton figure concurs with the 120 cotton bale figure quoted in Table 2 below, given that the average cotton bale weighed 136kg (300lbs), (Crowson 1971:17).

While the Santee Canal may have been the first true canal started, and completed in North America, it was far from being alone. Other canals in Northern and Southern states were begun within a few short years of 1793. In South Carolina alone, ten more canal projects were constructed in the early years of the nineteenth century (Bennett 1988:87):

Table 2: Chronological Development of South Carolina's Canal System

1800	Santee Canal
1816	Winyah and Wando Canal
1821	Dreher's Canal and Saluda Canal
1823	Landsford Canal and Lockhart's Canal
1824	Lorick's Canal and the Columbia Canal
1825	Catawba Canal
1826	Wateree Canal
1830	The Rocky Mount Canal

Source: Bennett 1988: various pages

Development of these canals resulted in the construction of some of the first water craft in North America designed solely for the purpose of navigating canals. Many of these craft were built and owned by the canal companies, others were built by planters and merchants. Others still were riverine craft that had dimensions that

enabled them the pass through canal locks. An 1805 list of tolls (Table 3) for the Santee Canal gives an indication of the types of craft then using the waterway:

Table 3: Canal Vessel Capacities, Crews and Tolls

Vessel	Length ft	Beam ft	Draft in		Capacity Bales	Crew	Toll
			Empty	Loaded			
Canal Boat	56	9.5	24	36	80-120	5-6	20.00
Canal Boat (2)	56	8.5	12	24	80	4-5	18.00
Mountain Boat	56	7.5	8-10	18-24	70	3-4	14.00
Mountain(2)	56	6.5	8-10	14-17	50	3	10.00
Flat	54	9.5	8	24	70	5	30.00
Flat (2)	u/k	u/k	u/k	u/k	120-130	u/k	60.00*

*Given as \$35.00 in Crowson. Vessels over 70 bales were subject to a surcharge.

Sources: Kohn 1938:267, Crowson 1971:9, and Orvin 1973:152

The canal boats built by the Santee Canal Company were constructed at basins on the canal, most notably at the northern terminus of the canal where the engineer, Col. Christian Senf had established a small town and a plantation on which the brick making, carpentry and metal work for the project was completed.

The only known information on these canal boats is contained in a few archival references. Senf, in his 1787 proposal, gave dimensions of vessels to be used in the canal. He specifically refers to the construction of such vessels, clearly indicating that he meant purpose-built canal boats rather than existing small craft that would have suitable dimensions for passage through the locks.

Senf states that such vessels:

"...should have no more than fifty feet length, and be nine feet wide."

In 1789 he wrote:

"...boats admissible into the canal, be flat bottomed, nine feet beam,...and from fifty to fifty four feet in length on the top, to draw no more that two feet six or eight inches water," (Webber 1954:128).

Further information on the design of these canal boats is afforded by an 1824 newspaper account of an accident involving a vessel in the canal. The Charleston City Gazette of May 18, 1824, reports:

"A Canal Boat, belonging to Mr. Samuel S. Saylor, from this city bound to Columbia, with a valuable cargo of merchandise, was

blown up in the Santee Canal, near the plantation of Dr. Ravenel, on Friday last. The boat, and most of the cargo, including an elegant new pianoforte, were destroyed. The crew, which consisted of five Negro men, were all more or less injured by the explosion, some of them dangerously. From the statement of the patroon* , it appears that a carboy of ether, or vitriol, must have burst in the hold. On hearing the explosion, he opened a slide between the cabin and the hold and on putting in his lantern to discover the cause, fire was instantly communicated by the candle to the foul air. The crew hastened to get off the hatches, but while in the act of doing so, a quantity of gunpowder, which was below exploded, and literally blew the boat to pieces."

*(African-American captain, slave or freedman)

This is an excellent reference for the wealth of information it reveals about the canal boats, and their operation. Evidently the canal boat was decked craft with a cabin and hatches, similar to those in use at this same time in England.

Flats used in the canal were doubtless similar in basic construction to those used widely on the lower coastal plain and on rice plantation canals. The archaeological record has shown that barges of extremely narrow beam compared to length were used on these plantations, indicating that the special construction of narrow beam flats for canals may not have always been necessary (Newell, 1992e:135-147). Only one archival representation of a local canal barge has come to light, but the illustrations of vessels used on the contemporary Middlesex Canal in eastern Massachusetts (Clarke 1974 Figs. on pages 99, 105 and 110) may be regarded as typical of other types used in the state (Fig. 9).

From such illustrations it can be deduced that construction methods were much the same as those used on the larger plantation flats. Certainly by the late nineteenth century, construction methods for barges on the Augusta Canal were similar to those used the lower coastal plain for larger craft used in rivers for the then active phosphate mining industry. Carpenter's drawings for several types of these barges were found by the author in the Augusta City Engineer's office during the archival sources survey for this paper.

The Augusta Canal was built in 1845 to provide transportation and water power to the city's factories from upland regions of the Savannah River, considered within the regional scope of this study. Little is known about the early canal craft used on

this waterway. The drawings located in the City Engineer's files were drafted in 1897 and 1900 and depict several different types of craft. The 1897 drawing depicts "dredge and spill boats." The designs are reminiscent of the sturdy construction used in coastal phosphate barges with very thick planking timbers, cross bracing timbers and extensive use of threaded drift pins or bolts.

The dredge barge is 14.63m x 6.1m (48ft x 20ft), and features a sharply angled ramp, mooring bitts, and 0.10m (4in) thick transverse deck and bottom planking. Side planking was 0.15m (6in) thick. The internal framing reflects the load bearing required of the deck, 0.10m, 0.15m and 0.20m (4in, 6in, and 8in) framing pieces set transversely approximately every 1.52m (5ft) to support longitudinal deck beams of 6in thick lumber. A cockpit in the craft was provide to house a boiler to provide power to the dredge machinery.

The spill barge design features a shallower ramp angle, a 4.57m (15ft) beam and 14.63m (48ft) length. Deck and bottom transverse planking is 0.076m (3in) thick on 0.15m x 0.20m (6in x 8in) framing fastened by threaded bolts with inset nuts and washers. Internal framing pieces of 0.10m x 0.15m (4in x 6in) lumber were spaced approximately 3.04m (10ft) apart and were fastened to two angled cross braces which ran from the uppermost strake to the bottom of the centre framing piece.

The second drawing from this source (Fig. 10) is entitled "Plan of barges for Augusta Canal" and was drawn by Charles A. Maxwell and dated "Augusta (sic) 10th, 1900" (a still common dating error in the Augusta area). Despite the relatively modern age of the drawing, it depicts an elegantly designed craft with some features clearly borrowed from much earlier regional designs.

Overall dimensions are 3.81m x 18.28m x 1.21m (12ft 6in x 60ft x 4ft) deep. The stern and bow ramps are curved giving the craft a side profile much like that of a late eighteenth-early nineteenth century chine-girder flat. The curved profile is achieved with two internal framing pieces cut from 0.30m x 0.15m (12in x 6in) lumber which is scarphed into 0.20m x 0.15m (8in x 6in) stringers, each made of two pieces of lumber joined by 0.60m (2ft) shallow angled shiplap scarph joints. The bow and stern framing pieces are mortised and tenoned into 0.20m (8in) square header logs, also an early construction technique. The stern of the craft is equipped with a steering sweep which appears to have been directly borrowed from the Petersburg boats which operated on the upland Savannah River and the canal during the nineteenth century. The sweep is 6.75m (22ft 2in) long and is balanced on a metal plate and pivot assembly in the centre of the stern.

A unique feature of the craft is the side planking. Four strakes are used, the lowest of 0.15m (8in) and 0.25m (10in) lumber and each strake above being reduced in the sided dimension by one inch to achieve a garboard or upper strake of 0.12m x 0.25m (5in x 10in). Transverse deck and bottom planking was of 0.10m (4in) lumber, the deck being sheathed with 0.025m (1in) planking. Internal framing was of 0.10m x 0.15m (4in x 6in) cross braces inserted between framing pieces approximately 3.48m (10ft) apart.

The Santee Canal may have been the first North American canal on which specially constructed vessels made one way trips after which they were broken up for construction lumber. The practice doubtless started on regional rivers (Murphy and Saltus 1981:201, also Saltus, Allan, personal communication 1989) but until a study in 1989, no illustrations of these temporary craft had ever been identified. During archival searches for information on the Santee Canal, an illustration of "a Santee canal barge" was located in the archives of the Caroliniana Library at the University of South Carolina (Fig. 11).

The illustration is remarkable for the kind of craft it probably documents. Most barges of the period, certainly those documented to date in the State's waters, were constructed of a minimal number of planks. Typically, a barge used three to four planks to a side ranging in width from twelve to nine inches and thickness from two to three inches. Lengths were as long as could be obtained. The simple reason for as few planks as possible was to reduce the number of seams to be caulked, and the number of plank ends to be butt joined, the preferred method to scarphs. In this way a sturdy vessel could be built in a minimum of time and with as few weak points as possible. It was usual for butt joints to be made over the top of internal battens, or framing pieces, and for planks on the "flared" ends or ramps to be supported by sizable knees. Flooring planks were most typically laid athwart ship, transversely from side to side, with longitudinal stringers laid end to end internally to provide additional support and rigidity (Newell 1985:38).

This illustration shows something quite different. The vessel is constructed with a typical overall beam to length proportion of 1:4. If the assumption is made that the barge is ca. 2.74m (9ft) wide this gives a length of ca. 10.87m (36ft). These sizes are in keeping with regional trends. These are the only traditional features of the craft.

The major differences from local traditional are many. In terms of overall design, the vessel is flat ended and appears to have a sharper than normal bow/ramp angle. Flat ended barges did not become common until the advent of steam powered

boats designed to push barges or lighters. The earliest documented barge of this type in the region dates to the 1930s and was used on the construction of Pinopolis Dam (Newell 1986:44). The Santee Canal Barge illustration (Fig. 11) shows a stern cabin or dry area formed by what appears to be a canvass cover stretched over wooden laths, a technique noted on James River Bateaux (Terrell 1988:117).

The exterior planking shows six strakes above the water line and, judging from the angle of view of the interior, there are probably no more than two strakes below the water line. This would give narrow widths, possibly no more than 0.15-0.20m (6-8in). It is also clear from the view of the starboard side shown that the planks are not lapped or staggered in order to reduce weakness at the points where they butt. Instead the upper planks are more or less of even length, 3.65m (12ft). They all butt over the same two battens and are evenly bolted or nailed on each of the rest of the battens.

The interior view of the port side shows that the only internal supports are vertical battens which are butted against *transverse* stringers. This is a clear indication that the floor planking is longitudinal, another non-traditional feature. Based on the overall scale, the size of the battens is rather small for the craft.

The same size battens are used to support the bow planking. It is particularly significant that the corner supports in the bow and stern are of the same size as the rest of the battens and that they protrude above the level of the "sheerstrake" or topmost planks. This indicates that there is no corner bracing used, a standard technique for giving strength and rigidity to rectangular craft when an oversize knee is not used for this purpose.

The overall impression of the construction of the craft created by the details given in the illustration is one of a very flimsy and temporary vessel. The uniform planking lengths on the sides, the longitudinal planking on the floor and the uniformity of the interior supports enable construction with the least amount of damage to the raw wood used, while retaining the longest possible lengths.

The illustration thus lends support to the hypothesis that it shows an example of the type of craft that made one way voyages through the Santee Canal, and were broken up for lumber for resale upon arrival. There is a heavy dependency here on the supposed accuracy of the drawing. It should be noted that such illustrations were the only means of conveying visual information during this period, and that two diarists of the time, Andrew Gibbes and Charles Drayton, are known for the accuracy of their sketches. Thus, this contemporary illustration may well be a reasonably accurate representation of the original craft.

At least one type of craft is unique to the Santee Canal, and indeed North American canal lore in general. This was the Cotton Box (Fig. 12). This craft is seen in a contemporary illustration made ca. 1852 by William Gibbes and now in the possession of the Charleston Museum.

Gibbes' illustration is a faded pencil sketch, it has been enhanced and re-inked by an artist for reproduction in this paper. It shows a view of Black Oak Lock on the canal. In the foreground is shown a craft carrying a cargo of cotton bales. There would appear to be one or two rows of bales eight deep, presumably stacked on a similar first layer for a total capacity of anywhere from 16 to 32 bales. A bale of cotton was approximately 1.52m (5ft) long, making two rows of bales in a 2.89m (9.5ft) wide vessel a possibility. A capacity of 32 bales would be a more reasonable assumption based on the general cargo capacities discussed above.

The construction of the craft shows some interesting comparisons with our knowledge of conventionally built flats. Only two strake levels are shown above the water-line and these seem to be wide planks. It is unlikely that there would be more than one additional strake below the water line in the vessel in its fully loaded condition. Lapping or staggering of the planks is also clearly shown, the butt joints of each plank being centred on the plank above or below, a commonly observed local technique which increases side strength. The fore end of the vessel, facing the viewer, is shown as constructed of two planks with an exterior batten and two interior battens. A stern sweep is indicated at the aft end. The profile of the fore end of the craft also shows a distinct reduction in beam from the gunwhale to the water line.

Although showing considerably less detail than other illustrations, certain conclusions can be based on the information given, namely, that the craft is sturdily built and was therefore intended for re-use. The tapering of the profile of the craft is also intriguing. Porcher reports that it was common practice to "nest" one boat inside another so that they might make the return journey through the canal as one vessel, thus paying the toll for one passage instead of two (Porcher 1970:17). This practice was unique in the history of American canals according to pre-eminent American canal historian Dr. William Trout (Trout, William, personal communication 1989). Nested iron ore barges were proposed for use on one northern canal but the idea was never adopted. Canal boats, mountain boats and most flats and barges would have been unsuitable for such a purpose. The Cotton Box shown in Gibbes' illustration, with its tapered sides, would have been ideally designed for such a use.

Post-Civil War Industrial Barges

An interest in exploiting easily available sources of cheap fertilizer is to be expected in a State with an economy based on agrarian enterprises. Early sources were imported guano (Tatham 1800:23), imported lime, and local marl found in the lower coastal plain (Mappus 1935:4). By 1859, chemical analysis of rocks associated with the marl beds led to the discovery of high phosphate contents (Holmes, Francis 1870, and Mappus 1935:5). Analysis of guano at this same time led to the realization that phosphates were the principal chemical constituents of this fertilizer.

Large areas of the lower coastal plain proved to be rich in phosphate rock beds. After the Civil War, efforts began in earnest to exploit this resource with the expectation that a large export industry would result (Mappus 1935:6). This proved to be one of the last major industrial ventures (Fig. 13) of South Carolina from 1867 to 1938 (Malde 1959:1).

Many of the deposits that were mined were from areas of land between major coastal river systems. Significant amounts of phosphates also were recovered from these same river beds. By 1894 more than three million tons of phosphate rock had been mined from local rivers.

As in the past, the rivers provided the principal transportation route for the phosphate rock to Charleston where it was processed or transshipped to other destinations. Flats were particularly important to the marine mining operations. In the early years of the industry deposits of phosphate nodules in shallow creeks were hand-picked at low water and loaded into flat boats. Oyster tongs wielded from flats also were used in areas unexposed by the tides. In still deeper waters of six to ten feet, the African-American labour employed in the industry would free dive to recover nodules (Mappus 1935:29-30).

In an eye witness account of this activity published in 1880, C.U. Shepard, Jr., gives a particularly graphic description:

"It was an exciting spectacle some years since to witness *the hundred phosphate flats, moored closely together*, teaming with blacks - naked and vociferating, brandishing their tongs and poles, or swimming about in the surrounding water." (Shepard, C.U. Jr. 1880:63, emphasis added).

In depths of 3.65-6.1m (12 to 20ft), flats supporting dredges were used to access phosphate beds lying under several feet of mud and sand. The dredges emptied each load hauled from the bottom onto floating washing machines which separated nodules from the sand, shell, and mud. The cleaned material was then transported by flats to shore stations for further processing (Mappus 1935:30). A further indication as to the importance of flats to the industry is given in an inventory of marine mining companies compiled by Mappus (Mappus 1935:33): Farmer's Phosphate Company, 13 flats, Oak Point Mines, 40 flats, Jos. G. Seabrook Co., 25 flats, David Roberts Co., 30 flats.

The Carolina phosphate industry continued to expand during the late nineteenth century and by 1884 it was the largest and most important industry in the state, and the world's chief producer of phosphate rock. The boom did not last long. Operations of all companies had ceased by 1938. Most of the marine mining companies had failed much earlier and none were in operation by 1904. This was due to some extent to competition from other states. Of importance to this study is the fact that major damage was done to the marine mining companies by a disastrous hurricane which hit the South Carolina coast in 1893. The storm destroyed floating plants and flats of nearly all the companies in the industry and injured their operations "beyond the hope of recovery" (Mappus 1935:61). Many of the abandoned industrial flats of the coastal region may date to this event.

The Pon Pon Barge studied for the survey might therefore be expected to date from 1874 to 1904. A major land phosphate operation was the Pon Pon Mines on the east bank of the Edisto River near the town of Jacksonboro. The mine opened up a 6,000 acre tract in 1874 and was operated by C.B. Fishburne with mostly African American and imported Italian labour.

Mountain Boats

Upland or mountain boats were the product of the mountain regions of most of the eastern seaboard States. This craft was designed in direct response to cargo type and operating environment. Cargoes were heavy and bulky, 136kg (300lb) cotton bales and 363 kg (500lb) tobacco hogsheads, yet the rivers were narrow and swift. The resultant craft had an extreme beam to length ratio, a responsive steering system, and durable construction.

The basic mountain boat design appears common to other areas of Europe where similar operating environments existed. Design and function parallels are easily found in Fig. 14, Finland's "Stockholm tar boats" (Cederlund, Olof,

personal communication 1991, and Greenhill, 1988:153), and in the wine boats of Portugal's Douro River (Filgueras, 1988). Both types of vessel transport barrels down mountain rivers and utilized a long narrow length with a narrow beam and a large steering sweep (Fig. 15). Historian Howard Chapelle credits the form with a Medieval origin in Europe and particularly in France where the type was known as the bateau. He gives several examples used in Quebec which had a bearing on a later experimental project (Chapelle 1951:34). Chapelle believed the craft and its name were adopted by early colonists, and certainly by the French in Canada where the vessel type is known to have been in use from 1680 to well into the nineteenth century (Wheeler 1972: 285).

A similar craft of narrow beam and extreme length called a Durham boat was used in the American northeast (Fig. 16). The craft was in use prior to the Revolution and is mentioned in numerous sources as the type of vessel used to transport General Washington across the Potomac during the conflict (Ringwalt 1966:13-14). After the war the vessels were used extensively on the Mowhawk River, New York, to transport tobacco barrels. According to Ringwalt, the Durham boats were patterned after early eighteenth century ore boats used by mines on the upper Delaware River. As in the South, historians of these vessels note that to date no archaeological evidence of these vessels has been found. Ringwalt states:

"Durham boats, which are supposed by some writers to have suggested the type of boats known as keel-boats on the Ohio and other rivers, were first built about 1750 on the Delaware River bank by Robert Durham, the manager and engineer of the Durham Furnace, in the northern part of Bucks County, and the boat was made nearly in the shape of an Indian canoe. Pearce, in his *Annals of Luzerne*, says : 'Durham boats were 60 feet long, 8 feet wide, and 2 feet deep, and when laden with 19 tons drew 20 inches of water. The stern and bow were sharp, on which were erected small decks, while a running board extended the whole length of the boat on each side. They carried a mast with two sails, and were manned by a crew of five men, one steering, and four pushing forward with setting poles, two being on each side.' In the navigation of a number of eastern rivers, these boats were of much service, and they closely resembled the keel-boats used in western rivers." (Ringwalt 1966:13).

A similar type of craft also was developed on the James River in the late eighteenth century by two Virginia tobacco planters (Terrell 1988:47). Terrell's hypothesis is that the planters, Benjamin and Anthony Rucker, may have been influenced in their design by observing the performance of dugout canoes used earlier on this same river for tobacco transportation. They may also have seen French style bateaux in use in Ohio. Whatever the root of the design, the Ruckers evidently felt that the product was sufficiently unique to patent which they did sometime after 1771 (Trout 1989:2).

Archival records give some indication of the characteristics of the James River bateau. Several early descriptions of the craft on the James River give an indication of overall design:

"The boats...are from 48 to 54 feet long, but very narrow in proportion to their length..." (Weld 1969:210).

"...These (batteaus) are very light boats about 60 feet long and 4 or 5 feet wide..." (Carter 1977:92).

Terrell was fortunate enough to make preliminary measurements of the remains of a bateau discovered in 1983 during excavation of building foundations in the remains of the terminus of the James River Canal. He concluded that, when empty, the James river bateau drew about eight inches of water. When loaded, the vessel drew about 21 inches with a cargo of some 12 tons (Terrell 1988:51-52).

A large number of vessel remains were revealed by the work and only the most rudimentary salvage archaeology could be conducted in the absence of any state support. Terrell reports finding:

"An open, keelless vessel approximately 57 feet 8 inches long and 7 feet wide amidships. It was 1 foot 6 1/2 inches deep between frames #1 and #25. The two ends were virtually identical in structure."
(Terrell 1988:146-147).

Terrell also describes the use of two inch planking for the hull. A two inch king plank was used in place of a keel and appeared to be made of a denser wood than

the rest of the hull planking, possibly oak compared to pine. This type of lightly built vessel may have been illustrated in 1875 in King's *Southern States of North America*, reprinted in an American Canal Society pamphlet (Trout 1986 and Fig. 17), and may be more accurate of the type than Tatham's illustration of 1800. (Fig. 18).

More than one design variation appears to have evolved in the specific study area of this paper. Although "mountain boats" or "tobacco boats" are widely reported in the archival record in South Carolina, the only representations of such vessels are found on the Savannah River, forming the state line between South Carolina and Georgia. These craft were locally known as "Petersburg Boats" since they appear to have been first developed at Petersburg, above Augusta on the Savannah, for the tobacco trade.

Terrell suggests that the craft were the same type of design invented by the Ruckers of Virginia. That at least the Ruckers thought so is supported by advertisements they took out in Augusta newspapers advising planters that their agents would collect fees in the area for the use of the Rucker patent (Terrell 1988:58). Terrell also states that the Rucker, or Virginia, tobacco boat design also may have been brought to the area by two Virginia planters who relocated to Petersburg early in the nineteenth century. There is evidence to suggest that this may in fact have happened much earlier. More than two hundred families, led by Virginian soldiers who had served for Georgia during the Revolutionary War, received 200,000 acres of land from the Georgia Legislature in what was to become the Petersburg area (Gilmer 1855:8-10). By 1786, Dyonysius Oliver was given permission by the legislature to establish a tobacco warehouse at the confluence of the Broad and Savannah Rivers (Watkins 1800:325). Oliver named the area after his hometown in Virginia, Petersburg (Wood, V.S. 1986:281). The new town flourished and shipments of tobacco hogsheads were being sent down river well before the advent of the nineteenth century. A post office was established in Petersburg in 1795 and by 1801 there were two tobacco warehouses and the town was rivaling Augusta in its commercial success.

The available evidence for the Petersburg boats does not support Terrell's hypothesis. The characteristics of the craft given in a reliable account by a United States Army Corps of Engineers surveyor (Gilmore 1879:750-763) differs from descriptions given in Terrell's sources. A photograph of these vessels made on the Augusta Canal in 1875 also shows a different design from those of Virginia (Fig. 19). One contemporary print also identifies the Petersburg boats as "cotton boats"

(Fig. 20). Another print has been widely circulated and published as a representation of a Petersburg boat (Fig. 21). When compared to other representations, it is clear that the craft shown is not. Shown is a small pole boat on the Savannah River in an area (judging from the high bluff) below the city. There was extensive work for these small craft in this area as deeper draft vessels from down river could not cross the bar at Sandbar Ferry, some two miles below the town. The Petersburg boat design also appears to have evolved considerably from what may have been the Finnish original, being a more substantial craft.

The Corps of Engineers account occurs in the 1879 Report of the Chief of Engineers (Gilmore 1879) and is made by Mr. J.P. Carson during a survey of the Savannah River. During a survey of the upper reaches of the river above Augusta, Carson states that he secured the services of an experienced pilot and a boat with a crew of four African Americans. He started his survey from the Canal basin at Augusta where the 1875 photograph had been taken:

"The boat was what is called a Petersburg or fall boat, such as are employed in the trade of the river. They are usually 70 to 80 feet long, of uniform cross section for 50 feet; 6 feet wide on the bottom, which is flat, and 7 1/2 feet wide at gunwale; the bow and stern are rounded and pointed for about 10 or 12 feet, like a cigar and decked over. They are steered by a large oar at the stern, and propelled upstream by six boatmen, with heavy iron-pointed poles, 18 feet long, who walk backward and forward along the foot-planks on the bottom, with their shoulders pressed against the point of the pole. In the rapids they bend over, clutch the gunwale, foot-planks and timbers, gradually pulling themselves along, inch by inch, until the boat is through. Considerable skill is required to properly plant the poles so as to assist the steersman. Coming downstream a pair of oars is used in the slack water, and in the rapids light poles at the bow to fend off from the rocks at the given signal of the pilot; they descend with great velocity; every one is on the alert; any mistake will cause a 'hang' for several hours, and very frequently, a smash up. They travel up stream about 1 1/2 miles per hour, and down stream at the rate of 4 1/2 miles per hour, varying with the condition of the river. Empty, they draw 4 inches of water, and loaded up to 18 to 20 inches. The load up stream varies, according to the stage

of the water, from 6,000 to 20,000 pounds. The load down stream is from 30 to 50 bales of cotton, placed breaking joints, piled three tiers high, and projecting about 2 feet beyond the gunwale. The men cook and live on the boats," (Gilmore 1879:750).

Another account of Petersburg boats is given in Stokes' "*The Savannah*" (Stokes 1951). According to Stokes:

"The 'Petersburg boat' so called, was devised to meet the peculiar needs of the tobacco trade in the way of river transport. It was a permanent vessel [which] varied in size from 35 to 85 feet in length with a beam of 6 to 7 feet and a draft of 10 to 20 inches. A deck was built over each end, and a plank laid around the vessel inside gunwales provided a purchase for the polemen. They would move slowly from bow to stern to propel the boat upstream. On the downstream run no poling was necessary, only steering. Each boat usually carried a crew of seven or eight boatmen, both white and Negro. The Petersburg Boats were built at various points along the river, constructed of 1 1/2 inch longleaf pine. They were owned and operated by a number of people living in the river bank towns. At one time there were as many as thirty-five or forty on the river, going back and forth between the upriver towns on the Savannah and its tributaries down to Augusta." (Stokes 1951:196-197).

Author Ruby Rahn, using local newspaper sources, also described Petersburg boats as one of the types of poleboats operating on the Savannah in the early nineteenth century:

"Tobacco was brought into Petersburg from the outlying farms, to be taken down river to Augusta by boat. The boats had to be quite shallow to navigate the swift water and the rapids, and the men had to be very capable to manage them. They became known to the river folk as 'Petersburg boats'. They were ten to eighteen or twenty inches deep, around six feet wide, and usually very long, anywhere from twenty-five feet to as much as seventy-five or eighty feet long. Petersburg as a town only lasted a few years, as the competition

from Augusta was too great, but the boats kept the name for many years." (Rahn 1968:15).

There is evidence that the working range of these vessel extended well beyond the Petersburg to Augusta region of the Savannah River. Advertisements for sale of Petersburg boats in Savannah, Georgia indicate that the type did make down stream journeys for the entire length of the river. Tantalizing evidence of other similarly designed upriver craft types making this same journey is given in advertisements in the contemporary press:

"For Sale. A SMALL Augusta BOAT, about 60 feet long and 15 feet beam, painted red, and has lately undergone a thorough repair, with pump and poles complete--carries 20 to 30 cords of wood, and would make a good lighter. For further particulars apply to EPHRAIM COOPER." (Columbian Museum and Savannah Daily Gazette, 1817).

Additional information on the construction of these vessels may be provided by original construction drawings found by the author in the office of the City Engineer of Augusta, Georgia. The drawings, made by Charles Maxwell in April of 1900, are for a wedge ended barge with an unusual cross section for barges designed in this area and at this time (Fig. 22). Instead of the usual angled ramp typical of the area, the barge employs a curved ramp reminiscent of late eighteenth century Low Country flats. The curve is achieved by insertion of a large curved knee or brace scarphed into the stringers. A large steering sweep counterbalanced on a pin is also a feature of the design. Both of these elements may have been borrowed from the design of the Petersburg boats which provided early transportation on the canal.

The long life of the Petersburg boat, 1790 to 1920, also offered the possibility of living memory accounts as part of the historical background study. The best single account follows:

Historical Background Research: Selected Interview, February 20th, 1992 at Balchin's Grocery, Elberton, Elbert County, Georgia with Mr. Fleming "Buck" Balchin.

Mr. Buck Balchin has operated Balchin's store since his brother's death some years ago (1987). The store was originally operated by his father. Mr. Balchin was born in 1912. The purpose of the interview was to record Mr. Balchin's recollections of stories told by his grandfather, Mr. James Henry Balchin, concerning Petersburg boats. His grandfather died in 1944 at the age of 97 (This gives J.H.Balchin's birth date as 1847). "Balchin's Gro" as it is named, is a large, early twentieth century unpainted pine clapboard covered frame structure on the route from Washington, Georgia. to Elberton, Georgia. The building is approximately 15m by 23m (50ft x 75ft), and is unpartitioned. The interview took place around a coal stove in the center back section of the store (Fig. 23). Christine Newell, and James Calhoun were present during the interview. Mr. Balchin first inspected the design model of the Petersburg boat developed from the interviewer's drawing by Flectwood in Savannah. Author's comments are in parentheses.

“ I believe you've got the wrong boat there - my Grandfather used to say that he slept across the front of the boat and that makes me think it was square - like a ferry boat. He was the pilot of the boat, there was also a steersman and a crew of anywhere from eight to ten men. He went into the Confederate States Army when he was 16 and half years old -- his father went into the army at the same time -- it was the last call for soldiers and his father was 60 years old at that time (using the above date this would have been in 1863). They both survived the war. My grandfather was captured soon after he signed up and was sent to Fort Delaware for two and a half years. When he came back here after the war he found his family had moved from down near the river (confluence of the Broad and Savannah Rivers) to a place between the two rivers. My Grandfather became a pilot for the Petersburg Boats -- he did that until he was 45-50 years old (assuming an age of 19 after release from Fort Delaware, this would give a period of 26 to 31 years on the river). There was a time when he took Sidney Lanier down the river to Augusta. Lanier told my grandfather he wanted to be awake at dawn so that he could see the sun come up over the river. He woke him up on time and he sat on the front of the boat and watched the sun come up -- then he wrote a poem about it -- and gave it to my grandfather. That poem got lost when his house burned. There was

a time when the Corps of Engineers came up here and wanted to map Trotter Shoals. They asked around for any old boatmen and my grandfather helped the surveyor (this appears to have been J.P. Carson, the Corps of Engineers surveyor who charted the river in 1879, cited above).

“When the water in the river was real high, that would be called a ‘boatin’ river’ and the boats would make the journey down to Augusta in about one day. If the water was low the trip usually took about two days. They would take mostly cotton down river -- sometimes people. They would bring freight back up and people as well. My Dad carried a set of scales and people had to pay for their cargo by the weight (Fig.24). The trip back up would take three or four days. If the water was high they would get the boat close in to the bank and pull it up the river by hanging onto the tree limbs. If the water was low they would have to pole the boat up (Fig. 25). The crews of the boats were almost always blacks and there was only one time he ever had any trouble on the river. There was this time when he had stopped on the riverbank overnight on the way down to Augusta. One of the blacks in the crew was known to be a real mean man. My grandfather went out onto the bow of the boat and rolled out his bedroll and pretended to be asleep -- he was watching this man and saw him leave the fireside and pick up an axe and walk towards him. My grandfather had a pistol with him -- he always carried -- and he made up his mind that if this black stepped onto the gangplank he would shoot him. The man came up to the gangplank and stopped -- thought better of it I guess and turned and walked away. He never knew how close he came to gettin’ killed. I remember the very last black ever to work on the river with my grandfather, his name was Joe Isom, I-S-O-M. He was 17 when he worked with my grandfather -- he’s dead now but he has two sons who are still alive -- though they are in a nursing home now and can’t remember much. When they had to stop over night there was one place everybody liked to stop at called ‘money rock.’ It got that name because it was large and real flat. The men would gather around it at night to gamble and drink. Next day, when they boarded the boats and headed down river, the locals would rush to

be first at the rock and pick up the coins that the boatmen had dropped during the night. They say there wasn't a spot on the rock that didn't have someone's name or initials carved on it. They would also cook on the riverbank if they stopped overnight -- otherwise they would cook on the boat as it went down the river. They would have a small fireplace surrounded by metal to protect the cotton -- the fire was often real close to the cotton. The boats were usually 60-65 feet long and they would carry about 60 bales of cotton. I reckon the boats had to be wide because they loaded the cotton in two bales wide and a bale is about five - five and half feet long -- I guess the boats were about as wide as a ferry boat, 12 or 14 feet (archival sources indicated a width of not more than seven feet in order to navigate through Trotter Shoals which was only nine feet wide in places). They would build the boats right on the river bank -- had to be close in order to get the boat into the water. My grandfather helped to build several of the boats -- they were made out of pine. They had big lumber in those days and would just take a broad axe and a foot adze and carve them down for the big timbers and the planks. I don't know that they used any other wood in the boats. Each plantation on the river here would build its own boats -- there weren't families that just boated freight for the planters, each plantation handled its own. There was a time when my grandfather and a builder traded with a man to build a cotton boat and the deal was that the man wouldn't have to pay for the boat if it leaked. Well, they built the boat and they used some field hands to help caulk it. You had to be a pretty fair carpenter in those days because the boat was fitted real close to where it didn't leak. On this boat, they finished it and put it in the river -- and when they did some water splashed over the gunnel into it. The man that made the deal with them was laughing -- real pleased -- because he said he didn't have to pay for the boat on account it leaked. My grandfather and the builder made him get into the boat and bail the water out and then dry it up with a cloth -- then he could see that the boat didn't leak at all and he had to pay for it. They would run those boats on the river for as long as they possibly could -- usually until the boat broke up in the river. Then they would just gather up all the bales of cotton

and roll them out on the river bank to dry (this would imply that the principal abandonment process occurred on the river and that the potential for remains in the river channels is high).

"I remember one story my grandfather use to tell about two blacks who were gettin' cotton bales out of the river. One of them was a Reverend and didn't want to get wet so he stood on the bank reaching over with his hook tryin' to keep out of the water. The other black was in the river and he brought up a cotton bale and pushed it towards the Reverend. He waited until the Reverend had hooked the bale -- then he suddenly pulled his own hook out and the bale spun over in the water. The Reverend flew right over the bale into the river. The other man then said that seeing as how the Reverend was now in the river -- he might as well help him gather up the rest of the bales!"

Pirogues

The name of the type of craft is typical of the general problem faced by researchers developing information from early historic accounts of locally built vessels. Early records and recent accounts use a wide variety of spellings for the vessel type including pirogue, piragua, pettiaugua, perryauger, and others. There is some evidence to suggest that changes in name occur within specific historical periods. The significance for this, if any, has yet to be determined and is worthy of future research. The term "piroque" is used in this dissertation since the French took the term directly from the Carib Indians, one of the local sources of the design (Vlach 1979:98).

The vessel type appears to have originated from various dugout traditions and is defined by the use of planks to build up a dugout keel to create a vessel of much larger size and beam than can be achieved by planking up a conventionally shaped dugout canoe. The transition may have been a development of the multiple log canoe, a type which may have been regarded by many (even makers and owners in historic times) as a pirogue. An excellent example of the type is curated by the Charleston Museum, the plantation boat "Bessie" built in 1855 on the Ashley River from two cypress logs. The vessel is expertly crafted and appears to be modeled after a naval ship's boat.

Vlach cites a 1667 description of a pirogue:

"Pirogues appear to be nothing more than two great planks joined to a base (which is the hollowed log), and these boats have a width across the gunwales of 6 or 7 feet. Where the planks join at each end of the boat, the opening is closed up with pieces of plank. This is especially true with the stern, which is almost always slightly higher than the bow" (Vlach 1979:98).

Vlach also discusses the construction of pirogues in Guiana in the context of their ethnic origins, on which comment is reserved for later in this section. The construction method, as will be shown later, may be similar to that of the Carolinas:

"A large log is first hollowed out and then burned slightly to make the hull pliable. The log is then spread out and propped open with short branches until it hardens into a wider shape. Planks are then attached to the sides to increase the amount of freeboard by as much as three feet," (Vlach 1979:101).

At least one source describes the above type of construction as a "Periagua" as opposed to a "Pirogue" which is given simply as the West Indian name for a dugout canoe (Bloomster 1940:169).

The vessel type is also described as a craft in which the hollowed log is split longitudinally, and a third plank, or log, is fastened between them. The difference here may in fact only be a matter of observer viewpoint and nomenclature and may only be confirmed or denied by study of actual examples of the craft in the field.

An account of this sequence of construction is given by Larry Ivers in *The South Carolina Historical Magazine*:

"Piraguas...were square sterned and were longer, deeper and wider than a canoe. Its greater size was often achieved by sawing a very long dugout in half lengthwise, fixing a bottom plank between the two halves with treenails and staples to form a new bottom, closing the open bow and stern with fitted pieces of timber, and placing wide strakes atop the gunwhales" (Ivers 1972:117).

An artist's impression of the above craft is reproduced in this article by Ivers, (Fig. 26). Early explorer John Lawson also describes this method of manufacture in his 1709 account of the Carolinas. Describing cypress trees he writes:

"Of these great trees the Pereaugers and Canoes are scooped and made, which sort of vessels are chiefly to pass over the Rivers, Creek and Bays and to transport Goods and Lumber from one river to another. Some are so large, as to carry thirty Barrels, tho' of one entire Piece of Timber. Others, that are split down the Bottom, and a piece added thereto, will carry eighty, or an hundred. Several have gone out of our inlet on the Ocean to Virginia, laden with pork and other produce of the country," (Lefler 1967:103).

Coasting Schooners and Sloops

The introduction of sailing craft of traditional design and construction into the Carolinas has been covered in a number of excellent publications including William Fleetwood's *"Tidecraft"* (first edition of 1982), P.C. Coker's *"Charleston's Maritime Heritage 1679-1865"* (1987), and Harold Hahn's *"The Colonial Schooner 1763-1775"* (1981). Both the archaeological record examined by the author and the archival record on which the above works are based indicate a wide variety of small craft in use in the area from its earliest times to the mid-nineteenth century when sail craft were being supplanted by steam vessels and railways.

Many of these small riverine sailing craft had their design origins in the smaller craft of European environments such as ketches pinks, cutters, sloops, and pinnaces (Fleetwood 1982:21:23 and Coker 1987:46-45). The predominant types were the flat bottom coasting schooner and the coastal sloop, the latter doubtless in part being a response to the difficulties flat bottomed coasting schooners had in navigating open ocean distances (Gallatin 1968:26). These vessels, sized in the 20 to 50 ton range, were built purely for local riverine and short coastal travel.

During the early to mid-eighteenth century, an industry building larger ocean ships developed. These vessels had their design origins in the traditions of Europe and most particularly, England. They were often built for the export trade and were sold in Europe along with the cargoes they carried from the Carolinas. The history, and construction of these vessels is also covered in other publications, although a definitive work has yet to be produced. The 150 ton *Princess Carolina* was probably one of the earliest ocean going vessels built in the colony. Constructed in

1715 by Benjamin Austin (Coker 1987: 47), and eleven shipwrights she made her maiden voyage to England, most probably with a cargo of rice. While the burgeoning rice industry fueled construction of many of these types of hulls, the same colonial shipyards also were producing smaller hulls for local trade. Despite the size of the *Princess Carolina*, the majority of hulls during the early part of the eighteenth century appear to have been these smaller vessels ranging in size from six to 30 tons (Coker 1987:47-48) or 25 to 30 tons (Chapelle 1935:11), a trend that also was true for the rest of the American colonies. While it may be safely assumed that many of these vessels were modeled after popular European types, this cannot be determined as fact from the archival record. The Navigation Act of 1696 required that vessels in the Colonies be registered. The ignorance of many recorders, and the early tendency to describe ship type by hull form rather than rigging, resulted in a single vessel being listed as several different types during its lifetime. This variation in name may have had much to do with changes in rigging as well, brigantines being rigged as brigs and as schooners, for example. The rigging of these small craft must be deduced from general, rather than regional, sources, other than the few maritime views of South Carolina ports that still exist (Fig. 27). The Colonial schooner, important to the early riverine trade of South Carolina, supposedly originated from designs created in 1715 in Maine (Hahn 1981:14), and was certainly in use in the state by as early as 1733, if the dating of the "Brown's Ferry Vessel" by loosely associated artifacts is to be believed.

The demand for these smaller hulls was fueled by the expanding plantation system during the early years of the eighteenth century. Early exploitation of the colony through the Indian, fur and naval stores trades followed the river systems. The subsequent rise of the plantation system followed these same routes and the resulting export trade was almost entirely dependent upon the river system for transportation to coastal ports (See figures 3.13, 3.16 and 3.17 in Lewis 1984 54-61).

The different demands of the plantation system, ranging from rice culture craft and purely local transportation needs to the more substantial vessels for long distance riverine transportation, gave rise in large part to the diversity of craft which are discussed in this paper. While many of these vessels were not ship type hulls, the archaeological record shows that traditional ship hull techniques were in fact used for quite small local craft. The "Transom Boat" found in Biggin Creek is a probable example of the kind of sprit or lug sailed small craft that may have been widely used in small rivers and creeks (Newell 1989:47-49). Similarly, a small

fishing vessel studied by the author on the beach of Hunting Island in 1987 (Newell 1988:8) may be typical of the small decked coastal craft used in the nineteenth century (Fig. 28).

Of these craft some general statements can be made. The shell type of these craft is beamy and shallow, square ended, and usually flat bottomed with a skeg. Construction is plank on frame generally utilizing yellow pine for the carvel planking, live oak for major framing pieces with additional use of cypress. This local wood also seems to have been the wood of choice for treenails.

While most early craft appear to have been built at shipyards, the plantation system clearly developed an ability to produce small craft ranging from plantation barges to sloops (Zierden, et al 1985:34). The construction methods used by shipyards and plantations, judging from the archaeological record, were relatively crude during the early eighteenth century. General descriptions of the process of converting the Colony's rich stands of native timber into sawn planks and shaped knees and other structural timbers is given in Chappelle (1935:9) and Coker (1987:49-52). The local archaeological record shows that these methods became more sophisticated as the century progressed. A typical example would be the use of few "mould" or control frames in the construction of the ca. 1735 vessel recovered at Brown's Ferry on the Black River compared to the large number of pre-cut control frames used in the Biggin Creek and Mepkin Abbey vessels of approximately one hundred years later (see discussion below).

These vessels, called coasting schooners, appear to be the most popular, and durable, of the ship-built sailing craft produced by South Carolina shipyards and ship building plantations. The shell was designed to be lightly built yet shallow and beamy enough to maximize cargo capacity in an operating environment which included shallow rivers and coastal harbours with shallow bars at the entrances. The flat bottom of the early eighteenth century and the later shallow keels of nineteenth century vessels were all built parallel to the water-line to facilitate docking at plantation landings where the vessel would rest on the bottom during low tide.

There has been some discussion suggesting that the coasting schooner hull was derived from the pirogue form (Hocker, Fred, personal communication 1991a), the term or its derivations being applied to any vessel with this flat bottomed shape. Considering the single log origin of the pirogue hull, it is more likely that the pirogue was a separate and distinct type of hull which was built and operated concurrently with the flat planked coasting schooner hull. Clarification of this point

is not offered by the archival record in which recorders may, or may not, have accurately identified the two types of the vessels in their entries. This hypothesis can only be tested by the discovery of pirogue hulls in the same temporal contexts as coasting schooners where a comparison of construction techniques can be made.

Products and containers

The purpose of this section is to synthesize data from a variety of archival sources in order to provide an overview of one the primary factors driving vessel design and function in the study area.

This factor is container form. The principal products of the area during the Colonial and ante bellum periods were naval stores, rice, indigo, and cotton. The full range of products exported from the north American Colonies, including South Carolina, ranged from flaxseed to spermaceti candles. An excellent discussion on the quantities and modern equivalent weights and measures is given in Shepherd and Walton, 1972. The nature of these products, and the containers required to transport them, became factors which dictated certain elements of vessel design.

Naval stores and pelts were among the earliest recorded export products of South Carolina. There is little evidence within the state on how these items were shipped from their point of origin to local ports. Animal pelts were not packed in any special container for the journey from the frontier to the coast. Rather, they were stacked within open vessels in such a manner as to minimize damage from water (Dr. Suzanne Linder, Suzanne, personal communication 1992). Certainly by the nineteenth century, when large volumes of rosin and pitch were being shipped down rivers such as the Waccamaw, the barrel was the primary container (Newell 1992d:16). The early importance of coopers to the Colonists would suggest that this had always been the case. The size, dimensions, and capacity of these tar barrels (as opposed to rice barrels) does not appear to be recorded in local sources reviewed for this study. A general standard for the time is given in Falconer in a discussion on the effects of expansion of tar in barrels. Falconer states that the standard British Admiralty tar barrel of the time (1815) had a capacity of 154.56 litres (34 gallons) and that the circumference of this size barrel was 1.54m (60in) (Falconer 1970:531). A later, and more authoritative work (Kilby 1971:64), gives the capacity of an early twentieth century tar barrel as 120.47 litres (26.5 gallons).

Rice, South Carolina's richest and most enduring ante bellum export product, was shipped to port from producing plantations primarily in a large barrel called a "tierce." Although several different capacities are given for the tierce, the most

commonly mentioned is 272.155 kg (600lbs), Drayton 1802:124). The local dimensions of a tierce are not given in the records reviewed for this study. Kilby, describing a tierce as a standard provision cask for ships of the eighteenth and nineteenth centuries, gives dimensions of length 0.80m (31.5in), head diameter 0.52m (20.5in) and pitch diameter as 0.64m (25.5in). This would appear to be smaller than a 500-600lb barrel, however (Kilby 1971:52). If local dimensions differed from Kilby or not, they were apparently well known enough at the time to be used as a common measure of size for ships. Lawson, for example, describes early canoes as carrying thirty barrels and pirogues as capable of carrying eighty to one hundred barrels. Later advertisements of the period 1737-1742 in the *South Carolina Gazette* also indicate that barrels were a standard of measure for ships. Numerous advertisements for vessels for sale indicate size by barrel capacity as well as more standard conventions. Some typical statements taken from advertisements include:

Measurement:

"...Carries 120 barrels of pitch..."

"...large wood pettiauger...will carry 80 barrels of rice..."

"...Large Pettyauger for sale, 70 barrels..."

South Carolina Gazette, 1737-1742, Charleston Library Society

Date

Jan. 22, 1737

Sept. 10 1737

Feb. 27, 1742

There are indications that the tierce was not the sole method of transportation. An illustration on file at the South Caroliniana Library (Fig. 29) shows "sacks of rice" being loaded onto a schooner. Author Duncan Heywood describes rice as being shipped in 300lb (136kg) barrels, and 100lb (45.35kg) sacks. He also describes loose rice being loaded directly into the holds of the schooner *Sallie Bissell* by children with baskets (Heywood 1937:105, 218).

Indigo also was shipped in barrels of two sizes. A 1747 pamphlet, reprinted by H. Roy Merrens in 1977, states:

"...As there is so many customary allowances in tare, draft, etc., and charges on every cask needless here to mention, which is almost the same on a large or small cask, I can demonstrate that there is a real difference of £4 sterling on 2,000lb* of indigo, being sent for sale in four large, or in ten small casks, and therefore advise the sending none in casks smaller than a rice-barrel, the best size casks is to hold about 450lb to 500lb* of neat indigo; and, if larger, to be

the size of pipes or puncheons told hold from 700 to 800lb*..."
(Merrens 1977:150).

*(906kg), (205 to 226kg), (317 to 363kg)

An inset illustration on a map by Henry Mouzon (Mouzon 1775), shows the process of Indigo manufacture, the final product being bricks or cakes of dye being packed in a tierce-sized barrel (Copenhauer 1936 V 22:894 Fig. 30). An important diagnostic feature of the barrel would be the air holes drilled in the heads to facilitate drying during shipment (Leland 1976:13).

Tobacco was a later crop in South Carolina as upland regions of the state came under cultivation. The crop only achieved major prominence in the area late in the eighteenth century (Newell 1992d:15). It was being brought through the Santee Canal during the early years of the nineteenth century and the containers in which it was shipped were clearly a factor in vessel design as demonstrated by mountain boats.

The standard container for tobacco was the hogshead, a type of barrel known in Medieval times in Europe (Kilby 1971:135). According to Tatham's study of the American tobacco trade in 1800, the hogshead...

"...is regulated by law to the standard of four feet six inches, in length if my recollection is right, but the shape and bilge of the cask generally varies according to the fancy of the cooper..."(Tatham 1800:47-48).

Tatham notes that most plantations of any size had at least two coopers engaged in making hogsheads. *Leslie's Illustrated Magazine* (Hart 1977:65), published between 1855 and 1860 (Gambie 1964), shows a good example of scale in a mid nineteenth century view of a tobacco auction (Fig. 31). There had been several efforts to regulate the size of the tobacco hogshead by 1850, probably because the name was being given to barrels which ranged in weight from 300lbs to 1600lbs. The heaviest barrels appear to be the type pulled by horses along "rolling roads." These were roads surfaced with pine planking (Terrell 1988:80). In traditional English cooperage, the hogshead was a cask designed for wet storage. Its dimensions were length 0.95m (37.5:), head diameter 0.58m (23in) and pitch diameter 0.72m (28.5in) and its capacity is given as 245.5 litres (54 gallons) (Kilby

1971:61). The measurements varied slightly depending upon the type of fluid the cask was intended to contain.

Cotton was an early crop, grown on coastal regions of South Carolina during the eighteenth century (Merrens 1977:152 and Barbee 1866:334). This was sea island cotton or long staple cotton, a type from which the seed could be separated by hand or with simple roller gins (Rosengarten 1986:72). It was not until the development of Whitney's gin for separating seed from short staple cotton at the end of the eighteenth century that the product assumed major proportions (Jones and Dutcher 1890:387).

There was a major difference in the forms of cotton bales between the eighteenth and nineteenth centuries. This was due to improved methods for packing the ginned lint. The early type of bag is pictured in an illustration in Diderot's eighteenth century encyclopedia showing the process on a Caribbean plantation (Gillispie 1959, and Fig. 32). Jones and Dutcher give a description of the process on Georgia plantations:

"..the staple at that time [1828] being packed only in round bales. To make the bales, the planter would cut off a piece of bagging about ten feet long. The edges were then joined and sewed together, and one end sewed up. This made a bag ten feet long and from twenty-two to twenty-three inches wide. Into this the cotton was tightly packed and rammed. When full, the mouth of the bag was closed. At each of the four corners and ear, or lug, commonly filled with cotton seed, was made. This round bale ordinarily weighed 200 pounds*, sometimes running to 300lbs(*) (Jones and Dutcher, 1890:395).

*(90.7kg), (136kg)

Merrens, cited above, gives 200lbs as a standard weight in 1747. Later in the nineteenth century mule driven screw presses, followed by steam driven presses, enabled greater compacting of the lint into square bales. Early bales weighed approximately 300lbs, the later ones closer to 500lbs (227kg). The heavier bales were 0.137m (54in) long, 0.68m (27in) wide and 0.40m (16in) thick (Anonymous 1916:12).

Field Data

Ferry Craft:

Avant's Ferry

The Black River Peg Flat was located during a 1985 survey by the author of the Black River near Georgetown, South Carolina. The flat had initially been located by avocational divers and reported to the author in 1983. The craft was found in the vicinity of Avant's Ferry and, in this context, the vessel may have been a discarded ferry craft (Fig. 33). A ferry is believed to have operated at that location as early as 1785, (Nylund 1989:74). The Avant family name dates back to the earliest occupations of the Georgetown area (Nylund 1989:17). The earliest recorded ferry at this location dates to 1803 (Wildes 1982:26). Minimal data were recovered from the craft as it was capsized on the north side of the channel and was mostly buried in mud and silt. One side of the vessel, and a portion of the bottom, was partially visible. Some internal detail was recovered by partially entering a hole in the bottom. End details were recorded after hand excavation of a small portion of one end of the craft.

The craft proved to be a chine-girder flat. Overall dimensions were 14.63m (47.99ft) long by 4.16m (13.64ft) wide. Each chine-girder was 14.63m (47.99ft) long by 0.685m (26.96in) deep by 0.20m (7.87in) thick at its thickest point. The gunwhale of each chine-girder was carved down to a thickness of 0.10m (3.937in). The 0.20m (7.87in) shoulder at the base of the chine-girder was rabbeted to receive bottom thwart ship planking. The rabbet was 0.0762m (3in) deep and received 0.254m x 0.0762m (10in x 3in) wide planking.

The header log proved difficult to measure since it was notched into the chine-girders and was partially obscured by them and surrounding mud (Fig. 34). The upper edge of each chine-girder was notched to receive the upper 0.254m (10in) of the header log. The lower portion of the header was then notched the same distance to receive the ends of the chine-girders. Two treenails of 0.0254m (1in) diameter were driven through the forward edge of the header log into the notched chine-girders. An additional two treenails of the same size were then driven through the side of the chine-girders and into the end of the header log inside the craft.

Tool-marks were not evident on the exterior of the craft due to extensive erosion. Adze and broad axe marks were visible on the inboard sides of the chine-girders.

Some structural information was gathered from the internal centre section of the flat through the hole in its bottom planking. Internal support for the planking was provided by three large keelsons spaced 0.91m (35.82in) apart. The keelsons appeared to be made of live oak and measured 0.10m (3.93in) moulded by 0.20m (6in) sided (Fig. 34 section A-A).

It was not possible to obtain the length of the keelsons, either internally or through tracing the treenail pattern on the outside of the craft. One other significant feature recorded was the use of traditional ship-lap scarphs to secure sections of the keelsons together. Four treenails were used to join the tables of each section.

All of the bottom planking lengths were single timbers converted from heart pine. Each was fastened by two treenails at each end where the plank fitted the chine-girder rabbet. Two additional treenails fastened the plank to each keelson, a total of ten treenails for each plank.

Pee-Dee River Ferry Flat

The Pee Dee River Ferry Flat was documented by the author after being reported by Mr. Earl Dowdy in 1986 on the north bank of the Pee Dee near Catfish Landing. The remains of the vessel were eroded, separated, and mostly buried in firmly packed silt and gravel. One quarter of the craft was exposed and it was from this portion of the wreckage that observations were based.

The wreckage was of a chine-girder flat with a reverse adaptation of the carving methods commonly observed. Namely, the logs were carved with a planking rabbet on the upper edge or gunwhale in order to provide a flush deck (Fig. 35).

The cross section was then narrowed to a hard chine where the bottom planking was attached. The initial assumption that the vessel was capsized was dismissed when minor excavation of the chine-girder revealed the ramp profile.

The craft appeared to be lightly constructed, although precise measurement was not possible to due to erosion. The chine-girders were approximately 0.38m (14.96in) deep by 0.17m (6.69in) wide. The gunwhale was trimmed down to 0.05m (2in) and approximately 0.019m (0.75in) below the inboard edge was carved a 0.12m rabbet to receive a 0.019m (0.75in) plank. The 0.17m (6.69in) shoulder for the rabbet was then carved down to a 0.05m (2in) thickness at the base of the log. Remains of bottom planking were found attached to this base.

Thwart ship pine planking was used for the upper flush deck and the bottom planking. The planks were 0.019m (0.75in) thick by 0.103m (4.05in) wide. Each plank end was fastened into the chine-girder rabbet with two 0.038m (1.5in)

treenails. Two large keelsons, 0.15m (5.9in) moulded by 0.1m (2.54in) sided and 0.17m (6.69in) apart, were located at the approximate centre of the craft, giving a possible beam of 2.74 - 3.04m (9-10ft) (Fig. 35 section A-A).

The ramp ends of the chine-girders were carved to form a 0.05 x 0.05m projection notched above and below to receive two 0.19cm (0.75in) planks instead of a header log. Total length of the assemblage was impossible to determined due to the overburden. The minimal data recovered were sufficient to develop the tentative reconstruction given as Fig. 36.

Potatoe Ferry Chine-girder Flat

The ferry at Potatoe Landing on the Black River in Georgetown County is known to have been in operation by 1775 (Hunley, Ruth, personal communication 1989). Wreckage of what appears to be an early ferry craft was located by the author downstream of the present landing ramp in July of 1989. The wreckage was first reported to the author by diver Kevin Rooney (Rooney, Kevin, personal communication 1989). Approximately one quarter of the vessel was visible, the rest being buried under coarse gravel and tree limbs. A chine-girder craft, the vessel exhibited a curved bow and stern profile similar to the Conway and Trent River chine-girder craft below.

The vessel was constructed from a log 0.18m (7.08in) wide by 0.24m (9.44in) deep. At the gunwhale the log was thinned down to a width of 0.15m (5.90in). The inboard base of the log formed a 0.10m (2.54in) high shoulder into which a rabbet was cut to receive the thwart ship planking (Fig. 37).

One side of the craft was deeply buried in silt. A visible beam of 2.24m (7.34ft) was measured. This portion of the vessel exhibited two keelsons, each 0.28m (11in) sided by 0.10m (2.54in) moulded (Fig. 37 section A-A).

One of the keelsons exhibited a rider keelson treenailed to its upper side and shaped to terminate at a point where the lower keelsons was scarphed. The scarph was a traditional ship-lap fastened with four treenails.

Considerable damage and erosion had occurred to the wreckage and it was not possible to determine if the second keelson had also once had a rider.

The thwart ship planking had typical widths of 0.28m (11in) and a thickness of 0.05m(2in). Each plank end had been fastened into the rabbet by two offset treenails approximately 0.035m (1.32in) in diameter.

Brown's Ferry Craft No. 1

Brown's Ferry on the Black River, Georgetown County, South Carolina, was first known as North's Ferry and has been in operation since at least 1785 (Nylund 1989:74) The site is known for the recovery in 1976 of a 1733 era vessel from the river bottom below the ferry ramp (Albright and Steffy 1979:24). The author first visited the area in 1983. Periodic re-visits were made culminating in extensive documentation in August of 1984. Two plank-built ferries had been discarded at this same location. They were located in close proximity to each other on the downstream side of the ferry crossing in a pattern that proved typical of other ferries in the state (Fig. 38).

Diagnostic artifacts recovered from the site dated to the mid-eighteenth century. Interestingly, many of these artifacts were recovered from eroded ledges above the site of the three vessels at this location, the third being the coasting schooner called "The Brown's Ferry Vessel" and dated by its first investigator to ca 1733 by virtue of artifacts found within the hull.

Ferry Craft No 1. was 12.5m (41ft) long by 4.26m (14ft) wide by 0.68m (26.77in) deep and was constructed as a basic flat with two strakes to each side and thwart ship bottom planks. The sides were constructed of 0.05 x 0.30m (2in x 12in) planks. The top strake, which was typical, consisted of three planks scarphed together with a ship-lap scarph joint with a 0.60m (23.62in) long table (Fig. 39). The longest single plank used in side construction was 6.55m (21.48ft) long.

The bottom planking of the craft was of a uniform 0.07m (2.75in) thickness but ranged in widths from 0.61m (2ft) to 0.22m (8.66in). The bottom planks were edge nailed to the lower side strake and to each of six internal stringers or keelsons. The internal keelsons were 0.07m (2.75in) thick planks, each set on edge. Four separate timber lengths were used to create the stringers, the joins being lapped to provide strength. The longest single length used was 6.55m (21.48ft).

Each gunwhale strake was notched to receive a 0.15m x 0.18m (5.90in x 7.08in) header log across each end of the craft. Two planks, the uppermost 0.05m x 0.18m (2in x 7.08) and the lower 0.05m x 0.15m (2in x 5.90in), were nailed over each header log to complete the ends of the ferry. Although ceiling planks were used on the craft, there were none present and there was no evidence of fastening patterns on the upper sided edge of the stringers.

Two stanchions were fastened to one side of the ferry. Two smaller ones of 0.09m x 0.09m (3.54in x 3.54in) cross section were fastened to the inboard sides of the strakes with through bolts which were washered and peened. Bolts or drifts

used throughout the construction were 0.019cm (0.75in) in diameter. Each was positioned at the join between the ramp and the floor of the craft. Behind these, positioned 1.67m (5.48ft) from each end of the craft were 0.91m (38.18in) high stanchions in which were mounted pulley blocks. A line of rope, usually hemp, passed through the blocks to each bank of the crossing.

Brown's Ferry Craft No. 2

The second ferry at this site was abandoned in close proximity to the first. It was positioned approximately 1m from Ferry No.1 and located further out in the river where strong tidally influenced currents had caused considerable erosion and separation of components of the craft.

Its dimensions were generally similar to those of the first craft, 13.41m (44ft) overall length, 3.665m (12ft) wide and 0.58m (22.83in) deep. Side planking was of 0.26m x 0.05m (10.23in x 2in)lumber, two strakes being used per side. The longest single plank used in either side was 6.70m (22ft). Unlike Ferry No. 1, planks on this craft were joined with a simpler diagonal scarf as opposed to a shiplap (Fig. 40). Each scarf was joined with three drift pins which were washered and peened. A 0.26m x 0.03m (10.23in x 1.18in) plank was fastened to the inboard side of one side of the ferry. On the opposite side the planking was strengthened by the addition of another 0.26m x 0.05m (10.23in x 2in) length of planking, in addition to the 0.26m x 0.03m planking. It was on this side of the craft that the rope pulley stanchions were attached. As with Ferry No.1, the craft was drawn across the river by ropes passing through stanchions on one side and 1.52m (5ft) from the ends of the vessel.

The bottom construction also was of athwart ship planking, with plank widths ranging from 0.23m to 0.42m. The planks were edge nailed to the side strakes and also to a series of four internal stringers or keelsons. The stringers were a uniform 0.26m moulded by 0.09 sided (10.23in x 3.54in).

"Ferry Bats"

Both ferry craft were heavily silted and airlifting equipment was used to remove overburden prior to recording. During this operation, five "ferry bats" were recovered from locations in and around the vessels. The random scatter indicated the probable loss of the bats from other craft operating above the wreckage. A typical bat measured 0.78m (30.70in) long and had been carved into a mallet shape from a section of wood 0.10m - 0.12m (3.97 - 4.72in) in diameter (Fig. 41). A

0.30m (11.81in) long section of the original lumber was retained, the rest being shaved down to a convenient handle approximately 0.05m (2in) in diameter. The thicker section of the bat was then cut across the head to provide a slot large enough to fit over the ferry rope stretched across the river.

Plantation Flat Boats:

The Conway Narrow Flat

This craft was discovered barely afloat in the Waccamaw river near Georgetown, South Carolina. near the confluence of Bull Creek, an area surrounded by abandoned rice fields. The vessel was recovered by the Horry County Museum and deposited in a freshwater pond near Conway, SC. By the time the vessel was documented a year later by the author, part of the bank of the pond had collapsed onto the vessel. It was cleared with a water jet after which the craft was found to be partially buoyant. Data were recovered in approximately 1m of water. It was not possible to examine the exterior of the hull beneath the craft.

Preliminary study of the flat showed that it was in a severely deteriorated condition with bottom planks, gunwhale strakes, header board missing from the most complete end. The other end of the barge was missing completely. The overall measurements of the barge were 7.9m (25.91ft) of remaining length with a beam of 1.26m (4.13ft). Widths of planking ranged from 0.22m to 0.18m (8.66 to 7in) with a uniform thickness of 0.025m (1in). Average treenail diameter was 0.03m (1.18in).

The principal structural strength of the barge was derived from two carved chine-girders 0.39m (15.35in) deep by 0.145m (5.7in) thick. Each chine-girder was reduced in depth at the end in a curving reduction to a point 0.14m (5.51in) from the end of the timber where a 0.08m (3.14in) rabbet was inset to receive a header plank (Fig. 42).

The gunwhale of the chine-girder was carved down to a thickness of 0.04m (1.57) for a depth of 0.24m (9.44in) where it flared out to its full thickness. The base of the chine-girder was then carved for the chine and a rabbet 0.105m (4.13in) wide and 0.025m (1in) deep was carved into the inboard side (Fig. 42 section A-A).

The gunwhale also showed evidence of 0.03m (1.18in) treenail holes in its top face at 0.1m, 0.72m, 0.98m, 2.16m, 2.33m and 3m (3.97in, 28.34in, 7ft, 7.64ft and 9.84ft) from the end (Fig. 43). The upper side of the carved shoulder at the base of the chine-girder exhibited a series of treenails located at 0.17m, 0.3m,

0.42m, 0.56m, 0.82m and 0.98m (6.69in, 11.81in, 16.14in, 22.39in, 32.28in and 38.58in) from the end of the log.

The 0.39m (15.35in) maximum depth of the chine-girder was achieved at 2.2m (7.21ft) from the end of the log and continued for a distance of 4.70m (15.41ft) before reduction in depth occurred for the opposite end of the craft. The breaking point at which this end of the craft separated was at 7.9m (25.91ft). Enough curvature of the chine-girder at this end was recorded to enable reliable reconstruction of the curve.

The pine planking for the craft was laid athwart ship between each chine-girder, being fastened into the rabbet on the underside of the shoulder with treenails. A large thwart was fastened to the floor of the craft at 2.24m (7.34ft) from the end, and measured 0.975m long by 0.255 sided, 0.07m moulded (38.38in x 10in x 2.75in). Two knees were attached to the centre of this thwart at either end and were attached to the thwart and the chine-girder by four treenails and two small wrought iron nails. The knees extended above the top edge of the chine-girder by 0.09m (3.54in).

A large cypress keelson was set into the centre of the flat and fastened to the thwart with three treenails. The keelson, which was found to be intact for its entire length measured 4.53m (14.86ft) long, an average of 0.305m (12in) sided and 0.10m (3.97in) moulded. The ends of the keelson were shaved down at each end to a height of 0.07m (2.75in) to meet the top of the thwarts. A 0.04m deep by 0.11m wide (1.57in x 4.33in) rabbet was cut into the end of the keelson to accommodate a portion of the thwart (Fig. 44).

None of the treenails examined appeared to be wedged and the only use of additional fastenings appeared to be the nails used to hold the toe of each knee to the thwart. The treenail pattern was recorded at two locations on the keelson, the end fastened to the remaining thwart and at approximately 3.6m (11.81ft) from this point. At the forward end attached to the thwart, the pattern was staggered, the first treenail 0.105m (4.13in) from the "port" edge of the keelson, the next 0.205m (8.07in) from the edge. An average distance of 0.13m (5.11in) separated each treenail. This pattern would have allowed an edge clearance of 0.045 (1.77in) on a 0.22m (8.66in) bottom plank and 0.025 (0.98in) on a 0.18m (7.08in) bottom plank. Individual planks could not be measured for width beneath the keelson to confirm this due to time constraints. In an interesting departure from the fastening pattern established at the beginning of the keelson, treenails at the 3.6m (11.81ft) point were drilled through the port edge in a straight line approximately 0.25m

(9.84in) apart. Only one treenail was positioned on the "starboard" side of the keelson (Fig. 45).

The Laurel Hill Flat

The Waccamaw River, running south through Horry and Georgetown counties into Winyah Bay, became the site of some of South Carolina's earliest, and most extensive tidally irrigated rice plantations (Smith, H.A.M. 1988a:36). In 1990, an area of this river became the focus of investigations by local sport divers following completion of "Certified Archaeological Diver" courses given by the author.

They were led by Hampton Shuping, discoverer of the coasting vessel wreck at Brown's Ferry. Surveying the river off Wachesaw, Laurel Hill, and Richmond Hill areas, the divers found four complete barges, three fragmentary barge wrecks and the remains of a dock system (Harris 1992:1). Diving a few yards south of the area in 1983, the author had discovered the remains of what is thought to be a pirogue. This wreckage could not be located and confirmed as a pirogue for recording on a return to the area in 1986. The concentration of craft is the most extensive of any found to date in association with plantation river fronts in South Carolina, bearing in mind that an extensive preliminary survey of such an area has not been conducted before in the State (Fig. 46).

One of these barges, off Laurel Hill and designated "Barge No.2," is of particular interest to this study. The vessel has design characteristics which closely match the chine-girder barge documented at Conway, South Carolina, along with other features which may offer the first indications of temporally diagnostic fastening techniques. As a result of a review of Mr. Hampton Shuping's findings, the author surveyed the vessel a second time for the purposes of this study. The barge is 17.1m long and has a 4.74m beam and a maximum depth of 0.88m (56.1ft x 15.55ft x 34.64in) (Fig. 47). The side construction is formed of curving chine-girders with a maximum depth of 0.57m (22.44in). An additional strake ranging in depth from 0.2m - 0.33m (7.87in - 12.99in) is fastened above the chine-girder with framing pieces, corner lodging knees and standard knees on a central thwart (Fig. 48).

This assembly method closely matches the existing and reconstructed assembly of the smaller Conway barge. This barge also was recovered from the Waccamaw River. Although the locations differ by a distance of several miles, the similarity in design is the first time this has been documented to this extent.

Of particular interest are the fastening methods used on the header log for the attachment of the sheerstrakes and the keelsons. Four keelsons are used in the floor of the vessel, each approximately 0.26m sided and 0.12m moulded (10.23in x 4.72in). In the case of both the sheerstrakes and the keelsons, a tenon is let into a mortise in the header or transom log and is then through fastened with a treenail. This is the same fastening technique observed in structures on the Santee Canal locks constructed in 1793-1800 (Newell 1989:34) and is described as a typical colonial period technique by a number of sources, Sloane 1964, for example.

The stern of this vessel is indicated by the two holes drilled in the header log. This indicates the former location of thole pins or a rowlock for the stern sweep. An interesting feature of the bow end is the presence of planking attached to the top of sheerstrake, possibly walking planks for poling the craft.

Friendfield Plank-built Flat

The Friendfield Plank-built Flat was located in the former Friendfield Plantation, a tract of land sold from the original Hobcaw Barony dating to the eighteenth century (Smith, H.A.M. 1988b:91). The plantation barely survived the Civil War and was abandoned in 1872 (Porcher, Richard, personal communication 1986). This gave a reasonable terminus post quem for the vessel. The vessel was found by the author in a silted canal adjacent to a ruined rice mill (Fig. 49). Prior to examination of the vessel, data were gathered on the construction of wooden retaining walls of the canal's north and east banks adjacent to the mill.

Recording was hindered by overburden on the craft, a dense black mud interspersed with layers of branches and vegetal detritus. Attempts to excavate portions of the craft were made difficult by the semi-liquid overburden (Fig. 50). Underneath the top 0.30m (11.81in) of liquid mud were layers of dried mud, reaching a consistency of dry hard soil at 1m (39.37in).

The flat lay in a NE-SW orientation in the bottom of the canal in ca. 1m of mud with gunwhales partially exposed in some areas, and covered by another 0.10m of mud in other areas. The bow had decomposed, the header log having separated, and most of the upper bow planking was missing. Overall measurements were taken after which as much as possible of the stern end was excavated. Additional preliminary measurements were taken by probing in the mud and retrieving measurements from the probe.

Overall measurements of the flat were 15.66m long by 4.8m wide, by 0.91m deep (51.37ft x 15.75ft x 35.82in) (Fig. 51). The stern area, determined by nail

patterns which fastened a missing rowlock to the header log, derived lateral strength from a square header log 0.18m wide by 0.20m deep by 4.8m long (7.08in x 7.87in x 15.74ft). Internal support for the stern was provided by five knees each 0.127m sided by 0.18m moulded by ca. 3.0m long (49.99in x 7.08in x 9.84ft).

The outermost knees were not attached to the side planking and no chine keelson could be located in the mud between the knee and the outer planking a space of 0.18m (7.08in).

Typical planking widths were 0.356m (14in); typical thickness was 0.063m (2.48in). The thwart ship bottom planks were fastened by wrought nails to the knees and keelsons or stringers. The side planks were fastened by iron drift pins 0.045m (1.77in) in diameter which penetrated all three strakes and were peened over a 0.05m (0.19in) metal washer at the gunwhale. This same technique and construction material, edge driven, peened and washered drifts through 0.356m by 0.063m (14in x 2.48in) planking, was used for the wooden retaining walls of the canal in which the flat rested.

The Trent River, North Carolina Barge

The Trent River in North Carolina forms the northern extent of the mid-Atlantic rice growing region of North America. For this reason, its vessels are included in this study as they are considered to be a part of the general geographic area under study, as are the rice growing regions of northern Georgia. The Trent River Barge was located during a river survey by Mark Wilde-Ramsing of the State Department of Archives and History. The remains of the vessel were eroded and disarticulated when found. In order to facilitate removal and storage, the vessel was completely disassembled and stored under a sprinkler system at the North Carolina Maritime Museum, North Carolina. The author was invited to document the disassembled craft at this location in December of 1988.

The Trent River craft was unique in that it employed a distinctly European form of chine-girder shaping in which the first of a series of longitudinal bottom strakes actually formed part of the chine-girder. This use of the log committed the builder to a rare longitudinal bottom planking instead of the usual local form of thwart ship planking. As a result, the barge closely resembles the early European form. Also of considerable interest on this vessel was the degree of preservation of tool marks on the inboard side of the chine-girder examined (Fig. 52).

The chine-girders for this vessel were carved from a log 9.57m long by 0.22m thick and 0.435m deep (31.39ft x 8.66in x 17.12in). The log was thinned down

from approximately 0.07m (2.75in) at the gunwhale to a 0.1m (3.937in) thickness at the base. Part of this base also formed the projecting longitudinal bottom strake which projected inboard an additional 0.12m (4.72in). The inboard strake was carved into place for the entire length of the chine-girder terminating at each end, at 2m (6.56ft) and 7.93m (26.01ft), where the profile of the log was narrowed toward the gunwhale creating a curving ramp (Fig. 53).

At each of these points, a shallow mortise was carved into the inboard side of the chine-girder to allow insertion of a square cross section floor timber. The mortise overlapped the end of the carved strake by approximately 0.10m (3.937in) to provide a fastening face for a separate curved strake forming the ramp. Another floor timber was supported by a second mortise carved at an angle into the inboard edge of the chine-girder. The floor timbers were end fastened with 0.02m (0.78in) trenails through the side of the chine-girder.

Data provided by the author's survey and the North Carolina Maritime Museum gives an overall beam of 3.454m, length of 9.45m and a depth of 0.45m (11.33ft x 30.99ft x 17.71in). The longitudinal planking was supported by seven floor timbers, the largest of which were 0.15m (5.9in) sided and moulded. Six additional half-frames, four on one side, two on the other, provided additional support but do not appear to have been intended to provide support for a planked-up sheerstrake. There appears to be no direct evidence for the presence of aprons on the craft, indicating its use as a ferry. Two large iron staples on the half-frames at either end do suggest a fastening point for raised aprons and this interpretation is given in the Maritime Museum's drawing.

Mepkin Mud Barge

The Mepkin Mud Barge was discovered during exceptionally low water in an abandoned rice field canal adjacent to the ruins of a rice mill. In 1983, the author was invited to participate in the excavation and recovery of the craft with members of the Institute of Archaeology and Anthropology at the University of South Carolina. It was found to be in such good condition that, with a few emergency repairs, it could be floated. The vessel was removed to a nearby fresh water trout fishery tank where the author documented the vessel during the rest of the summer.

The overall dimensions of the barge were 9.14m x 3.04m x 0.76m (30ft x 10ft x 30in) Construction throughout was of 0.25m x 0.06m (9.84in x 2.36in) pine plank (Fig. 54). The sides of the craft were built up of three strakes, each plank being butt joined over a 0.07x 0.26m (2.75in x 1.23in) batten.

Support for the side planking also included a series of 0.07m x 0.07m (2.75in x 2.27in) square battens placed 1.22m (4ft) apart. Corner support was mainly provided by a large knee cut from 0.12m x 0.26m (4.73in x 1.23in) lumber which was set into each corner. Additional support was added by a 0.38m x 0.38m (15in) triangular fillet fastened to the sheer strake and top bow and stern plank, holding the two together. Internal support for the bow and stern planks was provided by four additional knees in each end of the same dimensions as the corner knees. Each of these knees butted against four stringers of 1.21m x 1.21m (3.93ft x 3.96ft) cross section which ran the entire length of the floor (Fig. 54, section A-A). The stringers were of 3.65m (11.97ft) lengths, each length being butt joined and sistered at the join with two small pieces of 0.025m x 0.10m (1in x 3.97in) lumber.

Each interior side of the barge had three runs of plank 0.038m x 0.23m (14.96in x 9in). Each interior plank ran the full length of the vessel. A 0.12m x 0.12m (4.72in x 4.72in) rub rail was fastened to the sheer strake 0.12m (4.72in) below the gunwhale. It was supported by a triangular cross section filler piece nailed beneath it.

The bottom planking was of the same 0.25m x 0.06m (9.84in x 2.36in) planking laid athwart ship. The bottom planks extended under each side of the craft, the join being supported by a 0.12m x 0.12m (4.72in x 4.72in) chine stringer.

A single 0.06m x 0.23m (2.36in x 9in) plank also was used amidships as a cross brace from sheerstrake to sheerstrake. Fasteners used throughout the vessel were wire nails. These ranged in size from 40 penny nails used for planking to 100 penny sizes used for fastening large structural members (Fig. 55).

Port, starboard, and stern gunwhales also featured metal thole pins, each made of galvanized 1.9cm (0.75in) iron piping. Minimal wear marks were present in the gunwhale between the stern thole pins. Samples of caulking material were removed from between the sheestrake and second strake on the port side of the vessel. The material proved to be burlap with a pitch sealant. The wood used throughout was longleaf pine, each individual piece having been converted from the heart of a longleaf pine log.

Post-Civil War Industrial Barges

The Pon-Pon Phosphate Barge

Documentation of the Pon Pon Phosphate Barge was completed in 1990 by the author as part of a survey of the South Branch of the Edisto River. The vessel lies on a bend of the river where it is now being incorporated by silt accretion into the

bank. The site is the location of an abandoned phosphate mine operated in the nineteenth and twentieth centuries by the M.C. Fishburne Company (Mappus 1935:44). The vessel was found to be in a severely degraded state. An undetermined portion of the upper construction, including the deck, was missing. The wreckage studied in this survey consisted of the base of the barge, the keelsons and chine keelsons and approximately 0.3m (11.81in) of the side construction. Enough wreckage remained with diagnostic artifacts, such as a large bilge pump, to provide sufficient data, coupled with an archivally developed history of the phosphate industry (above), from which interpretations and conclusions could be drawn. The overall dimensions of the wreckage were length 18.24m, width 6.65m by 0.61m in depth (59.83ft x 21.81ft x 2ft). The base of the craft comprised of thwart ship planking attached to seven stringers and two sills. The sills were 0.29m x 0.29m (11.41in x 11.41in) square. The sides of the barge at this point were formed by the sill with another sill of the same dimensions above it. The first strake of the side rested on top of this "rider sill" supported by a 0.23m x 0.23m (9in x 9in) square timber forming a third rider sill (Fig. 56). Planking strakes were built up on this base and through fastened with iron drift pins. The two rider chine keelsons were both angle cut, the lower one to start the ramp or flaring of the end of the barge, the other to receive the shaped end of a timber 0.3m x 0.29m (11.81in x 11.41in) forming a corner support for the ramp. The seven sills laid between the sides of the barge averaged 0.1m sided by 0.23m (3.93in x 9in) moulded. They appear to have been laid down asymmetrically and no distortion due to degradation of the craft is evident. A profile taken of the one remaining end section showed a steep 50° angle.

South Edisto River Barge

The South Edisto River Barge is the largest documented for this study. Initial documentation was made by avocational researcher Mr. William Judd (Judd, William, personal communication 1985). A follow up visit to the site was made by the author to gather data of particular interest to this study and the information below is from both surveys. The craft lies on a mud bank on the South Edisto in a region known for its terrestrial and marine phosphate mining activity. The vessel is severely damaged but sufficient wreckage remains for a full re-construction of the craft to be made (Fig. 57). The craft was studied in 1983 and 1985 by William Judd and again by the author in 1991. The data presented is from these combined sources.

The barge has an overall length of 22.55m, beam of 6.7m and a depth in the waist of 1.83m (73.98ft x 22ft x 6ft). Two different planking widths were used at each end of the barge, 0.076m x 0.45m (3in x 17.71in) on one end, 0.076 x 0.3m (3in x 11.81in) on the other. Side planks were 0.076m x 0.28m (3in x 11in) and were very heavily fastened for lateral and vertical strength. Each plank was through fastened with either two washered and peened drift pins, or one drift pin and one spike, to internal 0.12m x 0.12m (4.72in x 4.72in) battens centred on 0.91m (35in) intervals (Fig. 57, section C-C).

In addition, each run of planking was edge fastened to the run below it with 0.019m diameter by 0.61m (0.75in x 2ft) long drift pins. The pins were driven at intervals of 0.76m (29.92in) along the entire length of each strake. Further support was provided by a composite knee and brace assembly set on top of the ends of each of five thwarts (Fig. 57, section B-B). The knee was a naturally shaped section of live oak cut to support a diagonally placed 0.12m x 0.28m (4.72in x 11in) brace of pine set at 45° on top of it between the sheerstrake and the thwart.

Internal framing strength was provided primarily by two large "sills" or chine keelsons of 0.3m x 0.3m (11.81in x 11.81in) cross section. Run lengths and joining technique for the components of the chine-keelson were not visible due to site conditions at the time of recording. Further longitudinal strength was provided by five additional keelsons for 0.12m x 0.3m (4.72in x 11.81in) lumber.

Two longitudinal partitions, raised to the height of the gunwhales, ran the entire length of the barge. These were mounted on each keelson either side of the centre keelson, dividing the interior length into three sections. These sections were divided further by five thwart ship partitions mounted on each of the five thwarts mounted across the keelsons and sills. These structures divide the interior of the barge into 18 bunkers approximately 2.13m wide by 3.65m (6.98ft x 11.97ft) long.

The ends of the barge were flared or ramped at a 50° angle, the ramps being supported by 0.12m x 0.3m (4.72in x 11.81in) frames off the ends of each keelson. The inboard angle between these frames and each keelson was filled with a 0.12m (4.72in) thick apron. This was fastened to the ramp frame and keelson beneath it with six drift pins (Fig. 57, section A-1).

A composite header log assembly was composed of two timbers let into notches cut into the ramp frames. No longer present, this assembly appears to have comprised of one 0.15m x 0.15m (6in x 6in) log and a 0.07m x 0.15m (2.75in x 6in) piece set behind it.

Three of the composite brace, thwart and partition structures, the centre and end most, also supported a total of six stanchions. Located along the sides of the barge, the stanchions measured 0.25m x 0.25m (9.84in x 9.84in) and were 1.98m (6.49ft) high, showing a short distance above the gunwhales.

Biggin Creek Barge

The Biggin Creek Barge was a large industrial flat abandoned in Biggin Creek at the head-waters of the Cooper River some time after the completion of the Pinopolis Dam. The barge was heavily silted with sand making access to its bilge impossible. A large section of the deck had rotted away, providing access for interior measurements of the upper structure. The barge listed toward the stern and was awash at high tide. In addition to the author's recording, draughtsman William Judd was contracted to spend three days gathering more complete data prior to the destruction of the barge which stood on the site a small dam to be built across the creek mouth by the Santee Cooper Power Authority. The data below is compiled from the author's notes and Judd's drawings (Fig. 58).

The barge was constructed as a push barge for heavy machinery used in the construction of the dam. The craft was built by the carpentry shop of the Santee Cooper Public Service Authority and is typical of the last of the wooden construction work barges of the area.

The barge had an overall length of 12.19m, a beam of 4.86m, a depth of 1.067m (40ft x 16ft x 3.50ft). The bow was framed with three 0.12m x 0.2m (4.72in x 7.87in) timbers, one on each side and the third in the centre. The stern was framed with 0.12m x 0.15m (4.72in x 5.9in) timbers between two corner stanchions measuring 0.15m x 0.15m (5.9in x 5.9in). Each side of the vessel was framed with 0.12m x 0.2m (4.72in x 7.87in) battens on 0.61m (24in) centres. The deck of the craft was supported by five transverse sets of six battens measuring 0.06m x 0.1m (2.36in x 3.93in) each placed under a 0.06m x 0.1m (2.36in x 3.93in) longitudinal deck support beam, and centred on 1.82m (Fig. 58 section B-B). Deck support beams averaged 4.57m (15ft) in length. Separate lengths were butt joined and sistered over stanchions with 0.91m (35.82in) lengths of timber of the same 0.06m sided and 0.10m moulded (2.36in x 3.93in) dimensions.

Random width, athwart ship planking with a thickness of 0.04m (1.57in) was used to sheath the deck. Planking widths ranged from 0.15m to 0.28m (5.90in to 11in). The hull of the barge was doubled sheathed. The under planking was 0.04m thick by 0.24m (1.57in x 9.44in) wide and, judging from its use on the

underside of the ramps, also was used for the bottom planking. A layer of sealing material, similar to tarred paper or roofing felt, was laid over the under planking before attachment of the outer planking. The outer planking, yellow pine, was 0.019m thick by 0.24m (0.75in x 9.44in) wide. Longest observed lengths of outer planking were 4.57m (15ft). Two joining methods were used for outer planking ends, butt joints over internal battens and ship-lap scarf joints with 0.91m (35.83in) tables. Two additional strakes were fastened to the upper inboard side of the craft (Fig. 58, section D-D). These were 0.04m thick by 0.19m (0.75in x 7.48in) wide and appeared to provide additional support for the deck-sheerstrake junction. At each corner of the barge, a drift pin passed through the hull planking and a batten. It was looped over at the outboard end to hold a mooring ring and was threaded, a large nut fastening the assembly over two washers.

Final construction components were a nose rail and two rub rails fastened to the upper edge of the sheerstrake. All three pieces were made of 0.09m x 0.09m (3.54in x 3.54in) lumber.

The ramp of the bow was angled at approximately 37° and a shallow stern ramp was angled at 20° providing for a vertical 0.83m (32.67in) stern counter.

Coasting Schooners and Sloops:

The Biggin Creek Coasting Schooner

A coasting schooner wreck was located in the entrance of Biggin Creek at the headwaters of the Cooper River, Berkeley County, South Carolina, during a survey called for under the terms of Section 106 of the National Historic Preservation Act. Under the direction of the author, data was collected from the site on two occasions, once by William Judd (Judd 1987) and later by Joe Simmons and Christopher Amer (Simmons and Newell 1989:65-77), as part of a wider study of the remains of a portion of the Santee Canal (Newell 1989:67-80). The wreckage had been partially covered by spill excavated from the construction of the nearby tailrace canal, connecting run off waters from Lake Moultrie hydro-electric project to the head of the Cooper River. An account of the field work is given in Newell 1989:67-80) by Amer, the data given here are synthesized from this work and the author's subsequent verification survey. The vessel had an estimated length overall of 14.0m to 20.0m (46ft to 65ft) and an estimated beam of 4.9m (16ft) [actually a fairly reliable figure based on later measurements by the author]. Amer estimates the depth of hold to be 1.3m (4ft), although the actual figure is probably closer to 1.5m (5ft). Significant is the number of pre-cut floor timbers, squared on all four

sides, typical of later nineteenth century coasting schooners built to pre-conceived plans and designed to extend maximum beam as far to the bow and stern as possible.

The Malcolm Boat

Over the course of the field research project portion of this program, a number of vessels were identified which were appeared to be sloop type hulls capable of extended coastal or ocean voyages. These were the Dean Hall Vessel, a large, very degraded hull at the landing dock of Dean Hall Plantation on the Cooper River, the Lewisfield Wreck, a heavily built sloop loosely associated with military artifacts and located off Lewisfield Plantation in the Cooper River (Fig. 2), and the Malcolm Boat, a sloop abandoned in a small slough in the banks of the Ashley River a few miles upstream of Charleston, South Carolina. The Dean Hall vessel has yet to be surveyed. The Lewisfield Wreck was excavated by two separate investigators from SCIAA at the University of South Carolina, by one in 1986-87, and by the other several years later. A report on the findings has yet to be published by either archaeologist. The author first documented the Malcolm Boat site in 1985 (Fig. 59) and selected this site for study for this research program.

In 1987, the Malcolm Boat was temporarily protected from erosion damage by a layer of sandbags (Fig. 60). In 1992, a grant application written by the author for work on the site was funded by the South Carolina Department of Archives and History, the first grant given by this agency for an underwater archaeological project. As a result, a research design and methodology was written by the author and formed the basis for an excavation by staff of the University of South Carolina with the author as project manager. The data presented here are synthesized from the project manager's report required by the Department of Archives and History (Newell 1992b:5-92).

The excavation of one half of the vessel remains revealed a round hulled sloop. The physical remains were accurately drawn by William Judd (Fig. 61).

The hull was of local pine planking with live oak frames. There were originally a total of twenty-nine frame locations, those frames remaining being made of live oak and white oak. They averaged 0.075m sided, 0.085 molded (2.95in x 3.334in) and 0.50m (19.65in) long, each extending to the turn of the bilge. Some 64 first, second and third futtocks survived, providing an opportunity to record the vessel almost to the sheerline (Fig. 62). The futtocks were of the same general size and material as the floor frames. The keelson was a single section of southern yellow

pine 8.35m (27.38ft) long, 0.10m (3.37in) molded, 0.17m (6.68in) sided. The keel was an almost 11m (36ft) long section of southern yellow pine 0.23m (9in) sided and molded at its thickest, amidships location.

Most of the stempost assembly of the vessel was intact, as well as a large portion of the sternpost. Sufficient fragments of the transom stern planking were recovered to enable reconstruction of one half of the transom stern shape. The data recovered by the author and the University team were sufficient for Judd to develop some preliminary sketches showing a reconstruction of the hull and an impression of the original vessel (Figs. 63 and 64).

Experimental Research:

The Magnolia Barge

Experimental research projects were made a part of this study in order to investigate aspects of vessel construction that were not readily apparent in the field.

This research program to date has studied the remains of a large number of vessels in the field and has resulted in a growing data base on rice flats, ferry craft, and phosphate industry barges.

While study of some of the remains has been detailed, certain questions about the process of construction of these craft are unanswered. The experimental projects were designed to address many of these questions in a manner seen as the logical conclusion of a long term study program: the actual construction of vessels based on the archaeological and archival evidence.

Research Design

Examination of the remains of sunken and abandoned barges of the rice culture and the archival record has resulted in a clearly defined body of data in which the "gaps" in the data are readily apparent.

At this point of the research, little is known about the actual construction process of plantation barges, little about the nomenclature used for the various vessel components or the actual function of some of these components in the overall design. Other questions relate directly to the data gained in the field. These data are the result not only of the construction and use of the craft, but also of the abandonment process and subsequent effects of time.

Without construction of a replica, information about the original appearance of these craft, about the changes resulting from normal wear and use, about the original appearance of tool marks can only be hypothesized.

The experimental project was designed to answer as many of these questions as possible through the process of construction of a plantation barge in a manner similar to that of the early nineteenth century.

The project also offered an opportunity to compare modern methods of construction with those of the past and to determine how study of these modern methods might facilitate interpretation of historic techniques.

Specific research questions were: What probable construction sequence was used to build the barge? How many men were required to handle large baulks of timber? How labor intensive were tasks such as planing and shaping planks or carving knees with hand tools? What was the original fastening strength of spikes and trenails? What certain aspects of the construction activity contribute to the site formation process, and how might they be detected on historic construction sites?

Methodology

A construction team of the author as principal investigator and small craft historian and boat builder Rusty Fleetwood and two ships carpenters were assembled to confer over a reconstruction drawing drafted by the author. Various aspects of the drawing were discussed, practicalities of time and cost being balanced against specific research interests. A final drawing was then prepared based on these discussions (Fig. 65).

The finished drawing called for a craft 12.19m long by 3.25m wide with a depth of 1.0m (40ft x 11ft x 3ft). A range of plank widths were called for from 0.23m to 0.3m (9in to 11.81in). A combination of internal side supports were used, natural live oak knees and framing pieces of 0.1 by 0.1m (3.93in x 3.93in) cross section. Five bottom supports, three stringers and two chine keelsons of the same size were added. A header log 0.12m by 0.2m (4.72in x 7.87in) was added at each end, a lodging knee being used to brace each sheerstrake into the header log. The flat was ramped at 20° to give it more of a ferry craft appearance. All side planking was through doveled with iron drift pins and planking length scarphed with 0.61m (2ft) table scarphs which were common.

As designed, the craft combined features observed in several ferries, chine-girder and plank flats, and phosphate craft documented for this study.

A construction area was prepared at Magnolia Plantation, an historic plantation in continuous operation on the banks of the Ashley River near Charleston since 1697. Timber selection was a combined process of searching the area for suitable

live oak trees for production of knees, milling of 150 year old pine log pilings cured by immersion in the Savannah River, and ordering of new lumber from a local mill.

The construction process was video- and photo-documented in order to develop an understanding of the problems most probably encountered by the original builders.

Modern tools and materials were used to some extent in the interests of speed and cost. Concurrent with this activity, a variety of nineteenth century tools also were used to prepare various components of the vessel. Area boat builders and ships carpenters were invited to visit the construction site and demonstrate use of various historic tools. At the same time, discussion of their range of knowledge of local craft construction and family traditions were video recorded.

Construction Sequence

A light awning was erected to keep the June sun off the newly milled wood for the craft. Under this, a raised platform or "strongback" was built using 0.15m (6in) square pilings sunk to the depth of 1.5m (5ft). Longitudinal sections of 0.08m x 0.3m (3in x 12in) scrap wood were attached to the top outside edges of the pilings to support the thwartship planking of the barge bottom (Fig. 66). The basic planking used throughout the construction was of 0.08m x 0.025m (3in x 10in) yellow pine. Even in the shorter 4.26m (14ft) thwartship lengths, it was assumed that these timbers would be heavy and cumbersome as they were frequently moved. To facilitate this movement, the top edges of the strongback were heavily waxed, two £1 (\$1.50) candles being sufficient to wax both of the runners. Several cross planks were then cut to approximate length and set up at 90° on the strongback. The barge stringers, the internal longitudinal supports for the cross planking, were then fabricated from 0.1m x 0.15m (4in x 6in) stock, three sections shiplap scarphed together using 0.025m (1in) treenails being required to make the needed length (Fig. 67). The ends of the stringers were shaped to the 30° angle of the ramps as was the leading edge of the two bottom planks on each end. Each bottom plank was then inserted between the strongback runners and the stringers, then slid along the runners to its final position and clamped in place to each of the five stringers (two chine stringers and three internals). A quarter inch drill bit with a half inch counter sink was then used to drill a pilot hole through the underside of the plank and into the stringer above. A pneumatic hammer was used to drive a 0.15m (6in) galvanized boat nail through the plank and stringer. Two nails were used per stringer, ten per plank.

With the bottom complete, two ramp supports of 0.1m x 0.15m (4in x 6in) stock were cut for each end of the barge. They were clamped in place and then treenailed to the chine stringer ends (Fig. 68). The first of three runs of 0.08m x 0.025m (3in x 10in) side planking were then positioned on the ends of the cross planks, against the chine stringers, usually three sections being needed to complete a run of approximately 12.19m (40ft). The sections were fitted together with angled shiplap scarphs (Fig. 69). The bottom strake was fastened to the stringers with the same pilot hole and boat nail technique used on the bottom planking. Four 0.1m x 0.1m (4in x 4in) vertical battens were then fastened to the inside edge of the bottom strake, resting on top of the chine stringers. Two were positioned at the base of the ramp, the other two 0.685m (2ft 3in) from the midship of the barge. These provided additional support for the strakes as they were installed.

The second strake sections were then installed. As well as being spiked to the battens, they also were through drilled from edge to edge (Fig. 70) with a 0.019m (0.75in) augur, the hole penetrating the edge of the chine strake to a depth of some 0.15m (6in). A piece of 0.019m (0.75in) reinforcing rod was then driven down the hole as a drift pin. This procedure was followed along the length of the second and third strakes at offset locations. As the strakes were being built up, header logs were cut from 0.15m x 0.15m (6in x 6in) heart pine and were mounted on each end of the ramp supports which were notched to receive them (Fig. 71). The ramp cross planking was then installed to complete the underside of the craft (Fig. 72). Two internal cross spalls were added from the top of each of the two centre battens. These were cut from 0.05m x 0.25m (2in x 10in) yellow pine and treenailed to each batten.

The author undertook to carve four standard knees and a large rowlock from live oak in addition to documenting and assisting the main construction of the craft. The wood was made available from trees on Magnolia plantation that had been damaged by a hurricane some years earlier. A plywood template was made for the knees, this being used to size various sections of wood (Fig. 73). These sections were cut from the downed trees with a chainsaw. Blanks were then cut from the sections for carving into the finished product (Fig. 74). A combination of saw, plane, and gouge were used to shape the knees (Fig. 75). The knees were installed in each corner of the barge, fastened there with long wooden dowels driven through the shoulders of each knee into the sheerstrake and the header log. Final touches included install a rub rail over the ends of the cross planks to seal and protect them. The finished barge was then treated with several applications of a linseed oil,

turpentine and pitch mixture. The completed craft was then lifted by a crane and placed on its display location (Fig. 76). The crane lift enabled an accurate weight for the craft to be determined: 280,323kg (17,500lbs).

The Conway Narrow Flat

This chine-girder flat was one of the few barge types for which there was some construction information in the archival record. Doar's description of the construction technique (Doar 1936:34) appeared reasonably complete. This, coupled with the data recovered on numerous archaeological sites, appeared to have answered most of the obvious questions, the most baffling one unanswered to date being the origin of the design. The lack of availability of very large cypress lumber also was a factor discouraging experimental replication of this vessel type. It was therefore decided to undertake replication in the form of a large scale (1:10) model for no other reason than to determine what additional information the process might reveal.

Research Design

Model building of historic shipwrecks had already been established as a viable way of developing new information on the full scale originals by the Institute of Nautical Archaeology at Texas Agricultural and Mechanical University at College Station, Texas. Southern yellow pine for example, was found to behave at a scale of 1:10 in very much the same manner as it does at 1:1 (Steffy, Richard, personal communication 1984). It was not known if the behaviour of cypress at this same scale would provide the same reliable indications of what full scale cypress timbers would do during and after the construction process. The principal question to be asked of the project was what, if anything, could be learned about the construction process that was not revealed by Doar.

Methodology

The method used for production of the model followed the description given in Doar's account. A bald cypress of suitable size was located on private property on the Savannah River and felled. The log, with a cross section of approximately 0.356m (14in), was drilled through at a distance of approximately 0.15m (6in.) down its entire length with a 0.013m (0.5in) hand augur. Iron wedges were then used to split the log. The two sections were then transported to the author's model shop for the construction of the model. Another section of cypress was cut for

production of the keelson. A carpentry shop was given a supply of 1902 heart pine (salvaged from floor timbers replaced in the author's residence). Heart pine is cut from the inner core of yellow pine, has a high resin content and is renowned for its durability and resistance to rot and insect damage. The outer, or sap, wood was commonly discarded until recent times. This pine was planed down to the scale required for the 1:10 pine planking for the model. Eight knees were then cut to scale from live oak. Tree nails for the model were made from scrap cypress, approximately 0.025cm (0.01in.) in diameter.

Construction Sequence

All of the woods used for the model were green but for the heart pine. It was immediately learned that the cypress chine logs underwent extensive warping as they dried. The thinning of the upper sections of the chines (where a sheerstrake was added) resulted in uneven drying which caused the upper section of the log to curve inwards. This was remedied by installing the thwart early in the construction process and then installing the four standard knees. This had the effect of making the warping process add tensional stress and strength to the frame by compressing the standard knees against the thwarts. Continued drying then caused the thinner ends of the chine logs to bend outwards. This was remedied by installing the header logs which locked the chine ends in position. The result was an extremely strong frame onto which the bottom planks were pegged. If the behaviour of the woods in the model reflect similar properties in the original, it would indicate that the original builders had a remarkable understanding of the properties of the woods they were using, and that they used these properties to excellent advantage. The process also suggest a construction sequence for chine-girder craft necessitated by the drying properties of the chines. The sequence amounted to carving and positioning of the chine-girders, followed by installation of the thwarts and the standard knees which braced them against the thinned sides of the chine-logs. This was followed by installation of the keelson, completing the inner framework of the craft. Then the header logs were installed to complete the framework. With the drying chine-logs thus stabilized, the bottom planking could be installed in the rabbets cut to receive them.

The Petersburg Boat

The mountain boat type was chosen by the author for experimental archaeological investigation in order to develop further information about the design

and construction methods. A summary of the project is presented here, extracted from the project data and initial proposal (Newell 1992a:4-28).

Petersburg Boat Research Design

The proposed project had a wide range of questions to ask about this type of vessel. Can archival research, reconstruction, and field testing of an historic vessel design generate data which can be compared to more complete histories in Europe? Can this information be used to develop an accurate understanding of the design and characteristics of the original vessel? Can operation of a reconstruction in the original operating environment generate accurate information about the performance of the original vessels and the techniques used by the crews to operate them?

Specific questions about the construction of the vessel also can be answered. Knowing the basic tools available to the boat builder and carpenter of the nineteenth century, can we develop an understanding of the labour and cost involved in historic construction? Will this information assist us in determining the economic factors/values relative to the operation of the vessel by a nineteenth century planter? What was the actual construction sequence of the craft? How were the construction elements first assembled and what kind of labour force was needed to complete the work? By using historic tools on some portions of the construction can recognizable tool marks be recorded and compared to marks found on historic vessels? How well did construction methods, fastenings and construction elements (planking, internal supports etc.) wear under operating conditions? Will this information indicate a typical life expectancy for the craft?

Experimental Methodology

Specific effort was devoted to developing additional pictorial representations of mountain boats used in other areas of the United States and also new information in countries in which the design may have origins, such as Finland. Archival accounts of the craft also were sought to increase knowledge of design and operational specifics and dimensions. Efforts also were made to identify individuals in the upper Savannah region of Georgia and South Carolina that may have memories of the vessels and the activities of their crews. Several such individuals were found. Their ages ranged from 87 to 96 and their experience ranged from cotton factoring to, in the best example, direct experience of the vessel through a grandfather who was a builder and pilot.

The data gathered was used by the author to produce a reconstruction drawing of a Petersburg boat (Fig. 77). The preliminary drawing was then input into a CAD-CAM system on which performance characteristics of the design could be tested (Fig. 78). The results showed that the reconstruction was reasonably accurate in that it produced a 0.1016m (4in) draft empty and a 0.53m (21in) draft when "loaded" with 320,369kg (20,000lbs). This particular study continued with the development of a full construction model (Fig. 79).

The model was then used to develop a final set of working drawings and a parts list. Once lumber was acquired, a facility was set up on the banks of the Augusta Canal, Augusta, Georgia. The construction process was open to the public and lectures were provided to the public and local visiting school groups as and when possible.

During the construction process modern tools were used to assure cost effective speed and quality of work. At the same time, there was limited testing of historic woodworking techniques and tools (Fig. 80). This activity was heavily photo-documented for future research purposes. Although some modern methods were used, i.e., electric instead of manual wood drills, the actual construction copied historic methods (treenails instead of metal screws, wrought nails instead of wire nails etc.).

The overall construction process also was video taped for use in a public television documentary.

The completed vessel was launched into the Augusta Canal before 3,000 onlookers. After testing on the canal, it was moved to a suitable location north of Augusta on the Savannah River. Studies were made on how the craft performed when empty and exactly how it could be poled against the current. It also made unloaded runs down the Savannah River for a similar performance assessment. The craft was then loaded with a crew of ten and again rowed down the river 189 miles to Savannah in order to assess its performance and handling characteristics.

Construction Methodology

The process of developing working drawings from archival sources and models proved extremely valuable in providing general guidance in the re-construction of historic craft from similar sources. The processing of this data in a CAD-CAM system also demonstrated the use of these software programs as tools for the analysis of historic craft and reproductions.

Invited experts made extensive reviews of the author's reconstruction drawings and the one existing photograph. A model of the design was then produced, providing further insights into the best construction technique. Analysis of the photograph produced a consensus that the vessel showed signs of considerable age, that it was badly hogged and even laterally curved. The apparent flare to the sides appeared to be due to stress and it was decided that the craft originally had little or no flare.

The model indicated that planking the craft would have been much easier using a 3.65m (12ft) bow and stern section instead of the originally designed 3.05m (10ft) section. The additional length allowed a softer transition from the aft and forward sections of the hull up to the stern and stemposts and a less extreme angle of curve for the chine planks. It also was decided that Carson's figure of 1.82m (6ft) for the bottom width of the craft may have been an estimate made from the inside of the vessel. There was considerable debate about the nature of the vessel chine. The early Finnish vessels were round bottomed, but Carson in his report specifically states that the Petersburg boat was flat bottomed. Despite this, the model maker crafted a model with a flat bottom but a rounded chine, a 0.3048m (12in) radius on the full-sized craft. His reasoning was that the vessel would negotiate sandbars easier with such a bottom. There was no archival evidence for this. In fact, similar northern boats exhibited a hard chine. The author therefore decided on a final construction based on Carson's "flat" bottom report (Gilmore 1879:750-763), the author's original design drawings, and Chapelle's lumbermen's bateau drawing (Figure 26 on page 82 of Chapelle 1951).

Construction Sequence

The actual construction process itself provided unique insights into the nature and sequence of the construction of these historic craft. Special problems in construction that the builders may have dealt with were revealed along with a better understanding of the actual design layout of the original craft. Traditional woods used in the construction of lower coastal plain small craft appears to be longleaf yellow pine for planking, live oak for internal framing and bracing, and cypress for planking and fasteners. Even though these woods would have been available to builders on the Savannah above Augusta, most likely via trade traffic on the river, it was decided to use only locally available pine for the entire construction. The oral histories seemed to indicate that the craft were not prized as a long-lived means of transportation. Rather, they were built to be used hard for as long as they would

last, even to the point of destruction in the river whereupon their cargoes were simply recovered and transferred to newer vessels.

Approximately 95% of the pine planking and structural timber for the craft was donated for the project by Georgia-Pacific Corporation. A critical problem faced by the project was the lack of availability of long runs of planking. Planking furnished was excellent quality export grade long leaf pine, but the greatest length available was 6.1m (20ft). This meant that the reproduction would require a great many buttjoints supported by buttblocks. It was feared that this would result in a subsequent loss of flexibility and greater inherent weakness in the overall structure.

Construction began with the laying down of a 7.5x 25.40cm (3in x 10in) king plank made of three runs of timber joined with shiplap scarphs with 60.96cm (24in) tables and 3.81cm (1.5in) nips. Two 6.35cm (2.5in) garboard strakes were laid down next to the king plank and a series of 10.16x 10.16cm (4in x 4in) floor timbers were spaced on 45.72cm (18in) centers over the mid-section of the craft with the 1.27cm (0.5in) extra height of the kingplank fitting into a notch cut in the floors, creating a completely flat bottom (Fig. 81). A brace was added to the building platform 3.65m (12ft) from the stern and stempost locations in order to force the kingplank and garboards upwards, creating 15.24cm (6in) of rocker or curvature of the bottom of the hull. The kingplank and keelson were then fastened with 1.27cm (0.5in) bolts and washers to ensure reliable mating of these timbers with the cross floors. The rest of the floor planks were then positioned and fastened to the floors with 10.16cm (4in) galvanized "boat nails." The 6.09m (20ft) lengths resulted in the use of large buttblocks to back up the buttjoint of plank ends where they occurred. This technique was employed rather than backing up the buttjoints under the floor timbers in order to give the bottom of the craft greater flexibility.

The shape of the hull from the chine to the sheerstrake was taken from the drawings with a plywood template, since the center of the vessel had the same cross section for 10.6m (33ft) of its length. Enough frames were then pre-cut from 7.5x 25.4cm (3in x 10in) stock to match the floors (Fig. 82). A 10.16cm (4in) rabbet was cut along the base of each frame leaving a 5.08cm (2in) thickness of the base butting against the floor timber. Two 0.095m (0.37in) machine bolts were fastened through the base of the floor to the frame, a washer and nut being used to cinch the assembly together.

Review of the construction at this point raised some questions about the strength of the structure at the chine, a point where the frames, hull planking and bottom planking meet. Fasteners piercing the ends of the 0.1m x 0.1m (4in x 4in)

frames at this location consisted of four 0.1m (4in) galvanized boat nails and two 0.095m (3/8in) bolts. It was felt that the fasteners might compromise the long term integrity of the structure at this point. It was decided to strengthen the area by adding a standard knee at every second floor at this location. Knees were cut from 0.075m x 0.25m (3in x 10in) stock with sufficient overlap to allow its fasteners, three machine bolts, to avoid the problem area. The knees were placed on top of the floors and were attached to the frames where they overlapped the floor timber (Fig. 83). At each end of the center section, two frames were fastened either side of the floor timber as support for a cross spall designed to strengthen the areas to which the bow and stern were to be attached.

Heavy sections of wood were needed as supports for the stem and sternposts. These were acquired from two sources, a dismantled ca. 1875 cotton warehouse and a local "stump yard." The warehouse yielded 12.19m (40ft) lengths of 0.45m x 0.35m (18in x 14in) heart pine and the stump yard was culled for a suitably shaped stump. Two knees were produced, one sawn from the heart pine and shaped on a bandsaw, the other adzed from the stump and shaped with wood chisels and a plane. Two large deadwoods also were cut from the heartpine to complete the components needed for stem and sternpost supports (Fig. 84). The stem and sternposts were then cut from the rest of the heartpine and a bevel cut on the leading edge of the stempost and the trailing edge of the sternpost to receive the hood ends of the planking (Fig. 85).

The side planks were then attached starting with the chine planks. These were carefully shaped from 0.05m x 0.25m (2in x 10in) stock, narrow at the side of the center section and fanning out broadly at the hood ends. A purpose-built steam oven was used to steam the four port and starboard sections of the chine plank which then was able to be molded around the extreme bend from the end of the center section to the stem or sternpost. This shaped strake then enabled additional strakes of standard 0.038m x 0.15m (1.5in x 6in) planking to be inserted between the chine and the sheerstrake without the use of stealer planks to fill the differential distance between the height of the center section sides and the posts. This additional space is normally created by the rake or angle of the posts, in the case of this craft it was an extreme 30°. The sheerstrake of 0.05m x 0.15m (2in x 6in) lumber was added, an inner rail or clamp being through fastened to it through the heads of the frames.

A careful study was made of the internal curvatures of the bow and stern sections. Sixteen small standard knees were cut from 0.075m x 0.25m (3in x

10in) stock. The base of each knee was cut to match the upward curve or rocker angle of the floor in both the stern and bow. The side of each knee was then shaped to the curvature of the hull at each of four locations on the port and starboard sides of the bow and stern (Fig. 86). Each knee was installed and a new "floating" cant frame was then cut to match the curvature of the hull above each knee (Fig. 87). The frames were then installed and attached to the tops of the knees with machine bolts. This assembly then provided the internal framing structure for bow and stern. Short clamp sections of 0.05m x 0.15m (2in x 6in) stock were then attached to the frame to provide additional support for four small deck beams which were then attached to each frame 0.3m (12in) below the gunwhale. These supported light, moveable deck sections. The edges of the decks were not notched around the frames in order to leave an open air circulation space.

Two breast hooks were then cut from 0.1m (4in) thick heart pine stock and installed at gunwhale height to provide further support for the stern and stempost/gunwhale assembly (Fig. 88). The stempost was then cut and shaped 0.15m (6in) above the gunwhales. The sternpost was cut flush with the gunwhale to provide a platform on which a heavy gauge metal plate and pin was attached. The pin provided support for the stern sweep.

The entire vessel was then caulked with cotton fibre, a mixture of pitch and whiting being used to fill each seam (Fig. 89). Several coats of a mixture of turpentine, pitch and linseed oil were applied to the outer and inner surfaces of the hull as a sealant.

During the construction of the hull, several searches were conducted in nearby woodlands for suitable saplings from which poles could be cut for the boat. These were then shaved and tipped with iron prongs based on those found by the author in the Santee Canal in 1989. Four rowing sweeps also were carved from 0.75m x 0.25m x 6.09m (3in x 10in x 20ft) stock. The steering sweep was designed for construction from 0.1m x 0.1m (4in x 4in) stock, the discovery of one sapling with exactly the right curvature needed on the sweep resulted in its use instead.

The Petersburg Boat was launched into the Augusta Canal in September of 1993 (Fig. 90). The empty craft, its finished weight was 3.55 metric tons (3.5 tons), floated exactly on the 10.16cm (4in) waterline indicated in the archival accounts (not without some measure of disguised surprise on the part of the design team, most of whom declined to take wagers on the waterline!). After final fitting out and some practice runs on the canal, the vessel was moved to the Savannah River by crane and truck. In November of 1993, the construction team and six

volunteers rowed the vessel 189 miles down the river to the Port of Savannah (Fig. 91). The trip took seven days.

Handling

During the trip it was evident that the craft was highly responsive to the helm and could be moved at an average 3.5 knots without difficulty by four inexperienced rowers handling a small cargo. With a river current of some 2 knots, this resulted in a speed of some 6 knots when rowed. The most notable demonstration of handling occurred shortly after the first downstream trip to Savannah began. The vessel was loaded with approximately 40,409kg (2,000lbs) of camping equipment and food and a crew of ten men and two women. At the first bend in the river the steersman was unable to prevent the boat from riding up on a large partially submerged tree. It appeared that the craft, hitting hard on the tree and riding up upon it, would be firmly stuck. Instead, to the relief and amazement of the crew, the current simply took the stern of the boat, and swung it around causing it to ride back off the tree. A few strokes of the stern sweep, coupled with vigorous rowing on one side of the craft, spun it easily around and back on course. Thus it was learned that the boat was in fact extremely maneuverable. From this experience developed a procedure for handling similar situations encountered upon turning a river bend. The pilot in the bow, usually the author, would identify the navigation hazard and the steersman would then order "row starboard!" or "row port!" while at the same time using the sweep as a steering oar to swing the bow away from the hazard. Two men rowing with some exertion for a minute or two were sufficient to quickly place the vessel on a course away from the hazard ahead. On a number of occasions, the boat was struck by large wakes created by passing power craft. Since there was no publicity for the down river trip, most of these encounters were surprises on river bends wherein boat drivers suddenly encountered the nineteenth century. It was found that the craft was extremely stable in such wakes. There was very little roll experienced in response to the wave action. The flat bottom of the craft tended to dampen in the impact of the wake wave.

Since no upstream tests were run, the effort required for return journeys awaits further research.

The reconstruction was produced with admittedly inexperienced hands and less than ideal lumber sizes, and a combination of modern tools and fastening methods. The original builders, using skill, long lumber lengths and traditional treenail and boatnail fasteners, could have produced a lighter, more limber craft. The

reconstruction, with its bolts and added strengthening knees, might be considered equivalent to a well used and repaired vessel of the 1890s.

Most importantly, the performance of the vessel gives strong indications that the reconstruction closely matches the original vessel in most major details. The project clearly demonstrated that a viable craft could be constructed out of local pine in a short time using a combination of shell first and frame first methods. Clearly, a good understanding of the original design can be developed from this experimental process, though obviously not as complete as would result from study of an original craft. The down river trips also demonstrated that a good understanding of the method of operation and performance of the vessel could be developed, along with some insights as to the behaviour and living conditions of the crews. The craft's 57 foot length allowed four rowing and poling stations (Fig. 92). With the addition of the steersman and the pilot, who usually occupied the bow platform, a vessel of these dimensions would appear to need a crew of at least six to operate it.

Construction economics

The reproduction vessel cost was approximately £30,000 (\$44,000) in actual funds (another £66,600 or \$100,000 was used in in-kind support). Given the vastly reduced costs of local lumber and labor in the ante bellum period, and the range of cotton prices, it appears likely that the boat would have paid for itself on the first voyage. The construction process demonstrated that a small crew of four men could build a Petersburg boat of locally available materials within a relatively short time. The cost of the boat, versus the number of times it could be used and the size of the cargo load it could carry, appears to indicate that the vessels were highly profitable and certainly expendable. Since local pine may have been used exclusively for the construction, it also appears likely that many pre-cut sections of wood may have been used for the frame, especially for the center sections of the craft. This would have been speedier and probably cheaper than using natural sections of pine for the large number of knees of the exact same shape and dimensions for the center sections.

Utilization stress

The river and canal journeys undertaken with the finished craft, while valuable for many research purposes, did not provide "extreme condition" tests for the construction. Ideally, the craft needs to be run down rapids of the type it might have encountered in historic times. A portion of the Savannah River which

parallels the Augusta Canal is now the only remaining section of the upper reaches of the river that in any way resembles the 60 mile stretch the boats once navigated. It is unlikely that an opportunity will arise for running the reconstruction through this area since once usable channels and sluices no longer exist. During the period from completion to this printing, the vessel has carried large numbers of passengers down the Augusta Canal and has negotiated two 189 mile trips down the Savannah to the coast (being towed the same distance on the return journey). The river trips required eight hoists by crane in and out of the canal and river. The vessel was sunk at one time when vandals reversed the function of a bilge pump designed to remove rainwater from the bilges. The hull rested on the canal bank and canal bed for some twenty-four hours, was then bailed out and raised. Despite this stress a recent inspection of the hull showed no major new stress-related problems, the hull integrity remaining much the same as it was at launch. The craft, constructed of green wood, was expected to last up two or three years with regular use and maintenance. This finding was based upon the wear and tear observed during the down river trip and subsequent decay observed when the craft was moored in the canal after its return to Augusta.

Hogging

As with any vessel of this type of design (long and narrow), hogging, the "drooping" of the ends of the craft, appeared as an early problem. Immediately after launching, it was noticed that a distinct hogging curve was visible along the gunwales. This appears to be a result of the design and the distribution of pressure forces, rather than a result of wear and tear of the vessel structure. The hogging was partially offset on the reconstruction by laying 500lbs of bricks under the ceiling planking at the centrepoint of the hull. This did not completely eradicate the hogging curve, but neither has it increased to any appreciable degree in the two years since the launching. Another factor in the hogging process may have been the weight of the stem and sternposts. These were cut from heavy and dense heartpine stock for two reasons. The first was the inclination to err on the side of strength and provide the vessel with a single solid timber at an important impact point. Archival accounts stress the skill of the pilot and steersman in avoiding impacts and relate how a "smash-up" was often the consequence of hitting a rock. In this case, the decision to fabricate a heavy bow may have been the wrong one. The second reason for the strong stem and sternposts was the need for a substantial timber to take the fastening stress of the severely curved bow and stern section planking.

Depending upon the position of the strake from chine to gunwale, stern or bow planks were forced into a tight angled bend from a position 3.65m (12ft) forward of the sternpost or aft of the stempost. The starting point of the bend ranged from 1.82m (6ft) to 2.13m (7ft) from the vessel centerline. There was no rabbet cut in the stem and sternposts to provide additional support for the hood ends when spiked to the stem and sternposts. Neither were aprons or a cutwater installed to provide additional bulk to the posts and protection for the planking hood ends. A shaped plank was placed over the forward face of the stempost to seal the open hood ends.

Weathering

One of the conditions of the transfer of the vessel to the ownership of the Augusta Canal Authority was the eventual construction of a shelter for the boat. During the past two years the vessel has remained in the open, moored on the Augusta Canal. This has resulted in noticeable drying of the upper timbers with an opening up of the grain on the port side planking and the inner frames and planking of the starboard side, these sections of the vessel being exposed to direct afternoon sunlight for most of each day. Even so, this degradation is minimal after two years.

A further survey of the craft was conducted in January of 1996, after two additional trips down to Savannah, Georgia, and after numerous weekend trips down the Augusta canal with a full cargo of local citizenry. It was found that the vessel was in remarkably good condition. During the period from 1993 to the survey, the vessel had been moored in open weather in the Augusta Canal with direct exposure to strong southern sunlight and heat, and to winter conditions of rain and cold. The only protective measures taken during this time was to recoat the vessel with a mixture of linseed oil, turpentine and tar (1/3 equal amounts). The port side of the vessel, which was exposed most often to afternoon sun, showed signs of weathering and drying, but not severely enough to need more than standard preservation treatment. Examination and cleaning of the vessel bottom with SCUBA gear showed the planking was in excellent condition with no rot or serious fouling. This leads to the conclusion that given the nature of its original use, such a vessel could have been in service for at least two to three years with minimal maintenance.

Poles and Oars

The production of poles for use on the boat resulted in an unforeseen and rather interesting problem. No information came to light during the project or during prior research as to what type of wood the poles might have been made of or of the dimensions of these poles, other than one pole tip recovered at Petersburg. Iron pole tips recovered from the Santee Canal were fabricated to fit a 0.05m (2in) haft. The saplings gathered for production of poles for the reconstruction were of pine and black locust. They averaged 0.127m (5in) in diameter. It was discovered that saplings of this thickness were very much weakened by the presence of large knots along their entire length. The resultant poles, being carved with a drawknife, tended to be thicker at the locations of the knots and thinner in between the knots. The poles tended to be weak at the location of each knot and broke easily when under stress. It also was discovered that poles of this thickness were largely useless in a depth of water much beyond 1.83m (6ft) of water. In 4.57m (15ft) of water, for example, the pole's buoyancy would work against the poleman's ability to drive the pole down into the water. If an attempt was made to drive the pole down at a shallow angle, its buoyancy would force it to the surface and no effective purchase could be gained. Even when driven down vertically, buoyancy still created a major control problem. It was apparent that the original poles were much thinner in diameter, much stronger despite this, and were probably cut from larger, seasoned stock that was turned on a lathe.

Site Formation

The reconstruction activity at the Augusta Canal site confirmed the observations made a year earlier, during the replication of a rice plantation barge at Magnolia Plantation near Charleston, South Carolina. There are very specific groups of activities that occur during the construction of a wooden vessel. Those people engaged in these activities tended to create their own work areas where their work could be conducted within easy access of the vessel. These areas also were sufficiently distant so as to not interfere with the activities of people directly engaged with work on the craft itself.

This behavior resulted in a specific patterning of the site which may prove useful as a predictive model in the field. Some of the activities observed were, carving of knees and other specialized vessel frame support components, shaping of planks, mixing and use of preservatives and caulking materials, production of forged metal components, and the steaming of planks.

When the reconstruction project was completed and all major evidence of the work removed (such as the awnings, equipment etc.); the ground on which the activity occurred was carefully photomapped (Fig. 93). The locations of activities could be clearly reconstructed from the debitage.

Carving of knees and other frame components:

Flat or lightly curved shavings of pine and hardwood from 0.102m to 0.152m (4in to 6in) long formed by blade of a shipwright's adze for preliminary roughing out of shapes. Deep, short, U-shaped chips of wood formed when gouges are used for next stage of shaping process. Thin strips of wood, triangular in cross section, formed when "peaks" between gouge cuts are taken off. Short, 0.05m - 0.152m (2in to 4in) flat sided chips or shavings formed when a flat chisel is used to shave down a gouged surface.

Planking production and modification:

Long, thin shavings of yellow pine produced by various sized planes, smaller quantities of short, thick shavings produced by drawknives, even smaller amounts of sawdust produced by saws when employed for shaping scarphs.

Mixing and use of preservatives and caulking materials:

Soils stains and residues of a resinous nature containing pine tar and oils. Short lengths of scrap lumber with one end covered in tar and oil residues, used for mixing. Coagulated lumps of pine tar containing kaolin clay or chalk dust used as sizing for seam sealant over caulking medium such as cotton.

Production of forged metal components:

Coal or coke ash mixed with metal slag and small fragments of heat altered iron. Material

thinly scattered and crushed in approximately 2m (6ft) circumference area around portable forges.

Steaming of Planks:

Single area of intense heat altered soil with accompanying concentrations of fine wood ash.

A 3m (9ft.) circumference area of bark shavings 0.025m x 0.457m to 0.609m (in wide and 18in to 24in), long was produced in the location where saplings were carved down for boat poles. It is doubtful that this method would have been used to produce poles in the past, based on the inherent thickness and weakness of the poles made by this method.

The area beneath the strongback on which the cotton boat was built was evenly scattered with shavings and chips. It was the only area of the construction site which also exhibited a variety of bent, damaged, or discarded nails, galvanized boat spikes and sections of treenails. Droppings of pitch, caulking medium, and scraps of raw spun cotton also were in abundance around the perimeter of the strongback.

Discussion

Context

Other small craft studies consulted prior to the commencement of this research program exhibit two principal approaches to such topics. Chapelle, for example, presents a broad overview on a national level for North America in "*American Small Sailing Craft*," (Chapelle 1951), using specific vessel types to indicate the presence of more extensive local traditions in various regions. Nicola O'Neil, in a very different approach (O'Neil 1991), offers a detailed study on one specific region's boat building traditions in West Africa, that of the dugout canoe in "*The Coastal Fishing Canoes of Ghana*." In the middle of this spectrum is McKee's (McKee 1983) study, "*Working Boats of Britain*" which offers a largely graphic, but highly detailed overview of a wide range of regional small craft in the United Kingdom.

This particular study goes beyond these, and similar studies, by also offering data on the environmental, historic, and ethnic contexts which determined the most common types of craft introduced into the South Carolina region, and generated

adaptations of their basic designs. The study provides some of the first organized data on these craft and provides a frame of reference for future research.

When Colonists first began to exploit the area, South Carolina offered the topography, climatic conditions, and riverine transportation routes ideal for the production and export of certain goods and crops. The Colony was founded with this very intention and the export economy was largely dependent upon these factors from the late seventeenth century until the destruction of the area as an economic force on the North American continent during the Civil War.

The export products of the area were dominated by naval stores, rice, indigo, and cotton. The nature of these products and the containers required to transport them were one of the factors which drove vessel design in the area. Products and crops were not produced in a single region of South Carolina. Consequently, differences in riverine environments coupled with the form of product containers, combined to require certain specifics in vessel form.

This is demonstrated best in two vessels, the mountain boat and the flat. The mountain boat carried extremely heavy cargo, tobacco hogsheads, down shallow, fast running rivers with very narrow channels. The result of the demands of cargo and environment resulted in a flat bottomed craft with framing and planking heavy enough to hold the tobacco barrels, yet light and pliable enough to negotiate narrow, fast dropping rapids.

The plantation flat by contrast, operated in wide shallow canals and occasionally local rivers. In the canals the flat carried materials ranging from earth for dikes to harvested rice. A requirement was the ability to carry voluminous cargoes such as rice sheaves or heavy cargo such as rice tierces while maintaining as light a draft as possible. The Magnolia Plantation Flat, for example, would have dropped 0.025m (1in) in the water for every 40,000kg (2,500lbs) of cargo (Fleetwood, William, personal communication 1992). As a ferry craft, the flat operated with the same requirement, maximum load and minimum draft, with heavier floor timbering and side construction being the only variation in design.

The cultural origins of the State's craft appear to be shared between the indigenous inhabitants, the European Colonists, which may have included French and Eastern European influences, and the West African slave population. It appears that the first vessels used were adaptations of Indian craft. As the need for different types of vessels arose, the traditions of Colonists and their slaves played a greater role. Specific cultural links are hard to establish. The Colonists widely adopted a practice of training slaves in ship building and carpentry skills. Yet there is ample

evidence that planters sought specific existing agricultural skills among imported slaves and, to a lesser extent, trade skills also. It is reasonable to assume therefore that West Africans with a strong tradition of water craft use and construction would also have been sought for these skills. The pirogue, which was used in the Niger delta, is a design which survived long after the plantation era and is still utilized in some areas of the Caribbean. Such knowledge may have been as readily assimilated into South Carolina plantation life as were African indigo, rice, tobacco and cotton growing skills.

Ethnology

The historical and archaeological evidence concerning small craft traditions in the region of South Carolina provides ample evidence from which an understanding of the technologies used can be developed. It is clear from this record that in most cases, while differing ethnic groups were involved in small craft construction, the primary design influence was European. Good examples of the imposition of European concepts of design on local craft would be the mountain boat, which can be traced back to the Stockholm tar boats of Finland, and the historic period dugout, built by Indians and Africans to European concepts of appearance and design.

Of particular interest to this study was a determination of the extent to which Africans may have been imported specifically for their boat building skills. There is a strong tradition of the use of African and African-American labour in traditional early American ship building industries. What is not clear from the archival record is to what extent early ship building utilized imported skills of Africans trained in the construction of West African craft such as the Niger delta pirogues or the Bullom boats of Sierra Leone (Smith, R. 1970:518). It is apparent, from the archival record noted above, that plantation owners and shipwrights apprenticed slaves to train in the methods used by white European owners of colonial and ante bellum shipyards. In general, many members of cultures from which slaves were exported to South Carolina had extensive craft and trade skills, and artistic skills with wood and metal of a high degree of sophistication (Bascom 1969:24-25 and Glascoe, Myrtle, personal, communication 1990). We have seen how there was an effort to import slaves from areas of West Africa where rice, cotton and indigo was grown, with the obvious intention of importing these skills with them (Littlefield 1981:77-78, 98-108, and Donnan 1930:476, note 3, and Matthews 1966:18, 52-53). A good direct example of this type of technology transfer is found in the "plug

trunk." This was a hollowed pine log with wooden plugs at each end. Set into a rice dike, and using tidal forces, it controlled water flow in to and out of the rice fields. Such a device is described as used by Africans on the Guinea Coast. It was called an "ehungat" and worked in exactly the same as manner described by David Doar who states that it was the earliest form of irrigation control used in the first South Carolina rice fields (Rodney 1970:22 and Doar 1936:12).

It seems reasonable, therefore, to expect to find the same kind of African technology transfers in boat building. One vessel, the pirogue, based on the archival record, does appear to be primarily influenced by African standards of construction and design. The complete absence of the remains of these vessels in lower coastal plain rivers is considered very significant. The one segment of slave society with the greatest mobility were the patroons who operated these pirogues. Since the end of The War Between the States, large enclaves of African-Americans have existed in coastal areas of South Carolina such as Cat and Dafauskie islands. It is most likely that the remains of pirogues will be found in the riverine areas around these islands.

In the case of dugout craft, various types of refinements make pronounced distinctions between pre-historic and historic period craft relatively easy. Determining the difference between ethnic origins of historic period craft is more complex. After the contact period the development of the dugout form becomes mired in various ethnic influences and traditions. McGrail (1982 and 1987:59-63), Basil Greenhill (1988), Goodburn and Redknap (1988), and others have documented ancient Celtic dugout traditions in England, Scotland, and Ireland in various publications and similar traditions exist elsewhere in Europe as documented by Ellmers (1974) and Cederlund (1993). Similarly, there is a strong West African dugout tradition as documented by researchers such as Smith, R. (1970:515-533), Vlach (1979:98) and O'Neil (1991).

Henry Glassie, quoted in Vlach (1979:97), says:

"The New World dugout may have a debt to pay in history to Africa and Ireland as well as to the Indian's America. It is suggestive that the idea of the canoe was not fully taken into Anglo-American culture until the population included its African and Irish element."

The "Europeanization" of prehistoric dugout forms has been advanced by some researchers as clear evidence of a single ethnic influence, the work of English shipwrights or of slaves trained in the English tradition.

In fact, there is strong evidence for many of these changes to the aboriginal form in African tradition. The dugout is known throughout West Africa and, most significantly in this study, especially so in rice producing regions of West Africa such as Sierra Leone from which South Carolina acquired slaves (Smith, R. 1970:515).

Historical accounts of early West African dugout traditions date to the late fifteenth and early sixteenth centuries (Smith, R. 1970:515-516). A recent study in Ghana clearly shows that methods of manufacture have changed little over the intervening period (O'Neil, Nicola, personal communication 1989. Also see O'Neil 1991). It is clear from O'Neil's observations and other accounts that changes in design of pre-historic dugout forms, from wedge ended to double ended bow and stern for example, owe as much to African tradition as they do to European. O'Neil's account of the initial production activity has parallels with the historic production accounts quoted above. The tree of choice in Ghana is the Wawa tree (*triplochiton scleroxylon*), a tree that often grows to a height of 60 meters with a straight and cylindrical shape and a lightweight yet firm wood which works well:

"The tree, once felled by hand saw and axe, is then cut to define the fore and aft limits of the hull. Shaping the canoe is begun by defining the sheer. A sheer line is drawn on the log by the head carver who usually has two helpers. Some guide-lines are used by the team leader for dimension proportions. The beam of the canoe is the maximum allowed by the diameter of the log. Horizontal dimensions are measured in hand spans with the curvature of the sheer line one handspan less in height above the base line or bottom of the hull at the mid point than the fore and aft ends of the hull. A measuring stick is used to transfer dimensions to other parts of the dugout. Cutting for bottom thickness is guided by placing a straight piece of lumber transversely from sheer to sheer and by then using the same measuring stick, subtracting a hand span from the outside depth of the hull. The inside bottom line is therefore dependent upon the sheerline. Side thickness varies from builder to builder but is

usually half a handspan...Normally two washstrakes are added to the sheer. They are fastened edge to edge at the same angle as the side - increasing the freeboard of the dugout..." (O'Neil, Nicola, personal communication 1989).

There is similar confusion in the published record about the ethnic origins of the pirogue. The type has been claimed as indigenous to the West Indies (Vlach 1979:98), but clear evidence exists that the type also was built in West Africa (Smith, R. 1970:521). Vlach states:

"The multiple log canoe is, however, indigenous to the West Indies (Vlach cites McCusick's *Aboriginal Canoes In The West Indies* to support this statement) where the Carib Indians made canoes from several hewn pieces of wood."

However, in a publication nine years prior to Vlach, Smith states that in the upper reaches of the Niger River the Tyindeketa and Zendji tribes were prominent boat builders and boatmen. He states:

"...from the Sixteenth century they may have been making larger vessels from planks as well as canoes," (Smith, R. 1970:521).

Smith bases his statement on a very significant observation by H. Moyse-Bartlett (Moyse-Bartlett 1946:2) on the upper Niger dugout tradition:

"By a crude process of pegging extra pieces of wood along the edges of the dugout canoes to secure greater freeboard, these evolved into plank-built boats, *of which the original canoe became merely the heavy keel*," (Moyse-Bartlett 1946:2, emphasis added. This may be a reference to the West African pirogue).

Vlach also cites modern day construction of pirogues in Guiana as a tradition learned from slaves:

"An example of how the Indian artifact (pirogue) survives in an Afro-American cultural setting is provided by the Maroon

communities of Guiana. The groups of Blacks, descendants of seventeenth century runaways, continue today to make canoes in the Carib manner....Africans acquired the Carib dugout with great ease, for in terms of form and structures boats made by Guyanese Blacks are identical to the Carib vessels described in sixteenth and seventh century travel accounts,"(Vlach 1979:101).

Vlach may have been unaware that many areas along the northern coast of South America imported slaves from West Africa and gave free rein to their boat-building skills during this time (Clayton 1988:123-124). It would seem to be more reasonable to credit the origin of pirogue design in these areas, and certainly in South Carolina, to a combination of indigenous Indian and imported West African traditions.

It is also significant that the pirogue appears to be the vessel of choice of African-American boatmen. To be sure, most vessels of any type from plantation flats to coasting schooners, were usually crewed by slaves, but the pirogue appears most often in the record as a craft under the command of a "patroon" as opposed to a "captain" (see numerous advertisements in the *South Carolina Gazette* and Nylund, Rowena, personal communication 1990).

In the mid eighteenth century, white crewmen complained about the use of slaves in this capacity. In 1744 they petitioned the State Legislature for relief from the problem:

"...planters and others in this Province did order, permit and appoint their Negro slaves as Masters or Patroons of their pettiaugers or small vessels *without any white man on board*. This hinders petitioners from being constantly employed here, and if not prevented, would cause them to leave (the) Province and others would be unwilling to come here," (Easterby 1954:552, emphasis added).

While the dugout and the pirogue may offer better opportunities for identifying African designs and construction methods, it is also true that Africans played a major role in construction of other craft types as well. While there may have been instances of boat construction by skilled "specialist" boat builders, it is also

apparent that the plantation carpenters were generally expected to include construction of boats and flats in their work:

"Perhaps the elite of the slave craftsmen were the carpenters. Not only did the carpenter build the Big Houses and the mills, the slave cabins and the barns, using such hand tools as the saw, plane, axe and hatchet, auger, adze, chisel and drawing knife, but also the floodgates to the "trunks" which flooded and drained the rice fields, and the fleet of flats, row-boats and dugout canoes. The technique of producing the dugout canoes was one of the traditional skills brought to the new World by West Africans." (Joyner 1977:64).

Author Charles Joyner, in his studies of slave life in the Waccamaw Neck region of South Carolina, also notes the importance attached to slaves with boat handling skills:

"Each plantation had certain slaves designated and trained to serve its transportation needs. Boatmen, for example, took charge of the fleet of flats, row-boats, dugout canoes which had to be maintained. Boats were valuable property, and the boat crews were charged not merely with their use, but with their care as well." (Joyner 1977:70)

In both northern and southern states, ship building was a major industry conducted by small scale enterprises controlled and managed by a working master carpenter (Rubin 1970:34). The practice of training plantation slaves in ship building techniques was apparently so common in the mid-eighteenth century that it threatened the livelihoods of these small shipyards in South Carolina. In 1744, English shipwrights petitioned the Legislature to ban the practice, in much the same way as white coasting schooner masters had objected to the use of all slave crews under African patroons on plantation ships. The conflict with the planters was avoided by allowing the English shipwrights to use slave labour in their own shipyards (Easterby 1954:547:550).

The general shortage of skilled labour in the Colonies further helped establish the practice of training slave labour in shipyards. As early as 1767, the sale of slaves formerly apprenticed to a ship's carpenter is recorded in Blandford, Virginia, (Pinchbeck 1926:29). Pinchbeck also states that Virginia slave owners apprenticed

young slaves to white ship builders to learn the trades of ship "ironers", ship blacksmiths, ship carpenters, ship axemen, ship sawyers, and ship riggers (Pinchbeck 1926:31).

Local archival evidence cited by Easterby and Joyner suggests that the practice was just as common in the South. By 1833, there were eight master shipbuilders working in Charleston and one hundred ships carpenters. Of these less than twenty were white (Hutchinson 1941:103). The number of skilled slave blacksmiths serving the ship building industry was probably as high. Advertisements for blacksmithing work commonly indicates wharves as locations for blacksmith's shops (South Carolina Gazette, May 21, 1753).

As with boat building, there are a few instances which indicate that Africans may have been sought for the blacksmithing skills. West African tradition and skill in metal working was well known and in certain areas blacksmiths belonged to guilds and often assumed positions of royalty or Priesthood (Christian 1972:49). Henry Laurens, one of South Carolina's most prolific letter writers, a planter and slave importer dispatched a newly imported slave to the Governor of East Florida in 1765 with the comment that the slave was a blacksmith and that..."if he as wrought any in his own country he will soon be improved in his knowledge by practice under a White man," (Littlefield 1981:107). That West Africans were apprenticed to Charleston blacksmiths also is indicated in the archival record (Deas 1941:27).

That South Carolina vessels tended to reflect the ethnic origins of the Colonists was noted by Baker (Baker 1962:Introduction). Baker states that "Shallops, pinks, galliots, bateaux, flats, punts, piraguas and Dutch sloops" were typical vessels found in the seventeenth century colony.

The search for evidence of other ethnicities through archaeological investigation is even less rewarding. French and German, (possibly east German and Polish) immigrants may well have brought cross planking and chine-girder ("iles" in early French construction) with them. As of this writing, neither direct archaeological evidence nor archival evidence of these connections has been found.

The one area of success in terms of identifying ethnic origin appears to be the case of the Petersburg cotton boat. As shown elsewhere in this study, the linkage between the vessel type and those of Finland appears to be reasonably direct in its travel down the mountain regions of the east coast of North America from the ore boat built by Swedish immigrants early in the eighteenth century.

The hope that West African workmanship may be detected in the archaeological record is yet to be fully realized due to the undoubted mix of imported native skills and the trade skills taught by Europeans. The question will not be answered in the area of shipbuilding until both the number of vessels studied is expanded and comparative data is developed on West African boat building of the same period.

Typological analysis

It is clear that a well-defined typology for South Carolina's historic working boats can be developed from both the archaeological and archival record. Further study may serve to expand and define the results presented here, but the data to date show that certain types of craft were designed and operated to meet specific needs determined by operating environment and the products shipped. The typology presented is therefore based on these factors.

Hull form was a response to environment, the most obvious examples being the mountain boat and the rice flat. Local response to the need to operate certain kinds of craft in mixed environments, the coasting schooner is the best example, has yet to be fully understood.

Some construction techniques appear to be adaptations of indigenous and imported methods. Early eighteenth century records show a preponderance of canoe and canoe derived craft (South Carolina Gazette, also Nylund, Rowena, personal communication 1989) which appears to indicate that adaptation of local craft was an early response to the expanding need for water transportation in the Colony. In other cases, influences are clearly European, as in the case of the mountain boat, in others there is less clarity. The chine-girder rice flat, for example could be a derivation of the cypress log dugout, or just as easily a French importation. Plank-built barges also offer no clear origins. Surprisingly, these transversely planked designs are not common in England (Marsden, Peter, personal communication 1991). They are found, however, in Poland. Jerzy Litwin describes transverse planking as an "extremely rare" technique in Europe generally and says the method has been used in "recent" times in Poland on the Kashulian Lakes and also in the Sprewald region of Germany (Litwin 1988:180). A Polish ferry boat known as the "galarek" (Litwin 1988:190) shows great similarity in design to the ferry craft at Brown's Ferry. Similar transversely planked craft are found in Podgradzie and Kielkow (Litwin 1988:206-211).

Aboriginal Dugouts

Aboriginal dugouts appear to have followed the conventions found in most temporal latitude countries around the world. Relatively large diameter, soft, or resinous woods were converted to crude types of canoe by the burn and scrape method (Hulton 1984:118). Prior to the contact period and the introduction of metal trade tools, canoes were produced by burning suitable trees and crudely shaping them with stones axes and shells. The earliest recorded date for an aboriginal dugout in North America is approximately 800 Before Present although far earlier dates are suspected (Creel 1984:40). Some of the earliest accounts of production methods were given in writings of early colonists in Virginia and North Carolina (Bartowe as quoted in Pittman 1970). One of these accounts, by Bartowe, is typical:

"They burne down some great tree, or take such as are winde fallen, a putting gumme and rosen upon one side thereof, they set fire to it, and when it hath burnt hollow, they cut out the coale with their shels, and ever where it hath burnt it hollow, they cut out the coale with their shels, and ever where they would burn it deeper or wider they lay on gummess, which burn away the timber, and by this means they fashion very fine boates...." (Pittman 1970:38).

Early dugout craft observed in the field have proven too degraded to exhibit much evidence of their method of manufacture. Possible pre-historic origins are indicated by crudity of bow and stern shaping and interior hollowing and an absence of "Europeanized" design features as discussed below, and metal tool marks. Size and beam of these pre-historic craft appear to have been determined more by the dimensions of the raw material than any traditional design factor. Those observed by the author in the field ranged in size from 3m to 5m (9.84ft to 16.4ft) in length and were probably capable of carrying no more than two to four people. That larger dugouts were constructed is indicated in the historical record (Pittman 1970:38) and in sport diver reports in South Carolina. According to Pittman's research some larger pre-historic canoes carried as many as 30 men and averaged over 14m (45.93ft) in length. One South Carolina dugout reported by a sport diver in the Cooper River measured 2m in beam with over 12m (39.37ft) of length exposed in an eroding river bank (Rooney, Kevin personal communication 1990). The need for craft of such size is attributed both to the size of lumber

available and the demands of trade and warfare. Lefler (1967:294) quotes early Colonial chronicler and traveler William Bartram who states that in Florida:

"...in these large canoes they descend the River on trading and hunting expeditions to the sea coast, neighbouring islands and keys, quite to the point of Florida, and sometimes *across the gulph, extending their navigation to the Bahama Islands and even to Cuba:* a crew of these adventurers had just arrived, having returned from Cuba but a few days before our arrival, with a cargo of spiritous liquors, Sugar and Tobacco..." (Lefler 1967:294 emphasis added).

It is significant to note that aboriginals may have routinely made long ocean voyages in what was regarded in historic times as an unseaworthy hull form.

All dugouts observed in the field for this study were of cypress. Historic accounts refer to the use of pine, cypress, walnut and poplar (Pittman 1970:53). The ability of cypress to survive well in wet environments may account for this bias. Pittman states a belief that resinous woods would have been preferred by aboriginals because their combustibility would have facilitated the burn and scrape method. This comment is made in apparent conflict with quotation from Bartowe about the use of flammable gums and resins on other woods which is also quoted in his paper.

The archaeological record does not appear to offer evidence of further sophistication of the basic dugout form in the pre-historic period. Large collections examined in North Carolina (Phelps 1989) and Mississippi (McGahey 1974:58) show little variation in production technique and basic form. Those dugouts observed in the field that had any structural integrity at all exhibited blunt bows and sterns. Other researchers consider this to be a diagnostic feature (Pittman 1970:57). The question remains as to what modifications were made to the design by aboriginals after the contact period when metal tools were available. Since, as cited elsewhere, there was an early practice of purchasing dugouts from Indians who had been provided with metal tools for the work, it is reasonable to assume that Indians may have "Europeanized" their own hull forms with these tools for their new "customers." Although there are many other sites to be studied, no evidence has yet come to light of transitional hull forms which can be attributed to such a source.

Historic Period Dugouts

There is no such clarity during the historic period. In fact, the dugout proves to be one of South Carolina's most enduring locally built water craft, being made and used well into the twentieth century (Creel 1984:40).

One of the most immediate changes in dugout tradition was by the aboriginal population which began to use European metal tools provided in trade from early Colonists. These craft appear to have been immediately adopted by the European settlers who induced Indians to make dugout canoes for them (Vlach 1979:97).

Various changes began to occur after the contact period. The basic shape of the dugout was modified to conform to European concepts of functional vessel form. Sterns were made rounder and fuller and some also were squared off, bows were shaped and pointed and splash boards added to the gunwhale at the bow. Describing an early form of canoe construction, Ivers states:

"The most common type of scout boat was the large canoe, a speedy offspring of the Indian dugout. A ten-oared canoe had a length of about 35 feet and a beam of six feet. The construction of a canoe began with a cypress or cedar log, hewn flat on two sides and usually sharpened at both ends. The outside of the log was shaped, three holes were drilled at intervals along the flattened bottom, the log was turned over, and the inside was hollowed out with chopping tools until the holes were exposed. The sides were tapered in thickness from about three inches at the bottom to an inch and a half at the gunwhales. Ribs and thwarts reinforced the thin hull. Sideboards, or strakes, were placed along the top of the gunwhales, increasing the canoe's depth. A stem, a keel, and a sternpost were attached, and a rudder was fixed to the sternpost with iron straps and pintles." (Ivers 1972:123)

The result still had the basic appearance of a dugout and this type of craft retained this form into the twentieth century, being produced in the Pee Dee region of the state as late as 1980 (Creel 1984:42). Creel's account of the production of one of these late dugouts provides information on techniques which are thought to have changed little over time:

"...boat diggers were always looking for straight-grained, sound cypress of a suitable size. "Tree selection was important because twisted or separated grain would result in a poor boat. Only heart cypress was used, but the twists in the bark usually gave away what was inside the tree," (quoting Dick Powell).

"..he used the foot adze, dressing knife, and howel passed down from his father. A critical device in his canoe building was the heart pine template his father made some forty years ago. The template sets the boat's side and end curvature and adapts to all canoes.

"To split a log, my father bored holes seven inches apart along the centreline and broke it apart with big wedges, Stone said," (quoting Moses Stone, age 72). The boat digger's tool collection has varied but little over the past two hundred years. It includes the broad axe, felling axe, hewing hatchet, foot or shipbuilder's adze, hand or cooper's adze, spokeshave, plane, drawing knife, maul, wedges, cross cut saw and hand augers. A squaring cord coated with chalk or soot was used to 'twang' the cutting lines. Even with twentieth century diggers, these hand tools were the primary armament at a work site usually well beyond the reach of modern power tools."(Creel 1984:42).

Creel's research has important confirmation in Doar's 1936 account of the felling and splitting of cypress for the building of chine-girder flats referred to later in this paper. Also, the account of tools used by Stone's father, compares favourably with the tools inventoried in the estate of Achilles Knight, an upper Pee Dee River boat builder who died in 1810. Among other general effects were listed; "1 iron square, 1 drawing knife, 1 gouge, 2 hammers, 1 pair compasses, 4 caulking irons, 1 smoothing plain, 1 foot adze, 3 screw augers, 2 barrel augers, 1 carrying knife, 1 broad axe and 1 narrow axe," (Marlboro County Estate Papers).

In addition to this basic dugout form, the craft also underwent radical refinements which produced craft indistinguishable in shell form from traditionally formed plank-built boats. Historian Michael Alford documented several such craft which were used on South Carolina plantations prior to 1860. A similar craft made in 1870 is also representative of this degree of refinement (Fig. 94). Another example was documented by the author and researcher Lynn Harris in Conway,

South Carolina (Fig. 95). Yet another was found being used as a planter in the garden of a canal side home in Horry County, South Carolina (Shuping, Hampton, personal communication 1992).

Another refinement was the addition of wash strakes or splash boards to the gunwhale of these craft. These were used to achieve considerable increases in the loading capacity of the craft. Different fastening methods appear to have been used depending upon the purpose of the additional planking. Some craft had wash strakes lightly held in place by edge to edge treenails, while others exhibit several built-up strakes held in place by both edge to edge nailing and the use of internal standard knees. None of these methods appear to echo the early flat bottomed, hard chine designs of European pre-historic dugouts (Johnstone 1980:164) The practice has also created some confusion in the historical record concerning the differentiation between the built-up dugout and the pirogue, historical accounts often leaving much doubt as to which type of craft was being discussed.

Barge Forms

There appears to be a decline in standards of craftsmanship for flats over the period of study (Fig. 96). Earlier craft are identified by hull forms similar to those in use in Europe and by the use of fastening techniques and components more closely associated with the shipwright's craft. Treenails, ship-lap scarph joints, and "ship specific" timbers such as standard and lodging knees, all are typical components of early craft. Later in the study period, craft were constructed with less durable methods, internal framing was of non-specialized timbers, standard lumber, and fastenings were common wire nails. Ramps at the ends of the craft were given long, gradual curves in early types, a skill and time intensive task. Later flats, even of the chine-girder variety, used short, sharply angled ramps which were easier to construct and plank. There also appears to be some diagnostic potential to the angle of the ramps used in various craft. After the early use of curved ramps, a form widely called a scow, it appears that shallow angled ramps were introduced for ferry craft. A 20° angle is a common feature of ferry craft examined for this study. Plantation flats appear to have used a 30° and higher angle while industrial barges of the later nineteenth century appear to favour a 50° angle

Although the planked up flat appears to have been built throughout the eighteenth and nineteenth centuries, the chine-girder type seems to have a specific temporal range linked to the period of the plantation system. During this period the clearing of lowland swamps made large cypress logs readily available. The

subsequent maintenance of the rice fields and the transport of crops generated a need for repair and replacement of plantation craft. The end of the plantation system as a result of the Civil War also appears to have resulted in the end of construction of this type of craft. No chine-girder craft have been found in contexts other than plantation rice fields with the exception of ferries which show no indication of dating beyond the ante bellum period. The current data suggest that temporal variations of chine-girder construction do exist during the period of use of this type of craft. It appears that the curving ramps pre-date angular ramps and that smaller chine-girders with planked-up sheerstrakes may be pre-dated by larger chine-girders that achieved the same hull depth without additional planking. Tool-marks also have the potential for establishing the temporal period of these craft. Extensive adze and offset axe marks appeared to be most often associated with earlier craft showing curving ramps, ship's timbers such as standard and lodging knees, and an absence of iron fastenings.

With one notable exception, all types of flats exhibited a marked reduction in construction timber size from earlier to later periods. Recording conditions, notably the surface erosion of timbers in tidal or underwater sites, made establishing accurate plank dimensions difficult. Despite this, it was found that planks on earlier vessel exhibited larger and less consistent dimensions than those of later periods. This is to be expected if craft were originally constructed from timbers prepared by hand at the construction site, by adzing, axing, pit or stage sawing for example. The use of consistent and smaller lumber sizing appears to be the result of the introduction of large scale lumber mills producing machine cut lumber such as sash mills in the 1820s to circular saw mills by 1835 (Moore 1967:19). The ready commercial availability of pre-cut lumber, especially after the collapse of the plantation system, was doubtless an influencing factor in the choices of lumber sizes used in construction. Subsequent construction was further influenced by the changing standards of the lumber processing industry which resulted in the "2x4" stud of the late nineteenth century, which measured 0.057m x 0.108m (2.25in x 4.25in), being reduced to today's stud measuring 0.044m x 0.095m (1.75in x 3.75in).

The exception to this general rule is the phosphate barge. These vessels, built between 1867 and 1893, are classic examples of the way in which function drives design even in the face of current practice. Rather than use readily available standard lumber sizes, which might have been "bulked up" to provide the needed strength, phosphate barge builders opted for massively cut solid timbers for

structural members as well as planking. In one case, a craft designated the "Hopper Barge" in the Edisto River, there is even a reversal to techniques common much earlier in the century, namely the use of naturally grown wood for standard knees. It is assumed that lumber of these dimensions had to be custom cut from local woods or cut from sources foreign to South Carolina where such large sizes may not have been readily available. Analysis of wood samples from these vessel should cast light on this problem.

There also appears to be greater uniformity in design in barges of this period. The early occurrence of workmanship peculiar to the carpenters of localized centres of construction, the plantations, declined in favour of the later workmanship of more centralized centres of construction, the industrialized boat yards.

Of the vessels studied only two, the Trent River craft presented here and a flat found beneath 6m of clay overburden on the banks of the Congaree River, exhibited typically European longitudinal planking. The origins of the almost universal athwart ship planking style in the study area has been difficult to determine. Several researchers such as Alford in the United States and Goodburn in the United Kingdom suggest that the method is an independent local invention having its origins in the re-utilization of the sides of worn-out dugout craft. Interestingly, Goodburn does recall documenting one cross planked barge in the UK (Goodburn 1984:48) Yet some evidence exists for transverse planking in Poland as reported in Litwin's work (Litwin 1988:180). Further insight into the method may be revealed by future study of Vistula River craft in Poland and early "ile" designs in France.

Ferry Craft

Unlike plantation craft, few references are found on the operation and construction of early ferry craft. The Amherst reference to a "scow" with flared ends (Amherst, General Jeffrey, Papers 1757-1863) implies the type of craft so named by Chappelle with inward curving side planks in addition to the usually curve from the bottom of the craft to the sheer line at stern and bow (Chappelle 1951:45-48, 67-80, 332-336). No craft of this specific design have so far been reported in South Carolina and only one chine-girder craft in the Waccamaw River at Laurel Hill in a ferry crossing context exhibits a curved profile as opposed to the angular ramped nineteenth century variety found at Avant's Ferry in the Black River. Though minimal at this stage of study, it is evident that early ferries were constructed in much the same way as flats used for other purposes. The use of the

term "rope ferries" in maps prior and up to the date of Mills 1825 atlas (Mills 1980) may indicate that the use of pulley stanchions and ropes were one of the early adaptations of the design to the specific function of a ferry.

Plank-built ferry craft, appear to have been used more extensively in the latter half of the nineteenth and earlier years of the twentieth centuries. These craft also appear to have undergone more sweeping changes in form in response to the changing nature of their cargoes. The livestock and carts of earlier periods do not appear to have required any change in the standard flat flooring construction of thwart ship planks fastened from underneath the craft into the side planks or chine-girders. If floors or ceiling planks were used they were most likely laid over the longitudinal keelsons as with most flats that were not used as ferries. The advent of trucks and cars appears to have coincided with the introduction of much heavier flooring structures in which multiple keelsons, actually heavy planking set on edge, were used with the ceiling planking nailed to the keelsons. Another diagnostic feature of these planked ferry craft appears to be the addition of strengthening planks or clamps to the inside of the gunwhale on the side which supports the pulley stanchions.

Chine-girder Plantation Flats

One general statement that can be made about chine-girder barges is the evident craftsmanship in their construction. Unlike plank-built barges, a reduction in quality of lumber, fastenings and workmanship is *not* apparent over time. This may indicate that the vessel type was not temporally sensitive. Sawmill cut planks tended to be reduced in size as "stock" lumber size conventions diminished from the Colonial period to the present. The chine-girder barge may have ranged from the mid eighteenth century when tidal rice culture became widespread to the mid nineteenth century when the Civil War ended the slave labour based culture. One reason for this may have been the ready availability of large cypress logs as more lowland swamplands came under rice cultivation.

The craftsmanship in all of these vessels observed is of a high quality. Wedged treenails and ship-lap scarph joints were not observed on the Conway Narrow Flat, but the general quality of the carpentry and the utilization of natural knees is consistent with skilled shipwrightry. Especially noteworthy is the skill with which each chine-girder was reduced to a plank like thickness at the gunwhale. This work was so well accomplished that upon initial examination, it was thought the craft was planked. As mentioned above, this does not suggest that the builder of the craft was

necessarily European, or trained by European shipwrights. The ethnic influences are too complex, especially in the nineteenth century, for such a definitive statement to be made.

The Conway Narrow Flat is an important example of the design because of the unique contribution it makes to the record of information we have on these craft. That record is small, so small that until this vessel was studied no common features between barges had been noted. The unique features of the craft are its overall dimensions. It is extraordinarily narrow in beam compared to its length, yet of equal importance is the fact that fastening methods are similar to those of the Black River chine-girder barge and another craft of the same type found by the author in Mingo Creek, a tributary of the Black River.

The curvature of the chine-girders also was a unique feature at the time of documentation. Other flats that have been recorded all exhibit a sharply angled profile for bow and stern. Only one other chine-girder flat with a similar curving profile has been found, significantly off Laurel Hill Plantation in the Waccamaw River. This type of profile is similar to those of early European flats (Newell, 1989:65).

Some questions still remain concerning construction of the Conway Narrow Flat. The method of attaching the sheerstrake is not fully understood. Four standard knees, each attached to the chine-girder and a thwart, provide attachment points for a sheerstrake. These fastenings alone would have been insufficient and presumably the slight treenail indentations on the top edge of the chine-girder are evidence of additional fasteners. As noted above, the treenail indentations are as thick as the gunwhale of the chine-girder. This is puzzling since such a treenail could not have held anything in place. The only solution that presents itself is that the gunwhale of the girder flared out at this point to provide a thickness which would hold the size treenail observed. This suggests an even more remarkable shaping skill and sheerstrake fastening technique. Further light may be shed on this problem when a more detailed examination of the craft is undertaken.

The fastening pattern on the centre keelson also requires further study. At the intact end of the craft the keelson exhibits a regular stepped pattern of treenails as observed on similar craft. At the 3.60m (11.8ft) point this pattern changes to a straight line of treenails on the port side of the keelson. The reason for this is not understood at this time.

Two small holes in the keelson present a similar problem, there is no apparent reason for their presence. The smaller hole is offset from the centre of the keelson

and the two larger ones, at 0.77m and 3.60m (30.31in and 11.81ft) pierce the keelson and show no signs of edge wear. It is possible that these indicate the use of small masts but this would seem unlikely considering the environment the craft may have operated in. It is also possible that the holes indicate re-utilization of salvaged lumber (Newell 1989:70). No indication of the use of masts, or of the re-utilization of timber, has been found in any of the other flats examined for this study.

The keelson, thwart, knee assembly provides the primary strength of the structure and may have been deliberately designed to provide a load bearing surface to keep weight off the planks. Detailed examination of the keelson is needed before these questions can be answered.

The experimental replication of the Conway Narrow Flat in model form produced intriguing results and data, provided the 1:10 scale chine girders were behaving in much the same manner as full scale chine-girder would do (Newell 1993b:11). If this is the case, then clearly the builders had, doubtless through trial and error, a sophisticated knowledge of how the green cypress would behave. Going beyond this, they also knew how to use these drying characteristics to their advantage, using the outward movement of the chine-girder ends and the inward movement of the thinned chine-girder sides to "pre-stress" the frame of the craft. This is an indication of a very high level of boat building skill.

The Laurel Hill flat is interesting in that it is only the second craft with the curving scow-type chine-girders similar to those found in Medieval Europe. More importantly, it has overall design characteristics which match reconstructions of the smaller and Conway Narrow Flat. This evidence suggests that the design of the chine-girder, curving as opposed to angle ramped, may indicate an earlier form of the chine-girder tradition in South Carolina.

Fastening and framing methods on these two craft, may also offer an indication of age. Both these vessels used standard and lodging knees to support a built-up plank or sheerstrake. The entire structure in both cases was fastening with trenails. The Laurel Hill Flat also used a pegged mortise and tenon technique known to have been common in Colonial times.

In general, the use of thwart ship planking is a departure from traditional chine-girder design as documented by Ellmers (Ellmers 1984:157-163, and Figs. 7.5 and 7.6 in McGrail 1982). The Trent River Flat (it may have been a ferry) offers the closest similarity to illustrations of European designs. Until more craft are studied in this region it cannot be determined if this is an example of a wider regional design preference or an exception to the general rule observed in South Carolina.

Plank-built Plantation Flats

Plank-built flats on plantations appear to have been built at the same time as chine-girder craft. Historical accounts describe the construction of chine-girders and planked barges prior to the Civil War and both types have been documented in plantation contexts. Since both types appear to have served the same function, the reasons why one type was built as opposed to another is yet to be understood. This may have been due to factors such as the availability of large cypress logs for chine-girder craft, the less labour intensive method of planked-up construction, or perhaps even the level of skill of the individual plantation carpenters.

If fastener type proves to be an indicator of age, it may well be shown that the chine-girder craft were produced in larger numbers than planked craft earlier in the development cycle of the plantation. This emphasis may then have changed late in the ante bellum period when factors such as the cessation of new rice field construction, labour intensity, cost and lumber availability, favoured construction of planked craft. Fasteners in all of the chine-girder craft studied tended to be treenails with minor use of wrought nails and only one instance of an iron drift pin. Planked barges, in contrast used metal fastenings almost exclusively. These ranged from wrought nails and drift pins to machine forged cut nails and wire nails. Tooling may also provide similar indications. Where erosion had not eradicated tool marks, all of those observed on planked barges indicated use of machine tools, notably sash or circular saw marks which post date 1830 in the area of study. Chine-girder barges showed extensive use of hand tools even on their planked components which could have been more easily produced by machine had the process been available.

The construction of a planked up plantation barge as an experimental archaeological project proved useful for the insights provided into the construction process. It was evident that three people could construct a typical barge in less than a month, assuming prepared timber was on hand. The movement of large lumber components around the work site was not particularly difficult with this number of people. The barge built by the author at Magnolia Plantation was constructed on an elevated platform. This would probably have been the choice of a yard or plantation where barges might have been built for resale. Examination of the completed structure indicated that its seams would not have to have been caulked immediately, perhaps within two or three years. As a result, the estimated life of such a craft would be five to seven years. Barges built so infrequently on a plantation would not

have been constructed in a specially prepared construction area. Instead, large sills or logs would have been leveled at the riverside and the barge constructed, launched, and the area returned to some other more frequent plantation function. This also suggests a possible hypothesis for explanation of the great variation in construction techniques and quality of workmanship observed on these craft. A single plantation in need of replacing its flats on a five to seven year schedule would tend to have this work done by the plantation carpenter (as the archival records has indicated). The implication is that if small craft, especially flats, were being built so infrequently, skilled or practiced workmanship and consistency in technique would be difficult to maintain.

Post-Civil War Industrial Barges

Phosphate Industry Barges

The wrecked barges of the South Edisto River region may well be one of the legacies of the hurricane of 1893. The region was a centre of land and river based phosphate mining industries and the relatively large number of eleven barge wrecks in a small area may be explained by the process of destruction by the hurricane which ended the marine mining phase of the industry, and less so by the expected process of normal attrition by use. This hypothesis is supported by the general temporal range of the wrecks, all appear to have similar construction methods, fasteners and design features. No evolution of design is readily apparent and deterioration of the wreckage is generally uniform. These are all indications that the craft were abandoned at the same time. The massive construction contrasts with the general trend of reduction in lumber size and appears to have been the result of commercial construction specifically for the needs of the marine phosphate mining industry. Since South Carolina was the origination point of phosphate mining in the Southeastern United States, study of these craft in other states might provide additional data on developments and adaptations of these South Carolina designs.

Another diagnostic feature of the craft appears to be the extensive use of heavily cast fastenings, bitts and the use of industrial bilge pumps made in the Northern United States. Several of the barges visited for the study utilized bilge pumps from one northern factory, another possible indicator of fabrication at the same time and place.

General Industrial Barge Craft after 1893

The construction and use of plank-built barges appears to have rapidly declined after the cessation of phosphate mining operations in South Carolina. The decline of the State canal system, the abrupt end of large scale rice production, and the equally abrupt end of the phosphate mining industry reduced demand for this type of vessel to a minimum.

Planked craft continued to be made for use as ferry craft up into the 1940s, the last known craft being the one used at Brown's Ferry on the Black River until the 1950s after which it was transferred to Cat Island where it was abandoned in the 1970s.

A number of different types of wooden barges were built in the 1930s specifically for the use of construction operations at the head-waters of the Cooper River. These ranged from small, lightly built craft of 0.05m x 0.23m (2in x 9in) planking to the large machinery platform documented in Biggin Creek. All of these craft exhibited the vertical transom stern of the modern push-barge. Construction materials were wire nails and pine used for both framing timbers and planking, a departure from the live oak framing used on earlier craft. The minimal metal fittings used on earlier craft were found to be wrought iron whereas the mooring bits and rings used on the Biggin Creek Barge were large iron castings.

These craft were abandoned after the construction of the dam. Three of the smaller push barges were found in Wadboo Creek and the large equipment barge was found sunk in the mouth of Biggin Creek, both waterways at the head of the Cooper River and less than a mile from Pinopolis Dam. This process of discarding the craft appears to indicate that there was no other use for the vessels when the construction project was complete.

That other planked craft were built is indicated by the 1940s construction of the mud barge at Mepkin Plantation. This appears to be a single response to a specific need, the repair of dikes due to erosion. It does indicate that similar needs may have arisen elsewhere in the low country region but have yet to be documented. No wooden barges or lighters associated with the industrial activities of Charleston Harbour appear to have survived. A survey of the area indicated that remaining wreckage in waterways on the periphery of the harbour are associated with historic plantations.

The Pirogue

The Pirogue is another example of a craft with mixed origins. It was clearly the vessel of choice for African crews in South Carolina's coastal plain and, according to Littlefield, was a type common in the Niger Delta (Littlefield 1981:91). There is strong support in the data for the hypothesis that Africans imported this type of hull form into the area. Yet there is also evidence for the co-invention of the form in the Caribbean and also suggestions in the archival record that the form evolved from the planked up dugout early in the history of the area. Study of examples of these craft will begin to answer questions about their derivation, and it is significant that so few of them are to be found in the regions of the lower coastal plain where they were known to operate. The remains of flats, ferries and coasting schooners are all to be found in these areas and the absence of pirogues within this disposal pattern is worthy of further investigation. It has been noted above that the pirogue appeared to be the vessel of choice of African and African-American captains and crews. The disposal pattern of craft associated with the rice culture appears to reflect the catastrophic cessation of the industry resulting from the Civil War. Does the absence of pirogues within the pattern indicate that these vessels were removed from their normal plantation and riverine contexts by their operators? The operators of these vessels were those members of the plantation population freed from a forced presence on the plantations at the end of the war. While many former slaves stayed close to plantations where they found paid work, or were given land to live on, that small portion of the population skilled in the use of sailing craft may well have traveled further afield. This hypothesis may possibly be tested by a survey of those coastal waters around islands in South Carolina where African-Americans concentrated after the Civil War, Cat Island, and Daufuskie Island are both examples. If these waters contain a preponderance of pirogue remains, this patterning may offer insights into both demographic changes after the Civil War and the absence of pirogues in the general lower coastal plain vessel disposal pattern.

Coasting Schooners and Sloops

The Vessel at Brown's Ferry

Remains of the coasting schooner, the prime example of a mixed environment vessel, have been found only in riverine contexts. The Ingram Vessel found at the head of navigation of the Pee Dee River may also have been of this type, but was too fragmentary for reliable identification as a coasting schooner type. Even if exhaustively studied, these sites will only reveal information about the vessels in

relationship to this environment. What is not known at this time is how these vessels may have been rigged or prepared for ocean travel. Did they use lee boards on coastal voyages? The absence of keels or use of shallow keels on later vessels, would suggest that these craft would have needed these devices for stabilizing and steering the craft in open waters. No such evidence has been found to date. There is no doubt that the coasting schooner traveled extensively on coastal voyages. As Richard Steffy notes on the coasting schooner found at Brown's Ferry in the Black River, Georgetown County in 1976:

"...Teredo damage indicated the vessel must have wandered beyond the confines of the Black River; she may have been one of the many coastal vessels supplying ports such as Charleston with building materials, farm products, and cargoes to be forwarded to deep water ships....We see her as a vessel which may have occasionally run her flat bottom on a bank to load where docks did not exist; to float downstream with the current and upstream with the tide, using...poles and oars...to keep off the banks or to provide propulsion when wind and tide failed." (Albright and Steffy 1979:138-141).

[Later evidence shows that bricks were being imported *into* Georgetown from northern ports early in the eighteenth century (Port Registry 1733, City of Georgetown, South Carolina)].

The archaeological record appears to indicate progressive design refinements from the early eighteenth century to the mid-nineteenth. This effort was directed at increasing the capacity of the coasting schooner while maintaining its flat bottom and shallow draft. There also appears to have been a greater use of pre-cut mould frames in later vessels aimed at simplifying the task of extending the midship beam fore and aft of the centre of the craft. It appears that craft built after the early nineteenth century used fully finished timbers for floors and frames as opposed to the partially finished timbers of the vessel at Brown's Ferry. Since this early craft is the only one of its type to have been documented in the State, there are certain dangers in using it for comparison purposes with later craft such as the Mepkin Abbey and Biggin Creek coasting schooner wrecks, discussed below. Two current interpretations of its design show deficiencies in light of archival evidence and experimental work done for this study. The later craft used heavy floor timbers to

which narrow planks were attached to build the flat bottom, whereas the vessel at Brown's Ferry used only three planks of extreme thickness to provide both planking and structural strength in addition to floor timbers for the flat bottom. When and if similar craft of the same period are studied, evidence may be found that the vessel at Brown's Ferry is an example of a third construction type with its own place alongside the pirogue and the plank on frame coasting schooner.

In terms of shell form, it is also significant that no evidence has been found of double ended designs (despite the early double-ender interpretation given the vessel at Brown's Ferry). All field data now on record, coupled with representations of vessels in the archives, indicate that this was not the design of preference in the region.

The earliest and only coasting schooner hull to have undergone some study is that of the vessel at Brown's Ferry. Unfortunately, none of the SCIAA archaeologists or conservators involved in work on the vessel since its recovery in 1976 have published a full report on their findings. A cursory study of the hull was made at that time when the vessel was excavated and raised by SCIAA. A further study was conducted in 1991 by a second SCIAA team following completion of a minimally successful polyethylene glycol total immersion conservation process.

The preliminary announcement of the recovery (Albright and Steffy 1979:121-142) determined that the vessel was built with edge fastened king and queen planks on which mould frames were fastened. The vessel was then planked, the additional frames being formed to the line of the shell (Fig 97). The frames were centred on 0.69m (24in) and averaged 0.116m (4in) moulded and 0.127m (5in) sided. Length was 15.37m (50.42ft), depth of hold 0.914m (36in) and beam 4.26m (14ft) (Fig. 98).

Steffy's original interpretation of the hull indicated a double ender. In 1984 the author participated in recovery of additional timbers from the site, including framing pieces from the area where the stern had collapsed. Re-interpreting these frames and other information in 1991, after conservation, Dr. Fred Hocker determined that the vessel had a transom stern (Hocker, Fred, personal communication 1991b, Fig. 99). This configuration is consistent with the general design preference in the state evidenced by other vessels examined in the field by the author.

Steffy's analysis of the hull type holds good for the general type in the state:

"The Brown's Ferry vessel was flat-bottomed and keelless, apparently for the purpose of reducing draft. The designer desired to

keep his hold volume as great as possible, maintaining rather full sides as far fore and aft of amidships as was feasible. The result was a complex framing plan for so small and simply appointed a craft, employing softly rounded hull sections amidships, compound shapes in the quarters, and pointed bow and stern. Thus the vessel was shallow enough to operate in shoal waters but full enough in the hold to accommodate a sizable cargo." (Albright and Steffy 1979:121-142).

At this writing, the vessel found at Brown's Ferry landing is the best example of the coasting schooner available for study. This is unfortunate, since the author recorded the locations of two similar vessels of the same period in far more complete condition within minutes of the vessel that was raised. The recovery of the partial remains of the vessel at Brown's ferry landing were driven not by archaeological necessity, but by the availability of funds for the task. Steffy's early interpretation, as has been shown above, was wrong, due to the lack of complete excavation by a professional investigator. Hocker's later interpretation is flawed also, clearly missing the fact that the king plank had an approximate 0.15m (6in) amount of rocker at the bow and stern (actual opportunity for study of the vessel remains by Hocker was a short period during which its preservation tank was being drained). The degree of rocker was only apparent in 1992 after the rather crude assembly of the misshapen ship parts on the upper floor of a museum building in Georgetown, South Carolina, by SCIAA staff. Here the long efforts of various conservators and investigators is understandably carefully hidden.

The Mepkin Abbey Vessel

Examination of the remains of other coasting schooner hulls dated over the next hundred years show some refinement of the basic hull shape. Construction does appear to have undergone change. The Mepkin Abbey Vessel, examined by the University of South Carolina in 1980, was dated to the early years of the nineteenth century by stonewares found by sport divers within the hull (Willbanks 1981:151).

The hull shape was clearly designed to fulfill the same function as the vessel at Brown's Ferry. The wreckage had a remaining length of 16.8m (55.11ft) and a remaining beam of 3.85m (12.59ft), suggesting an overall length of approximately 15.5m (50.85ft) and an extreme beam of 4.9m (16ft), dimensions not dissimilar to those of the earlier vessel. Also, the designer clearly attempted to extend the hull

volume fore and aft as did the designer of the vessel at Brown's Ferry. This effort was more successful, the floor timbers showing that the hull volume extended well beyond the fore and aft limits of the earlier vessel (Fig.100).

This indication that there was a demand for greater cargo capacity in later coasting schooners is also supported by differences in the construction. While the floors were centred on approximately 0.6m (23.62in), the timbers were slightly heavier, 0.13m (5in) sided by 0.15m (6in) moulded compared to 0.13m (5in) sided by 0.1m (4in) moulded on the vessel at Brown's Ferry. These floors extended the full remaining beam of the vessel, the keelson being notched to receive them. In addition to these 18 floors, another 14 first futtocks also passed under the keelson and were fasteners fore and aft to the floors. Most of these futtocks were positioned aft of the midsection creating an especially heavy load bearing area. Another significant variation in construction was the use of a keel which was 0.305m (12in) sided and 0.25m (10in) moulded at its thickest point amidships. A different design criteria was at work during this period of coasting schooner construction. Other construction variations of interest in this vessel include the use of a "saddled" mast step similar to those used in Chesapeake Bay vessels built during the Revolutionary War. The step was carved into a semi-circular section of live oak which was notched over an assemblage consisting of the keelson and two small sisters strapped together with two iron bands (Fig.101). The mortise for the step appears to have been cut with an early mortising machine (Sloane 1964:77). Unlike the vessel at Brown's Ferry, an entire stern post and rudder assembly was found at the Mepkin Abbey site, providing a first inspection opportunity for construction of this later vessel component (Fig 102). Rudder construction is similar to that of another wreck discovered by dock construction workers in Hobcaw Creek and also dated to the early nineteenth century by ceramics found in the wreckage (Fig. 103).

The King's Grant Vessel

An even more extreme example of the attempt to achieve maximum beam and hold capacity over hull length is the King's Grant vessel. This wreck was first documented by William Judd in the Ashley river in 1983 and 1985. The site was surveyed by the author in the Spring of 1988 to confirm Judd's data. The overall length of the remaining wreckage is 17.37m (57ft) and the remaining beam is 4.44m (14ft,6in), indicating a probable original 21m (70ft) overall length and 4.87m (16ft) beam. The beam is maintained over eight frames forward of the midship section for a distance of approximately 1.82m (6ft) and 14 frames aft for a

distance of 3.04m (10ft). The last remaining frame on the wreckage, no. 14, is slightly more than 0.91m (36in) from the end of the keel (Fig. 104). Even allowing for lost length on the wreckage, this configuration would be pressing the limits of hull design for this type of vessel.

The vessel's keel was 0.35m (14in) sided by 0.18m (7in) moulded, the keel's sided dimension being the greatest, probably to reduce draft. The keelson had the same dimensions as the keel and the frames were 0.13m (5in) sided and 0.15m (6in) moulded, centred on 0.3m (12in) instead of the more common 0.6m (24in). This extremely heavy construction may be indicative of the last design stage of the coasting schooner where the limits of shell form and cargo capacity were being reached, probably in the latter years of the ante bellum period.

In closing, the early coasting schooners appear to be the product of imported European traditional ship building technique and were doubtless the product of European shipwrights, or local shipwrights trained by European shipwrights, or using information such as Bushnell's "*The Compleat Shipwright*" (Bushnell 1716). The later coasting schooner, such as those of the early nineteenth century, appear to have evolved in response to greatly increased cargo capacity demands, a probable explanation for the extension of the wide beam as far forward and to stern as possible. Certainly the demands of cargo capacity appear to have been highest in the first quarter of the century when delivery of cotton to Charleston's Cooper River wharves was at its highest (Pease and Pease 1985:50). It is from this period that most of the extant remains appear to date.

Offshore Sloops

Some small, round hulled forms, the "transom vessel" and the Hunting Island fishing craft, have been mentioned above. There is, in addition, evidence of a substantial tradition of much larger hulls of the sloop form and it is apparent that some plantations owned and operated deeper draft ocean going hulls that were able to negotiate the lower reaches of rivers such as the Ashley and the Cooper (Newell 1985:3).

The Dean Hall Vessel, Lewisfield Vessel, and the Malcolm Boat, confirm the archival indications that there was an extensive coastal trade using small ocean going sloops. These vessels, as the remains reveal, were sufficiently well built to make long coastal and offshore trips a distinct possibility. Navigational texts which were written specifically for these types of voyages were readily available throughout most of the eighteenth century (Furlong 1796). The use of local woods

from live oak, cypress, and pine indicate a local construction tradition and there is ample archival evidence that small coasting craft navigated long coastal distances. Unlike barges, which showed a distinct local variation in construction technique (the thwartship bottom planking), these vessels appear to show no truly distinctive local design features.

One such vessel, at the abandoned dock of Dean Hall Plantation on the Cooper River, appears to be a deep draft, rounded hull with extremely heavy framing. A similar vessel studied by the author in 1986, lies at the landing of Lewisfield Plantation near Monck's Corner, supposedly the victim of a Revolutionary War encounter between British Forces and rebels led by Wade Hampton. The third vessel of this type, named the Malcolm Boat after its original discoverer, was initially documented by the author in 1985. These vessels, some of which may not have been locally built, appear to be examples of traditional building techniques. Evidently these vessels were owned by planters rich enough to afford craft which they used in open ocean trade to East Coast ports and the Caribbean.

Mountain Boats

Examples of all but one of the types of craft identified in the historical record above have been located in the archeological record of the lower coastal plain of South Carolina (a pirogue has been tentatively identified but not yet confirmed). The one exception is the mountain boat. The vessel type appears to have ceased operation in the late nineteenth, early twentieth century, and no examples have come to light in those rivers examined as part of this dissertation. Little survey activity has taken place in the upper piedmont or mountain region of the state, nor, given the current thrust of research and resource management in the State, is it likely to in the near future. The extraordinarily long life of the vessel type, from the 1790s to the 1920s, suggested a high probability for still extant "living records" of the boats and their crews in the memories of area residents. Carson's account in Gilmore and the Augusta Canal photograph offered reliable evidence on which analysis and reconstruction of this vessel type could be based. In light of this information, the vessel type was considered an excellent candidate for further experimental archaeological studies, as reported below and in Newell 1992c:8.

Other Upland Craft.

Not all craft in the upper Piedmont were of the mountain boat type. Remains found at the upper reaches of navigation of the Pee Dee River in 1990 clearly

indicated that the coasting schooner also was adapted for shallow upriver environments. This wreckage was discovered by sport diver Miller Ingram off the town of Cheraw, South Carolina, at the head of navigation of the Pee Dee River. Its location is consistent with archival evidence that the Pee Dee was made navigable as far as the North Carolina Border, if not beyond (McCord 1840:584). The author examined the wreckage with the diver in 1990. It was clear that the partial wreckage was the remains of an extensively damaged vessel. Sufficient data were recovered at this time to determine that the wreck was capsized. The widest available beam on the fragmentary remains was approximately 4m (13.12ft) and the construction was entirely of pine. The floor timbers were of 0.1m x 0.08m (4in x 3in), the keel a shallow curved cross section piece of pine 0.33m wide (13in) pine. The craft was flat bottomed and fastened with treenails, many of them spiked with wrought nails. The author subsequently wrote a grant, research design and methodology for excavation of this site (Newell 1993a:8-22). This work was later done by others, but insufficient data were gathered to advance further professional analysis of the remains. At this writing, it can be said that there is minimal evidence for the construction of the coasting schooner hull type in upland river regions.

Experimental Archaeology

The Magnolia Barge Replication

Unlike the experimental Petersburg Boat Project, enough examples of plantation barges were studied as part of this research to provide a good knowledge of the basic construction itself. Of greater interest during this project was the development of information concerning the process of construction. It was learned that a large plantation barge could be built within a matter of weeks by one experienced carpenter with three assistants and a ready supply of cut wood. A probable construction sequence was recorded and an understanding of the various tasks involved was developed. Most importantly, an understanding of historic craft construction site formation was developed, providing an experimental predictive model for use in finding historic construction sites on area plantations. A ready supply of large live oak timbers were available for this project as a result of a recent storm. This added a study of the possible production methods and the conversion process for these huge timbers which were commonly used for internal framing members, most frequently knees and deadwoods.

The project demonstrated that large, heavy sections of wood could be handled with ease by two men, and moved on a strongback by one with complete ease and a

little candlewax. One interesting revelation concerned the use of hand tools versus power tools. One of the most labor intensive tasks anticipated during the planning stages of the work was the driving of more than 500 1.52m (6in) boat nails through yellow pine and cured heart pine. This was considered a daunting job, so much so that serious consideration was given to building the barge bottom upside down solely to facilitate driving spikes or boat nails through the bottom planking. This idea was abandoned because of the subsequent difficulty envisaged in turning the bottom structure over to complete the sides and ramps. It also was considered doubtful that this was done in the nineteenth century, as opposed to chine-log barges, for much the same reason. Instead, it was decided to use a strongback and drive the boat nails from underneath using a pneumatic hammer. In actual practice, the pneumatic hammer could not drive the boat nails further than 0.1m (4in) into the wood, and it broke completely after some 300 nails. Then a short handled 96.11kg (61b) hammer was used. It was discovered that the hammer, swung at arm's length, swiftly and efficiently drove the boat nails into their pilot holes.

Similarly, it was found that a power plane and power augur were not easier to use than their hand powered historical counterparts, they were simply about twenty per cent faster. Even in the case of power saws, they were sometimes set aside in favor of hand saws which were easier to control, more accurate and only minimally harder to use.

Among the more interesting observations the project allowed were those on the behaviour of the construction crew. Swearing, the longer and more colourful the better, was reserved for tools or wooden components that did not behave as desired. This behaviour was almost considered an art form by this particular crew, causing the author to wonder if there was any historical basis in the ship building trade for such a tradition.

There also was a natural tendency, doubtless born of prior experience, to place tools and lumber in certain locations to facilitate carrying and lifting. All finished lumber, planking, for example, was placed right alongside the building location after being sorted in order to place the highest quality pieces on the top of the stack. This was so that they would be used for the bottom sections of the craft where they would be subject to the greatest stress and wear.

There also was a tendency to set aside certain areas around the building site for specific functions. Planking was planed and shaped in one area, heavy internal logs were cut and shaped in another area, and knees, which required a great deal of shaping with chisels and gouges, were done in a third location. The type of work

done in each of these areas could be easily determined by the nature of the shavings produced, from sawdust to planer shavings to gouge and chisel chips.

Since mill cut lumber was transported to the site for the barge, there was no experimental evidence created for another important function missing from the project, the conversion of raw lumber into finished stock. This would have been done in historical construction sites, adding elements such as saw pits to site formation.

These physical remains may indicate a site formation process that could serve as a predictive model for locating future historic ship construction sites. Since the same process was observed during construction of the next experimental craft, the Petersburg boat, discussion of these findings is covered below.

The Petersburg Boat Reconstruction

Original working assumptions were that these vessels were probably built by area carpenters who were probably not full-time shipwrights. This assumption was based on similar findings on lower coastal plain plantations where evidence shows this to be the case on many plantations. To the contrary, detailed analysis of the only surviving photograph located to date, coupled with evaluation of the known performance characteristics of the craft and the author's initial reconstruction drawings, indicated that much skill and knowledge went into the construction of these craft. To perform as they did, it appears that the craft may well have closely matched the reconstruction vessel. The evident wear and tear on the craft in the photograph would also indicate an extended lifetime and an ability to continue to operate after considerable abuse.

In developing the hull form during solid modeling, it was apparent that the midship hull form remained the same throughout the length of the hull. The bow and stern were designed to be simply added on to whatever length hull the builder desired. This may be an explanation for the wide variation in reported lengths of the vessels.

The width of the craft appeared to "work" better on the solid model if a soft chine was added with a 0.305m (12in) radius resulting a slightly narrower bottom width. It also was felt that the craft would travel more easily over rocks and gravel banks with the rounder chine. In actual practice, a hard chine, as originally designed by the author, was used. This appeared to considerably add to the stability of the craft, while making no difference to its ability to negotiate over or around sand banks and snags.

In any area where boat building was an on going commercial enterprise, or seasonally repeated activity such as on a plantation, site patterning might reasonably be expected to be evident on the form of a formalized layout. Since a large number of these craft appear to have been produced by a small number of builders and plantations, there would seem to be some value to field testing such a predictive model in the areas of Petersburg not inundated by the Lake Russell (These plantations along the Savannah River were inundated when the hydroelectric project was developed). Considerable material culture of the now defunct town remains and may hold the prospect for productive investigation.

Vessel Disposal Patterns

Some distinct disposal patterns emerged from the data. Rice flats appear to have been abandoned in a pattern consistent with the sudden, even catastrophic, cessation of the rice culture at the time of the Civil War. Most commonly, large rice flats were found submerged in the remains of main canals next to rice mills. This phenomenon was observed throughout the tidal rice culture plantations. There appears to have been no attempt to adapt these craft to any other use after the Civil War. There were no indications that the massive amounts of lumber in these craft may have be re-used for other purposes, other than in modern times (Michie, James, personal communication 1983). Despite the survival of the rice culture in limited form after this war, there is no evidence that new rice flats were built after 1860.

An consistent with this pattern was the deposition of a small fleet of flats in the Waccamaw River off Wachesaw, Laurel Hill and Richmond Hill Plantations. A small skiff and a possible pirogue also were part of this assemblage. This pattern matches that found in the river front component of other plantations. It appears that river craft associated with the plantations were either destroyed or abandoned near the plantations, also as a result of the Civil War. This pattern was observed in the Savannah, Cooper, Ashley, and Waccamaw rivers, suggesting a statewide occurrence. The majority of vessels in this context were coasting schooners, large scow type craft and small round hulled ships.

Some disposal patterns emerged which do not appear to be connected with the destruction in the State by northern forces. In several plantation locations, late eighteenth, early nineteenth century coasting schooners and river vessels appear to have been deliberately run ashore and used as foundations for dock structures. This was observed in the case of a wreck at Lewisfield Plantation on the Cooper River,

and the "Argyle Island Wreck" in the Savannah River, both examined by the author, and the "Clydesdale Vessel" documented by Fred Hocker of Texas A&M University (Hocker, Fred, personal communication 1992). The Clydesdale vessel, in the Back River near Savannah, Georgia, lay under a dike constructed in 1756 (Wood, Judy, personal communication 1992). Hocker's preliminary findings indicate that the vessel dated to the period of construction of the dike, and had been driven into the dike bow first, the bow removed by cutting and burning and dock pilings driven through the wreckage. These sites are typified by vessel remains being positioned with the bow ashore and the remains of dock pilings through the hull or heavy decking remains deposited on top of the wreckage by the decay process. To date these sites have all been located on alluvial flood plains or tidal marshes where bedrock suitable for a dock foundation was not within reach of pile driving methods of the time.

On two occasions, similar vessels were abandoned in ways which may have served another function. A coasting schooner designated "The Hobcaw Creek Vessel" also was found in the remains of a small slough running into Hobcaw Creek, near Charleston, South Carolina and appeared to have discarded material of a later period thrown on top of it. The Malcolm Boat, also appears to have been run bow first into a small creek mouth after which it may have been stripped. These two vessels appear to have been discarded in a manner designed to ensure that the wreckage was not a hazard to navigation. They also appear to have been used to fill in the small sloughs which they occupied. Information on the use of hulks as dock foundations and "slough fill" developed as a result of a statistical analysis of permit applications to the state for new docks (Barshafsky 1987:12). Many of these new dock locations appeared to match the choices of the historic occupants of the same river front property.

Ferry crossing sites also displayed a disposal pattern. Typically, a ferry craft which had exhausted its usefulness was sunk at the crossing. These craft were usually found downstream of the crossing, perhaps indicating that they were scuttled to ensure the wreckage remained downstream of the route traveled by its replacement. The sites observed would indicate that there is a potential for discovery of craft ranging over the entire temporal period of occupation of these ferry crossings if enough of them were surveyed.

Conclusions

A study of widespread vessel remains in South Carolina waters, and of archival records over an nine year period reveals a diverse range of basic design adaptations

from ferry craft to phosphate carriers, dugout canoes to coasting schooners. A typology of these craft can in fact be developed based on hull form and context, and, to a lesser degree, on the container form of the cargoes the craft were designed to carry. There are indications that morphological analysis also may be based on socio-economic environments and ethnic origins of the builders and operators. As with other areas of the world in which these craft may have had their design origins, there appears to be direct and tangible links between the design of the craft and the environments in which they operated.

Craftsmanship and construction technique also showed a wide range of quality over the temporal period of the activities studied. As a general rule, earlier vessels were of better workmanship and materials. Indicative of this was massively cut woods carved or sawn by hand, greater use of joinery and support techniques typical of the shipwright and hand forged iron fastenings or hand cut treenails (though the study revealed only one treenailed craft in which the fastenings were wedged or spiked). Later vessels were typified by lighter weight woods, simple joinery and mass produced fasteners. There was a significant lack of shipwright's skills and a greater use of simple carpentry.

Direct evidence of the ethnicity of the builders has so far proved difficult to detect on many of the vessels studied. Although some construction techniques suggested an African origin, edge doweling of strakes with iron drift pins and the tendency to dress only working surfaces on vessel frames, for example, it is also true that these same techniques have been observed in European construction. In cases where the type of vessel studied was most likely built by slaves, such as plantation rice barges, there was still no discernible characteristic which indicated a specific ethnicity. The fact that many plantation vessels most probably built by slaves exhibit European characteristics may be a reflection of the widespread use of slave labour in area shipyards earlier in the eighteenth century, as cited above.

Clear differences in ethnicity of builders was apparent only in the case of dugout craft. Those craft fashioned by native populations showed marked differences in production methods and design, mostly as a result of crudity of construction techniques forced by lack of metal tools. There also were markedly European features found in some craft built during the historic period under the direction of Europeans, an ethnocentric preference to re-shape the aboriginal dugout into traditional European ship's boat designs borrowed from plank on frame shell forms. In contrast, simple, early planked-up dugouts documented in Finland (McGrail 1987:Fig. 6.4) clearly used much the same production techniques as have

been recently documented in West Africa and Suriname. This makes direct attribution of a particular historic dugout form to one ethnic group even more difficult.

The data base does suggest that further research has the potential of confirming certain diagnostic characteristics. These range from size of the construction lumber, type of fastening, including the amount of iron versus the amount of wood. The hull profile on flats, and the degree of angle of ramps used on later craft, appear to have direct temporal links. Such features, in an expanded data base, may offer reliable dating tools and indicators of function, and of origin from plantation to commercial boat yard.

Some researchers advance the hypothesis that early chine-girder flats were derived from expanded dugout canoes as a result of a repair process in which worn hull bottoms were replaced with planking, creating the transversely planked chine-girder variety of flat. This seems hardly likely given the markedly different dimensions of chine-girders and canoe hulls. The process of independent co-invention of these craft in South Carolina is a possibility, yet the influence of European craftsmanship is so strong throughout the types of craft studied that it appears there must have been a European source for South Carolina's chine-girder flat tradition. The chine-girder craft were of course common in early Europe but appear to have declined in use so far in advance of colonization of the North American continent as to make the technology far beyond the living memory of European boat builders.

European chine-girder craft from Roman to German types, utilized longitudinal planking (McGrail 1982:170). The only similarity observed in this study was with the Trent River craft.

What is clear is that the chine-girder flat, and for that matter, the planked up barges, provided the same construction solution met in similar working environments in Europe, how to give longitudinal strength to a vessel that had to operate in very shallow drafts and calm waters where a keel was impractical.

The origins of the craft cannot be clarified until archival research determines the latest date of production of similar craft in Europe, or until chine-girders showing evidence of re-utilization of dugout canoe sides are discovered.

It would be overly optimistic to conclude that many of our research questions about these craft and their makers will in time be answered by an expanded research effort. To many maritime archaeologists, the barge is an unrewarding and unglamorous craft on which time and effort is wasted. There also is the reality that

state budgets in America devote minimal funds and resources to the study of locally built small craft, or maritime archaeology at all, for that matter.

The traditionally built merchantman or ship of the line offers attractive research avenues which attract public interest. Study of such craft is, however, research into the individual ways traditionally trained craftsmen solve their daily working problems to produce a product others will use. Local water craft, on the other hand, offer opportunity for the study of a far broader range of vernacular craftsmanship by less formally trained workers meeting needs and solving problems to produce craft designed to play an integral role in their daily lives. The result can be a tangible connectivity with the lifeways of the rich and complex societies that forged South Carolina's past.

The African Contribution

In the discussion above we have seen that the technology used to produce the region's fleet of inland and coastal working craft is can be to determine from the archival and archaeological record. This same record sheds much light on the subsistence economics, and the social and religious organization of the dominant segment of South Carolina society, the Europeans. Yet of the Africans, it is an acknowledged fact that even today the slave culture is an aspect of the southern past of which little is known, and of which little has been revealed by historical or archeological research (Weir 1983:173). The imposition of "politically correct" concepts concerning the life of slaves and the relationship they had with their European owners seeks to place artificial concepts of the era in the public conscience. This further serves to cloud the record and discourage research. What does in fact emerge from the archival and archaeological record is a very different picture from the popular image.

Few Americans, least of all African-Americans, are aware today of the rich tradition of agricultural and craft skills which Africans and African-Americans brought to the success of the Colonial and ante bellum plantation system in the south.

As referenced above, Africans brought the knowledge of rice, indigo, tobacco, and cotton culture and processing to North America. Industrial skills also played a major role in the success of this system. Africans skilled in working wood and iron became the plantation carpenters and blacksmiths on which the operation of the plantations pivoted. It is clear that they also brought many of their lifeways with them, even down to re-creating African style settlements as slave quarters on early

plantations (Michie 1990:65, Vlach 1986:58-78 and Ferguson 1992:63-82). It is suspected by Weir that tribal identities were often preserved among slave groups (Weir 1983:179), and it is now known that many elements of language and song remain intact among descendants of these group today (Glascoe, Myrtle, personal communication 1992).

It is also suggested that slaves, from plantation workers to boatmen, were given far greater freedom and control over the plantation operation than is popularly imagined (Weir 1983: 173-203). The European contribution may have amounted to little more than the huge organizational system and financial skills that enabled the plantations to dominate world markets.

While no one can defend slavery in any form, the system employed by southern plantation owners, based on the archaeological and archival record, appears to be quite different from that portrayed by popular writers, film makers and many modern African-American political and social leaders. This modern opinion seeks to reject the southern plantation system in its entirety, yet within it there appears to be strong evidence that the "slave" had evolved into a highly valued component of the agricultural exploitation process. Key individuals were clearly given great freedom and responsibility (Weir 1983:180-181), and the relationship between planter and slave was clearly not exactly as portrayed by the modern media.

In his 1936 reminiscences, David Doar writes:

“That there may have been cases of cruelty we do not deny, but they were few and far between...If there was a thing the planter were least afraid of, it was any uprising or violence from the Negroes on the rice plantations, and they proved it by living, both planter and overseers, amongst these Negroes, far away from cities and protection, in perfect security, though outnumbered a hundred to one. During the Civil War hundreds of soldiers' families were left alone on their places with only their slaves to protect them, and there is not a recorded instance where they betrayed their trust.” (Doar 1936:36-37).

The broad acceptance of Northern Civil War propaganda began to weaken when modern researchers such as Elizabeth Donnan (Donnan 1930) and Peter Wood (Wood 1974) began to reveal the African slave as a generally well treated and highly skilled contributor to the success of the plantation system, instead of a

savage and mindless workhorse in the paddies. Later writers such as Eugene Genovese (Genovese 1988, First Ed. 1970) began in the 1960s a process of critical evaluation of slavery in the South which leads to a broader understanding of the paternalistic relationship between the planter and the slave work force.

In his fascinating commentary, "*In The Light of History*," J. Plumb comments on the patriarchal system:

"...there was always food, always a roof, even in old age. Slave workers could not, like factory workers, be turned out to starve in bad times, or left to die in destitution in old age. Both societies, North and the South were slave societies, but the South at least retained moral responsibility for its slaves." (Plumb 1973:120).

This was graphically born out by the author's research when slave descendants were documented living in still existing slave quarters on the Carswell Plantation in Burke County, Georgia (Newell, 1995:3-9). The plantation owner, Mr. James Carswell, when asked why he provided free food, fuel, and shelter to the residents of the slave cabins, replied, "These are *our* people, they have been with my family for generations and our responsibility to do right by them didn't end when the Federal Government won the Civil War," (Newell 1995:1).

The residents were all either retired or in ill-health. In interviews they confirmed that even though they and their parents had lived and worked elsewhere in the region, it was always understood that they were free to return to the plantation where their ancestors had once been slaves. Although the living conditions were harsh (Fig. 105), they were at least without cost. This was by no means an isolated example. A similar situation existed on Magnolia Plantation in Charleston County, where the author built the experimental replica of a plantation barge (Hastie, Drayton, personal communication 1992).

This academic examination of the true role of slaves on the plantations, and their relationship with their masters, has received little attention in the popular media. This is due, perhaps, to the greater value of the image of the plantation system as totally without social worth, and the slave as a universally abused human being, to various political movements within America.

This is unfortunate, to say the least, for the archaeological and archival record demonstrates that the Southern slave made great contributions to American nation building. The accomplishments of Africans and African-Americans during this

period represent a conquest of slavery and offers much that could be cherished by their descendants. The Civil War removed slaves from this morally corrupt but largely "benign" system and forced them to compete for survival with lower status immigrants who had lived on the fringes of the plantation system without sharing in its wealth. This may have contributed much to the racial tensions which persist in the region today.

Contributions of Experimental Archaeology

Experimental archaeology as a method for examining the possible linkages between systemic and archaeological contexts has been in use for some time by archaeologists working in terrestrial contexts (Thomas 1989:189-200, McIntosh 1986:148-9, 150-1). Use of these methods in maritime archaeology has been less extensive, a notable early example being the Pacific voyage of the *Kon Tiki* by Thor Heyerdahl in 1947 and a later Atlantic voyage in the *Ra* (McIntosh 1986:149). These projects concentrated more on theoretical considerations concerning the transfer of social systems across these oceans, than on the construction of early ocean going reed boats.

Notable later projects involved studies of an early Greek trireme (Morrison 1984:215-222) and a medieval logboat (Goodburn and Redknap 1988 7-10;9-22). Debate still continues as to the real value of this type of middle-range research for developing worthwhile data.

The decision to embark upon three experimental projects for the above research program required consideration of various aspects of this debate. In the case of the two plantation flats, there was considerable archaeological data with which to work. In the case of the Petersburg boat there was no such data, much like the problem discussed by Morrison in connection with the trireme (Morrison 1984:215). The indirect evidence on which the construction of the Petersburg boat was based was very strong, reliable accounts by a trained observer coupled with photography, but still, the value of the result had to be carefully considered.

To continue, some definition of terms is needed, those of replication as opposed to reconstruction. A replica of an historic vessel is defined by the author as a completely faithful copy of the original using the same types of fastenings, workmanship and even tools used to create the original. Such an approach is certainly costly, time consuming and is still questionable since certain aspects of the original can never be replicated, the original craftsmen, as an extreme example. A reconstruction is defined, at the very least, as a visually accurate copy of the

original. With no other constraints than this, the vessel is built using modern methods, tools, fasteners and materials. For these reasons, it might appear to have little value in terms of valid research data.

It is rare indeed for an archaeologist to be given an opportunity to spend large sums of money for the creation of a full scale vessel replica. Full scale "copies" of historic vessels have been built in various countries. These vessels are usually involved in ventures that range from sail training and research to paid passenger service. These functions are usually the reason behind the funding for the construction, and in North America, these functions would require the vessel to have a United States Coast Guard Certificate of Inspection. The certificate of inspection process begins at the concept of such projects, and continues beyond launching and fitting out, to ensure that modern methods and materials are used in order to assure safety of crew and passengers (Millar, Michael, personal communication 1995). These requirements also largely negate the research value of such craft.

The Magnolia Barge project involved the construction of a craft which was to be displayed on an historic working plantation. As a static exhibit, faithful replication was possible. Even in this case, some consideration had to be given to cost and time, and mill cut lumber and some modern tools had to be used. As the project demonstrated, many of the modern tools were eventually rejected for their historic counterparts.

The Petersburg boat project is termed a reconstruction, simply because modern bolts were used in its construction. The vessel was not financed as a research project, the only way the author could obtain funding for the project was by offering a working vessel for the Augusta Canal as an end product. For this reason it was deemed essential that the vessel actually float when launched, and remain intact for a reasonable period of time. This necessitated the use of modern fasteners. In all other respects, except as in the case of the Magnolia Barge the use of some modern tools and modern craftsmen, the vessel was a replica.

It is the author's contention that the data generated by the three experimental projects clearly demonstrate the value of this technique as a middle-range research function. Nevertheless, such data cannot be presented without also a clear presentation of the aspects of each project which might have the potential for compromising the validity of the results. A final evaluation can then be made with the appropriate caveats in mind.

Ethnoarchaeology

The work of O'Neil, cited above, is a good indication of the contributions further ethnoarchaeological research may have for developing middle range data of value in the interpretation of the pirogue and the dugout. Clayton and Vlach, as cited above, both noted the use of African boat building techniques in South America. The practice continues in recent times, as evidenced by photography provided to the author by missionary/photographer Daryl Miller (Fig. 106). Miller photographed "bush Negroes" building African style dugouts in the Lawa River region of Suriname as recently as 1973. The practice continues to this day (Miller, Daryl, personal communication 1994) and offers an opportunity for ethnoarchaeological research on African boat building techniques imported to the Western hemisphere.

A Typology for Historic working craft of South Carolina

The historic small craft of South Carolina can be categorized in a number of different ways: by geographic region, by function, by construction and hull type. Craft can also be viewed in terms of owner-operator relationships, albeit with less clarity, where socio-economic and ethnic factors appear to have a bearing on where and how certain types of craft were built and used.

Typing by geographic region was found to be too general to be of any great use. The majority of craft used in the historic period are found in the coastal plain region where they operated in plantation, riverine and coastal environments. There appear to have been four different broad categories of craft used in this region prior to the introduction of steam: Ocean going sailing vessels, coastal and riverine sailing vessels, aboriginal and European built riverine dugout craft and flatboats or barges.

Morphological analysis of the range of small craft is harder to clarify and define than the simpler characteristics of function. Certainly, vessel forms can be attributed to specific environments; the coasting schooner to the lower coastal plain and the Petersburg boat to the upland region as obvious examples of how differing environments are causative factors in hull form design. Less distinct are the socio-economic environments of vessel types. The ready availability of free slave labour, and the large amount of freedom afforded slave boatmen, meant that African-Americans were often the operators of most craft. This is documented in the cases of canal craft, coasting schooners and pirogues. Even upland mountain boats appear to have been largely operated by freewheeling crews of African American

slaves and freedmen. Ownership of these craft appears to draw distinct lines between the craft types. Small fishing dugouts and even flats were evidently owned and operated or sold by slaves. The larger craft were however the property of plantation owners, white captains, or commercial factors who arranged transportation of products from plantations to markets or ports. Ferry craft were typically owned by the landowners where the ferry crossing was located. The most common utility craft of the late in the nineteenth century, the massively constructed phosphate barges, were the property of mining companies, although again primarily operated by African-Americans.

Topological Listing by Type, Temporal Range, Characteristics, and Function:

Aboriginal Dugouts 4,500BP - 1690

Resinous or other easily worked woods. Crudely worked by burn and scrape method using stone tools. Crudely formed bow and stern, usually square and wedge shaped. Range in length from approximately 3m (9ft) to 20m (60ft.) and beam from approximately 0.5m (18in.) to 2m (6ft.). Smaller craft were used for riverine travel, larger craft, possibly with splash boards, used for ocean travel. Earliest known example dated to 4,500BP (Rooney, Kevin, personal communication 1990).

Historic Period Dugouts 1690 - 1963

Same woods as pre-historic craft, bald cypress being preferred. Easily distinguishable from prehistoric craft by "Europeanization" of design including European shell forms with shaped bow, transom sterns, wash strakes and carved or added keel. Workmanship usually shows use of metal tools (especially in earlier examples) and modern sanding tools in later examples. Used for riverine travel and racing during the historic period.

Built-up Dugout 1690-1860

Usually large dugout hulls to which one or more wash strakes have been added, often edge doweled to the gunwhale and supported by internal frames. Appear to have been most commonly used as planter's boats for personal and pleasure transportation. Ethnic origins may be a mix of aboriginal, European (from Irish to Finnish) and African.

Barge Forms:

Ferry Craft 1690s-1970s

Basic flat design adapted for use on ferry crossings, typically 20m (65.61ft) in length and approximately 5m (16.4ft) in width. Constructed with cypress chine-girder

sides (usually earlier craft) or planked with 2 to 3 strakes. Designs featured low ramp angle, approximately 20°, and two stanchions on one side containing pulleys to hold a rope which ran across the river. Craft were built of cypress, pine and live oak.

Large Rice Flats 1750s(?)-1860

Basic flat design adapted for use in main rice field canals. Constructed with cypress chine-girder sides or planked with 2-3 strakes. Chine-girders appear to have been used throughout the ante bellum period. Earlier vessels may have had curved, scow-like profiles, later craft had angled ramps (30° - 20°). Construction of pine, cypress and live oak, featured transverse planking (with one or two exceptions), heavy header logs, internal stringers and rake timbers. Common size ranged from beam of 4m (13.12ft) to length of 15m (49.21ft). May have been in use earlier than 1750 since evidence suggests tidally irrigated rice plantations may date to first quarter of the century. Used to carry harvested rice to the main canal mills, to carry pile drivers for puncheons and earth for dikes. Also used to transport various cargoes on local rivers, usually propelled by tide.

Narrow Rice Flats 1750s(?)-1860

Narrow variety of chine-girder design, beam of 1m (approx 3ft), length of 9m (approx 30ft). Used to transport harvested rice, mud and materials on narrow rice plantation quarter ditches.

Phosphate Barges 1870-1899

Massively constructed barge forms designed for the South Carolina marine phosphate industry, 1870-1899. Sizes ranged from beams of 5 to 7m (16.4ft to 22.96ft) and lengths of 20 to 30m (65.61ft to 98.42ft). Construction featured extremely heavy stringers and chine-sills (up to

35cm [1.15in] sided and molded) and steeply angled ramps (typically 54°). Also featured heavily cast iron fittings, bitts and bilge pumps. Most of these craft were destroyed in the hurricanes of the late nineteenth century. Operated in lower coastal plain environments where marine phosphate beds were mined.

Industrial Barges 1880s-1940s

Both small and large industrial barges were built in the late nineteenth, early twentieth centuries. Most extant examples were built for the Pinopolis dam project in the 1930s. Featured lighter weight timbers, decks, often double sheathed, wire nails and transom sterns reinforced for push movement by powered tugboats.

Canal Craft:

Canal Boat 1793-1860s

Probably conventional English canal boat design first built for the Santee Canal, 1793-1800. Beam of 3m (9ft) length of approximately 20m (65ft) with covered cargo area accessed by hatches.

Cotton Box 1800-1860

Type of craft unique to the Santee Canal, 3m (approx 10ft) beam approx. 15m (approx 50ft) length and built with a wedge shaped cross section which enabled one vessel to be "nested" in another. Designed to carry cotton bales and specifically to reduce toll fees when empty on return journey. May also have been used on later South Carolina canals.

Canal Flat 1793-1860

Basically a rice flat adapted to canal use by reducing the beam to approximately 3m (9ft).

Pirogue 1700-1860

A large vessel, probably of the built-up keel type influenced by West African construction techniques. The built-up dugout differed from this craft in that it had vertical or nearly vertical wash strakes added to the gunwhales, whereas the pirogue was a dugout keel to which planks creating a low deadrise were added, continuing past the curve of the bilge to the gunwhale, thus making the craft a ship hull of which the dugout was simply a keel. Alternative construction method may have been split-log type with log insert. Current information based on strong archival sources, but examples have yet to be found in archaeological contexts. Shell form has rounded bottom and transom stern

Coasting Schooners 1670-1860

Flat-bottomed, transom sterned ship hull of conventional European design and construction. Earlier types used king and queen planks; later types (1800) used shallow keels. Shell form designs featured extended maximum beam fore and aft of center to maximize cargo capacity. Built of pine planking, live oak framing with cypress treenails. Operated in riverine areas, and in coastal regions, possibly with leeboards.

Coastal Sloops 1670-1860

Conventional historic period ocean-going sloop-rigged ship hulls with deep drafts and round hull form. Built to traditional European designs on plantations and local shipyards and ranging in tonnage from early 15 tons to later 40 tons. Used for extended coastal voyages and capable of short off-shore voyages. Ranged in length overall from approximately 10m (30ft) to 20m (60ft) and in beam from approximately 4m (12ft) to 5.5m (16ft). Construction woods included pine, cedar, white oak, live oak and cypress. Used for transportation to distant coastal plantations, general transportation and trading voyages.

Mountain Boat 1790-1920

Extremely long, narrow-beamed and lightly built vessels, typically approximately 2m (7ft) in beam and 10 to 27m (30 to 80ft) long. They were constructed mostly of pine, a 20m (60ft) craft capable of carrying 15 to 20 tons. They were used to transport tobacco hogsheads and cotton bales down upland rivers, general merchandise on return voyages.

Historical and archaeological evidence for steam powered craft throughout the South is very extensive. In order to make this research program manageable, powered craft were reserved for a separate research program which commenced in 1990. For the same reason, small "personal craft" including bateaux, punts and "Geechee" boats etc. also were reserved for a separate research program, begun by the author in 1993.

References Cited

- Albright, Alan, and Steffy, J. Richard.
1979 "The Brown's Ferry Vessel, South Carolina: Preliminary Report" *The International Journal of Nautical Archaeology and Underwater Exploration*, Vol. 8.2 pp. 121-142, The Nautical Archaeology Trust Ltd., London, UK.
- Anderson, Richard K. Jr.,
1988 "Guidelines for Recording Historic Ships." The National Park Service, US Department of the Interior, Washington, District of Columbia, USA.
- Anonymous.
1916 "Cyclopedia of Textile Work." Prepared by a corps of leading experts and manufacturers, The American Technical Society, Chicago, Illinois, USA.
- Baker, William A.
1962 "Colonial Vessels. Some Seventeenth Century Sailing Craft." Barre Publishing Company, Barre, Massachusetts, USA.
- Ballantyne, R. M.
1874 "Man on the Ocean." T. Nelson and Sons, Paternoster Row, London, UK, (for Figure 28).
- Barbee, William J. MD.
1866 "The Cotton Question: The Production, Export, Manufacture and Consumption of Cotton." New York Metropolitan Record Office, New York, New York, USA.
- Barshafsky, Deborah
1987 "Public Notice Response System Database Report." Underwater Antiquities Management Program Series No. 1, South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, South Carolina, USA.
- Barry, John M.
1980 "Natural Vegetation of South Carolina." University of South Carolina Press, Columbia, South Carolina, USA.
- Bascom, William.
1969 "The Yoruba of Southwestern Nigeria," *Case Studies in Cultural Anthropology*, University of California, Berkeley. Holt, Rinehart and Winston, San Francisco, California, USA.
- Bennett, R.

- 1988 *"The Santee Canal 1785-1939."* Master's Thesis, Department of History, University of South Carolina, Columbia, South Carolina, USA.
- Benton, John T.
- 1973 "Place-Name Survey." *Names In South Carolina* Winter, 1972 pp. XIX:54-55. Department of English, University of South Carolina, Columbia, South Carolina, USA.
- Bloomster, Edgar L.
- 1940 *"Sailing and Small Craft Down the Ages."* United States Naval Institute, Annapolis, Maryland, USA.
- Bunker, John. G.
- 1979 *"Harbor and Haven."* Windsor Publications, Woodland Hills, California, USA.
- Bushnell, Edmund.
- 1716 *"The Compleat Shipwright."* Published by Richard Mount, London, UK.
- Carter Edward C. (ed.).
- 1977 *"The Virginia Journals of Benjamin Henry LaTrobe, 1795-1798."* Vols. 1 and 2, Yale University Press, New Haven, Connecticut, USA.
- Carpenter, James G.
- 1973 *"The Rice Plantation Lands of Georgetown County, South Carolina: A Historical Geographic Study."* Masters Thesis, University of North Carolina, Durham, North Carolina, USA.
- Carolina Geological Society.
- 1979 *"Geological investigations of the eastern Piedmont, southern Appalachians: (with a field trip guide on the bedrock geology of central South Carolina)."* The South Carolina Geological Survey, State Development Board, Columbia, South Carolina, USA.
- Cederlund, Olaf.
- 1993 *"Small Craft In Northern Europe."* The Swedish National Maritime Museums, Stockholm, Sweden.
- Chapelle, Howard I.
- 1935 *"The History of American Sailing Ships."* W.W. Norton and Co., New York, New York, USA.
- 1951 *"American Small Sailing Craft."* W.W. Norton and CO, New York, New York, USA.

- Christian, M.
1972 *"Negro Ironworkers in Louisiana 1718-1790."* Pelican Publishing Company, Gretna, Louisiana, USA.
- Clarke, Mary Stetson.
1974 *"The Old Middlesex Canal."* Center for Canal History and Technology, Easton, Pennsylvania, USA.
- Clayton, Lawrence A.
1988 *"Carpenters and Caulkers In A New World: The Shipyards of Colonial Guyaquil."* Ohio University Press, Athens, Ohio, USA.
- Clifton, James M. (ed.).
1978 *"Life and Labor on Argyle Island: Letters and Documents of a Savannah River Rice Plantation 1833-1867."* Beehive Press, Savannah, Georgia, USA.
- Clowse, Converse D.
1981 *"Measuring Charleston's Overseas Commerce 1717-1767."* University Press of America, Washington, District of Columbia, USA.
- Coker, P.C. III.
1987 *"Charleston's Maritime Heritage."* Cokercraft Press, Charleston, South Carolina, USA.
- Commager, Henry Steele (ed.).
1950 *"The Blue and the Grey. The Story of the Civil War as Told by Participants."* Two Vols., The Bobbs-Merrill Company Inc., New York, New York, USA.
- Cooke, Charles Wythe.
1936 *"Geology of the Coastal Plain of South Carolina."* United States Government Printing Office, Washington, District of Columbia, USA.
- Copenhauer, James Earl.
1936 *"Culture of Indigo in the Provinces of South Carolina & Georgia"* Reprint from Industrial and Engineering Chemistry Vol. 22 p 184 Society of Industrial and Chemical Engineers, New York, New York, USA.
- Cowan, T.
1987 *"William Hill and the Aera Ironworks,"* *Journal of Early Southern Decorative Arts*, November 1987, Vol. XIII, No. 2 pp. 1-31. Museum of Early Southern Decorative Arts, Winston-Salem, North Carolina, USA.

Creel, Robert.

1984 "From the Rivers of Antiquity." *South Carolina Wildlife Magazine*, Vol. 31 No 3: 40-45, South Carolina Department Wildlife and Marine Resources Department, Columbia, South Carolina, USA.

Crowson, E. T

1971 "The Santee Cooper: a Pioneering effort on South Carolina canaling." *The South Carolina Magazine*, 35:8 (August): 6-9 and 14-20. Columbia, South Carolina, USA.

Dabbs, Edith M.

1970 "*Face of an Island, Liegh Richmond Miner's Photographs of Saint Helena Island.*" The R.L. Bryan Company, Columbia, South Carolina, USA.

Davis, William and Wiley, Bell I. (eds.).

1984 "*Photographic History of The Civil War, Vicksburg to Appomattox.*" Black Dog and Leventhal Publishers, New York, New York, USA.

Damianidis, Kostas II.

1989 "*Vernacular Boats and Boatbuilding in Greece.*" Vols. I and II, Ph.D. Dissertation, Scottish Institute of Maritime Studies, St. Andrews University, Scotland, UK.

Deas, A.

1941 "*The Early Ironwork of Charleston.*" Bostick and Thornley Columbia, South Carolina, USA.

Derting, Keith, Pekrul, Sharon L. and Rinehart, Charles J.

1991 "*A Comprehensive Bibliography of South Carolina Archaeology.*" Research Manuscript Series No. 211, South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, South Carolina, USA.

Dethloff, Henry C.

1988 "*A History of the American Rice Industry, 1685-1985.*" Texas Agricultural and Mechanical University Press, College Station, Texas, USA.

Doar, David.

1936 "*Rice and Rice Planting In the South Carolina Low Country.*" Museum of Charleston, Charleston, South Carolina, USA.

Donnan, Elizabeth.

1930 "*Documents Illustrative of the History of the Slave Trade To America.*" Carnegie Institution, Washington, District of Columbia, USA.

Easterby, J. H.

1949 "*Guide to the study and reading of South Carolina History.*" Historical Commission of South Carolina, Columbia, South Carolina, USA.

1954 (ed.)

"The Colonial Records of South Carolina - The Journal of The Commons House of Assembly, September, 1742 - January 27, 1744." South Carolina Department of Archives and History, Columbia, South Carolina, USA.

Ellmers, D.

1974 "Nautical Archaeology In Germany," *International Journal of Nautical Archaeology*, Vol. 3, 137-145. The Nautical Archaeology Trust Ltd., London, UK.

1984 "Punt, Barge or Pram - Is there one tradition or several?" *Aspects of Maritime Archaeology and Ethnography*. Papers based on those presented to an international seminar held at the University of Bristol in March, 1982. Trustees of the National Maritime Museum, London, UK.

Falconer, William and Burney, William.

1970 "*A New Universal Dictionary of the Marine.*" Reprint of 1815 edition, modernized by Dr. William Burney, LL.D., by MacDonald and Jane's, London, UK.

Ferguson, Leland.

1992 "*Uncommon Ground: Archaeology and Early African America 1650-1800.*" Smithsonian Institution Press, Washington, District of Columbia, USA.

Filgueras, Octavio Lixa

1988 "Local Boats." *4th International Symposium on Boat and ship Archaeology*, Poro 1985, BAR International Series 438(I), London UK.

Fleetwood W. Rusty.

1982 "*Tidecraft.*" Coastal Heritage Society, Savannah, Georgia, USA

Furlong, Capt. Lawrence.

1796 "*The American Coasting Pilot.*" Blunt and March, Newburyport, Connecticut, USA.

Gallatin, Albert.

1968 "*Report of the Secretary of the Treasury on the Subject of Public Roads & Canals.*" Reprint of 1808 original by Augustus M. Kelley, New York, New York, USA.

Gambee, Budd Leslie.

1964 "*Frank Leslie and his illustrated newspaper, 1855-1860.*" Department of Library Science, University of Michigan, Ann Arbor, Michigan, USA.

Garrett, W. E.

1987 "Waterway that led to the Constitution: George Washington's Patowmack Canal." *National Geographic Magazine*, 171.6 (June): 716-753. National Geographic Society, Washington, District of Columbia, USA.

Genovese, Eugene.

1988 "*The World the Slaveholders Made.*" Wesleyan University Press, Scranton, Pennsylvania, USA, Harper and Row, New York, New York, USA.

Gillispie, Charles C (ed.).

1959 "*A Diderot pictorial encyclopedia of trades and industry: manufacturing and the technical arts in plates, selected from L'Encyclopedia: ou , Dictionnaire raisonne des sciences des art et des metiers, of Denis Diderot,*" Dover Publications, New York, New York, USA.

Gilmer, George R.

1855 "*Sketches of Some of the First Settlers of Upper Georgia, of the Cherokees, and of the Author.*" D. Appleton and Company, New York, New York, USA.

Gilmore, General Q. A.

1879 "*Report of the Chief of Engineers.*" United States Government Printing Office, Washington, District of Columbia, USA.

Greenhill, Basil.

1988 "*Evolution of the Wooden Ship.*" B.T. Batsford, London, UK.

Goldenberg, Joseph A.

1976 "*Shipbuilding in Colonial America.*" University Press of Virginia, Richmond, Virginia, USA.

Goodburn, Damian.

1984 "Barges of East Anglia." *Model Shipwright Magazine*, No. 50. Conway Maritime Press, London, UK.

Goodburn, Damian and Redknap, Mark

1988 "Replicas and Wrecks from the Thames Area." *The London Archaeologist*, Winter 1988, Vol. 6 Pages 7-10, 19-22, London, UK.

Goodyear, Albert C. and Hanson, Glenn T. (eds.).

1989 "The Earliest South Carolinians." Albert C. Goodyear, III, James L. Michie and Tommy Charles. Chapter in "Studies in South Carolina Archaeology,"

Anthropological Studies No. 9, Occasional Papers of the South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, South Carolina, USA.

Hahn, Harold M.

1981 *"The Colonial Schooner 1763-1775."* Conway Maritime Press Ltd., London, UK.

Harrelson, J.

1973 "Origin of Landing Names on the Pee Dee" *Names In South Carolina* pp. XX:27-28. Department of English, University of South Carolina, Columbia, South Carolina, USA.

Hart, Harold H. (ed.).

1977 *"Hart Picture Archives."* Hart Publishing Company, New York, New York, USA.

Harris, Lynn.

1992 "The Waccamaw-Richmond Hill Waterfront Project 1991: Laurel Hill Barge No.2." *Research Manuscript Series No. 214*, South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, South Carolina, USA.

Hetrick, John R.

1979 *"Treatise on the Economics of Rice Production in Georgetown County, South Carolina: The Middle Period, 1788 to 1860."* Masters Thesis, University of South Carolina, Columbia, South Carolina, USA.

Heywood, Duncan Clinch.

1937 *"Seed From Madagascar."* University of North Carolina Press, Chapel Hill, North Carolina, USA.

Holmes, Francis S.

1870 *"Phosphate Rocks of South Carolina and the Great Carolina Marl Bed."* Holmes' Book House, Charleston, South Carolina, USA.

Horton, Holbrook L, Schubert, Paul B and Garratt, Graham (eds.).

1973 *"Metric Conversion Tables and Factors."* Industrial Press Inc., New York, New York, USA.

Hulton, Paul.

1984 *"America 1585 : The Complete Drawings of John White,"* The University of North Carolina Press and British Museum Publications, London, UK.

Hutchinson, John G.

1941 *"The American Maritime Industries and Public Policy 1789-1914."*
Harvard University Press, Cambridge, Massachusetts, USA.

Ivers, Larry E.

1972 "Scouting The Inland Passage 1685-1737." *The South Carolina Historical Magazine*, Volume 73 Number 3, July 1972. The South Carolina Historical Society, Charleston, South Carolina, USA.

Israel, Jonathan I.

1989 *"Dutch Primacy in World Trade 1585-1740."* Oxford University Press, London UK.

Jaher F. C.

1982 *"The Urban Establishment."* University of Illinois Press, Chicago, Illinois, USA.

Johnson, Henry S.

1971 *"Geology in South Carolina."* Division of Geology, State of South Carolina, Columbia, South Carolina, USA.

Johnson, Nexsen B.

1969 "Names in Williamsburg County." *Names In South Carolina*, Winter, 1969 XVI:39-40. Department of English, University of South Carolina, Columbia, South Carolina, USA.

Johnstone, Paul.

1980 *"The Sea-Craft of Prehistory."* Routledge and Kegan Paul, London and Henley, UK.

Jones, Charles C and Dutcher, Salem.

1890 *"Memorial History of Augusta, Georgia."* D. Mason and Co., Syracuse, New York, New York, USA.

Jones, Lewis P.

1985 *"South Carolina: one of the fifty states."* Sandlapper Publishing, Orangeburg, South Carolina, USA.

Joyner, Charles W.

1977 *"Slave Folklife on the Waccamaw Neck: Ante-Bellum Black Culture in the South Carolina Lowcountry."* Ph.D. Dissertation, University of Pennsylvania, Philadelphia Pennsylvania, USA.

Judd, William R.

1987 *"The Biggin Creek Vessel: Drawings and Field Notes."* MS on file, author's collection and on file at South Carolina Institute of Archaeology

and Anthropology, University of South Carolina, Columbia, South Carolina, USA.

Kilby, Kenneth.

1971 "*The Cooper and His Trade.*" John Baker Ltd., London, UK.

Kohn, D (Editor and compiler).

1938 "Waterway to the West," *Interpretive Series No. 1.* Eastern National Park and Monument Association, Washington, District of Columbia, USA.

Kurtz, Stephen G. and Hutson, James H. (eds.).

1973 "*Essays on the American Revolution.*" University of North Carolina Press, Chapel Hill, North Carolina, USA and W.W. Norton, Inc., New York, New York, USA.

Land, Aubrey C. (ed.).

1969 "*Bases of the Plantation Society.*" University of South Carolina Press, Columbia, South Carolina, USA.

Leland, Jack.

1976 "*Indigo in America.*" Bicentennial Pamphlet by BASF Wyandotte Corporation, Parsippany, New Jersey, USA.

Lefler, Hugh Talmadge (ed.).

1967 "*A New Voyage to Carolina by John Lawson.*" University of North Carolina Press, Chapel Hill, North Carolina, USA.

Lewis, Kenneth E.

1984 "*The American Frontier.*" Academic Press, New York, New York, USA.

Linder, Suzanne, (ed.).

1993: "*Diary of Evander McIver, 1791, March 23-31.*" Ms on file, Applied History Department, University of South Carolina, Columbia, South Carolina, USA.

Lipke, P., Spectre, P., Benjamin, A. G. (eds.).

1993 "*Boats: A Manual for their Documentation.*" American Association for State and Local History, Nashville, Tennessee, USA.

Littlefield, Daniel C.

1981 "*Rice and Slaves: Ethnicity and the Slave Trade in Colonial South Carolina.*" Louisiana State University Press, Baton Rouge, Louisiana, USA.

Litwin, Jerzy.

1988 "Changes in Boatbuilding Techniques along Two Tributaries of the Vistula: The Dunejic and the Wisxova." *4th International Symposium on Boat &*

Ship Archaeology Porto, 1985, BAR Series 438(i), Octavio Lixa Filgueras
Ed. British Archaeological Society, London, UK.

McCann, Allison.

1981 "The Letterbook of Robert Raper." *South Carolina Historical Magazine*
Vol. XX p 113, Charleston, South Carolina, USA.

McCord, David (ed.).

1840 "*The Statutes at Large of South Carolina.*" Volume Seven Containing Acts
Relating to Charleston, Courts, Slaves, Rivers. A. S. Johnston, Columbia,
South Carolina, USA.

McDowell, William L., Jr. (ed.).

1970 "*Colonial Records of South Carolina. Documents Relating to Indian
Affairs.*" Three Volumes: September 20, 1710 - August 29, 1718, May 21,
1750-August 7, 1754 and 1754-1765. South Carolina Department of
Archives and History, Columbia, South Carolina, USA.

McGahey, Sam.

1974 "A Compendium of Mississippi Dugout Canoes," *Mississippi Archaeology*,
Vol. 21. No. 1 pp. 58-70. Mississippi Department of Archives and History,
Jackson, Mississippi, USA.

McGrail, Sean, (ed.)

1982 "*Aspects of Maritime Archaeology and Ethnography.*" Papers based on
those presented to an international seminar held at the University of Bristol
in March, 1982. Trustees of the National Maritime Museum, London, UK.

1987 "*Ancient boats in N.W. Europe. The archaeology of water transport to AD
1500.*" Longman, London, UK.

McIntosh, Jane.

1986 "*The Practical Archaeologist.*" The Paul Press Ltd., Oxford, UK.

McIver, Petrona.

1967 "Early Taverns of the Georgetown Road." *Names In South Carolina*,
Winter, pp. XIV:33-34. Department of English, University of South
Carolina, Columbia, South Carolina, USA.

McKee, Eric.

1983 "*Working Boats of Britain: Their Shape and Purpose.*" Conway Maritime
Press, London, UK.

Mappus, Helen Florilla.

1935 "*The Phosphate Industry of South Carolina.*" Masters Thesis, University
of South Carolina, Columbia, South Carolina, USA.

Malde, Harold E.

1959 "Geology of the Charleston Phosphate Area, South Carolina." *Geological Survey Bulletin 1079*, United States Government Printing Office, Washington, District of Columbia, USA.

Matthews, John.

1966 "A Voyage to the River Sierra-Leone." Reprint of 1788 original, Frank Cass and Co. Ltd. London, UK.

Merrens, H. Roy (ed.)

1977 "*The Colonial South Carolina Scene, Contemporary Views, 1697-1774.*" University of South Carolina Press, Columbia, South Carolina, USA.

Michie, James L.

1990 "*Richmond Hill Plantation 1810-1868. Discovery of Ante-Bellum Life on a Waccamaw Rice Plantation.*" Reprint Company, Spartanburg, South Carolina, USA.

Mills, Robert.

1826 "*Statistics of South Carolina.*" Hurlbut and Lloyd, Charleston, South Carolina, USA.

1980 "*Mills' Atlas of the State of South Carolina, 1825.*" Reprint by Southern Historical Press, Easley, South Carolina, USA.

Moore, John Hebron.

1967 "*Andrew Brown and Cypress Lumbering in the Old Southwest.*" Louisiana State University Press, Baton Rouge, Louisiana, USA.

Morgan, Dr. William J. and Basoco, Lt. Richard M., USNR, (Preparers).

1971 "*Civil War Naval Chronology 1861-1865.*" Compiled by the Naval History Division, Navy Department, United States Government Printing Office, Washington, District of Columbia, USA.

Morrison, J. S.

1984 "Some problems in trireme reconstruction." *The International Journal of Nautical Archaeology and Underwater Exploration*. Vol. 13, No. 3, The Nautical Archaeology Trust Ltd., London, UK.

Moyse-Bartlett, H.

1946 "*From Sail to Steam.*" Historical Association, London, UK.

Mouzon, Henry.

1775 "*An accurate map of North and South Carolina with their Indian frontiers, shewing in a distant manner all the mountains, rivers, swamps, marshes, bays, creeks, harbours, sandbanks and soundings on the coasts; with the*

roads and Indian paths; as well as the boundary of provincial lines, the several townships and other divisions of the land in both provinces."

Special Map Collection, Caroliniana Library, University of South Carolina, Columbia, South Carolina, USA.

Murphy, L. and Saltus, A.

1981 *"Phase II Identification and Evaluation of Submerged Cultural Resources in the Tomigbee River Multi-resource District, Alabama and Mississippi."*

National Park Service Report of Investigations No. 17, University of Alabama, Mobile, Alabama, USA.

Newell, Mark M.

1983 *"Recovery & Construction Analysis of the Mepkin Abbey Barge."*

Author's files and MS on file at South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, South Carolina, USA.

1984 *"Current Small Craft Research in South Carolina."* Lecture delivered at the XXIVth Conference on Underwater Archaeology, The Society for Historical Archaeology, Boston, Massachusetts, USA. MS on file at South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, South Carolina, USA.

1985 *"The Dean Hall Landing Wreck."* Field Notes and MS on file at South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, South Carolina, USA.

1986 *"Current Small Craft Research in South Carolina."* MS on file at South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, South Carolina, USA.

1988 *"The Hunting Island Boat: A Site assessment of 38BU157, a small historic fishing vessel on Hunting Island State Park Beach, Beaufort County, South Carolina."* MS on file at South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, South Carolina, USA.

1989 *"The Santee Canal Sanctuary Part II, Preliminary Archaeological Investigation of a Portion of the Old Santee Canal and Biggin Creek, Berkeley County, South Carolina."* Cultural Resource Management Publication No.6, South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, South Carolina, USA.

- 1992a "*Proposal for the Reconstruction of the Nineteenth Century Petersburg Boat.*" MS on file, South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, South Carolina, USA. Research Manuscript No 1, The Georgia Archaeological Institute, Augusta, Georgia, USA.
- 1992b "*The Malcolm Boat, (38CH803): Discovery, Stabilization, Excavation, and Preservation: The Project Manager's Report.*" Report on file at South Carolina Department of Archives and History, Columbia, South Carolina, USA.
- 1992c "*The Petersburg Boat: Experimental Archaeology on the Upper Savannah River.*" Research Manuscript No 2, The Georgia Archaeological Institute, Augusta, Georgia, USA.
- 1992d "*Underwater Archaeological Reconnaissance Survey of the Section of the Historic Waterfront District, City of Conway, SC.*" Cultural Resource Management Publication No.12, South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, South Carolina, USA.
- 1992e "Preliminary documentation of a chine girder barge at Conway, South Carolina." *The International Journal of Nautical Archaeology and Underwater Exploration*, 1992 21.2: 135-147. The Nautical Archaeology Trust Ltd., London, UK.
- 1993a "*Proposal for the Excavation of the Ingram Vessel, Including A Research Design & Methodology.*" Grant Application on File, South Carolina Commission for the Humanities, Columbia, South Carolina, USA.
- 1993b "*Archaeologists Research Model of the Conway Quarter Ditch Barge.*" Research Manuscript No 3, The Georgia Archaeological Institute, Augusta, Georgia, USA.
- 1993c "The Historic Ships Supply Program: A proposal for utilization of live oak and other woods for historic ship reconstruction projects in the US and abroad," Proposal Memorandum on File, South Carolina Department of Transportation, Columbia, South Carolina, USA.
- 1995 "*Living' On the Rim: A Photo-documentary of the lives of Retired Slave Descendants on the Carswell Plantation, Burke County, Georgia.*" Research Manuscript No. 4, The Georgia Archaeological Institute, Augusta, Georgia, USA.

Nylund, Rowena.

1989 "*The Historical Background of the Brown's Ferry Vessel.*" Masters Thesis, University of South Carolina, Columbia, South Carolina, USA.

O'Neil, Nicola.

1991 "*The Coastal Fishing Canoes of Ghana.*" Masters Thesis, Scottish Institute of Maritime Studies, St. Andrews University, St. Andrews, Scotland, UK.

Orvin, M. C.

1973 "*Historic Berkeley County, South Carolina, 1671-1900.*" Comprint, Charleston, South Carolina, USA.

Pease, William A. and James H.

1985 "*Web of Progress.*" Boston University Press, Boston, Massachusetts, USA.

Phelps, D. S.

1989 "*Ancient Pots and Dugout Canoes: Indian Life as Revealed by Archaeology at Lake Pettigrew.*" Pettigrew State Park, Creswell, North Carolina, USA.

Phillips, U. B.

1908 "*A History of transportation in the eastern Cotton Belt to 1860.*" Columbia University Press, New York, New York, USA.

Pinchbeck R. B.

1926 "The Virginia Negro Artisan and Tradesman." *University of Virginia, Phelps-Stokes Fellowship Papers, No.7*, William Byrd Press, Richmond, Virginia, USA.

Plumb, J. H.

1973 "*In The Light of History.*" Houghton Mifflin Company, Boston, Massachusetts, USA.

Pittman Robert H,

1970 "*Dugout Canoe Tradition in The Southeastern Woodlands.*" Master's Thesis, Department of History, State University of New York, Binghamton, New York, New York, USA.

Porcher, F. A.

1970 "*The History of the Santee Canal.*" Prepared by the late Prof. F. A. Porcher and dedicated to the South Carolina Historical Society, 1875. Reprinted by the Berkeley County Tricentennial Committee, Monck's Corner, South Carolina, USA.

Prunty, J. E.

1955 "The Renaissance of the Southern Plantation." *The Geographical Review* Vol. XLV, Number 4, October 1955 pp. 459-491.

- Rahn, Ruby A.
1968 "*River Highway for Trade: The Savannah.*" US Army Engineer District, Savannah, Georgia, USA.
- Richards, Addison.
1859 "*The Rice Lands of the South.*" Harper's Bazaar No CIXV, November 1859, Vol. XIX, Harper and Brothers, New York, New York, USA.
- Ringwalt, J. L.
1966 "*Development of Transportation Systems in the United States.*" Reprint of 1888 original by Johnson Reprint Corporation, New York, NY, USA.
- Rodney, Walter.
1970 "*A History of the Upper Guinea Coast 1545-1800.*" Clarendon Press, Oxford, UK.
- Rogers, George C. Jr.,
1970 "*The History of Georgetown County, South Carolina.*" University of South Carolina Press, Columbia, South Carolina, USA.
- Rolt, L. T. C.
1973 "*Navigable Waterways.*" Arrow Books, London, UK.
- Rosengarten, Theodore.
1986 "*Tombee: Portrait of the Cotton Planter.*" William Morrow and Company, Inc., New York, New York, USA.
- Rubin, Lester.
1970 "The Negro In The Shipbuilding Industry." *The Racial Policies of American Industry*, Industrial Research Unit of The Wharton School of Finance and Commerce, University of Pennsylvania, Philadelphia, Pennsylvania, USA.
- Salley, A. S.
1920 "History of the Santee Canal." *The State*, June 26th, Columbia, South Carolina, USA.
- Sass, H. R.
1956 "*The Story of the South Carolina Lowcountry.*" J. F. Hyer, West Columbia, South Carolina, USA.
- Scott, John A. (ed.).
1984 "*Journal of a Residence on a Georgian Plantation in 1838-1839 by Frances Anne Kemble.*" Brown Thrasher Books, University of Georgia Press, Athens, Georgia, USA.

Shepard, Charles U. Jr.

1880 "*South Carolina Phosphates. A Lecture delivered Before the Agricultural Society of South Carolina, Charleston, S.C, December 12 1879.*" The News and Courier Book Presses, Charleston, South Carolina, USA.

Shepherd, James F and Walton, Gary M.

1972 "*Shipping, Maritime Trade, and the Economic Development of Colonial North America.*" Cambridge University Press, Cambridge, UK.

Simmons, J and Newell, Mark.

1989 "*The Santee Canal Sanctuary Part I: Preliminary Archaeological Survey.*" Cultural Resource Management Publication No 5, Underwater Antiquities Management Program, South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, South Carolina, USA.

Sloane, E.

1964 "*A Museum of Early American Tools.*" Ballantine Books, New York, New York, USA.

Smith, H.A.M.

1988a "*Rivers and Regions of Early South Carolina.*" Reprint Company, Spartanburg, South Carolina, USA.

1988b "*The Baronies of South Carolina.*" Reprint Company, Spartanburg, South Carolina, USA.

Smith, Julia Floyd.

1985 "*Slavery and Rice Culture in Low Country Georgia 1750-1860.*" University of Tennessee Press, Knoxville, Tennessee, USA.

Smith, Robert.

1970 "The Canoe in West African History." *Journal of African History* XI.4 (1970) pp. 515-533, London UK.

South, Stanley.

1979 "The Search for Sixteenth Century Santa Elena." *The Conference on Historic Site Archaeology Papers*, 1978, 13:25-27. Conference Proceedings. Occasional Papers of the South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, South Carolina, USA.

South, Stanley, Skowronek, Russell K. and Johnson, Richard E.

1988 "Spanish Artifacts from Santa Elena." *Anthropological Studies*

- No. 7, Occasional Papers of the South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, South Carolina, USA.
- Stokes, Harold H.
1951 *"The Savannah."* The University of Georgia Press, Athens Georgia, USA.
- Tatham, William.
1800 *"An Historical and Practical Essay on the Culture and Commerce of Tobacco."* Printed for Vernon and Hood, London, UK.
- Taylor, Eva G. R. (ed.).
1936 *"The Original Writings and Correspondence of the Two Richard Hakluyts."* Cambridge University Press for the Hakluyt Society, London, UK.
- Terrell, Bruce G.
1988 *"The James River Batteau: Tobacco Transport in Upland Virginia, 1745-1840."* Masters Thesis, East Carolina University, Greenville, North Carolina, USA.
- Thomas, David H.
1989 *"Archaeology."* Holt, Rinehart and Winston Inc., Fort Worth, Texas, USA.
- Trout, William E. III.
1986 *"The Bateaman's Guide to the James."* American Canal Society, Richmond, Virginia, USA.
1989 *"The James River Festival Batteau Trail."* The American Canal Society, Richmond Virginia, USA.
- Vaitses, Allan H.
1980 *"Lofting."* International Maritime Publishing Company, Camden, Maine, USA.
- Vlach, John Michael.
1979 *"The Afro-American Influence in Decorative Arts."* Cleveland Museum of Art, Cleveland, Ohio.
1986 *"The Shotgun House: An African Architectural Legacy."* University of Georgia Press, Athens, Georgia, USA.
- Watkins, Robert and George.
1800 *"A Digest of the Laws of the State of Georgia."* Published by the authors, Philadelphia, Pennsylvania, USA.

Webber, M. L. (ed.).

1954 "Colonel Senf's Account of the Santee Canal." *The South Carolina Historical Magazine* 55:8-21 and 112-131, South Carolina Historical Society, Charleston, South Carolina, USA.

Weir, Robert M.

1983 "*Colonial South Carolina, A History.*" KTO Press, Millwood, New York, USA.

Weld, Isaac.

1969 "*Travels Through the United States of America.*" Augustus M. Kelly, New York. Reprint of 1807 original by John Stockdale, London, UK.

Wheeler, Robert C.

1972 "The North American Fur Trade " in *A History of Seafaring* George F. Bass (ed.) Walker and Company, New York, New York, USA.

Wildes, Jeffrey.

1982 "Ferries and Landings on the Black River." *Names In South Carolina*, Winter 1982 XXIX:26. Department of English, University of South Carolina, Columbia, South Carolina, USA.

Willbanks, Ralph.

1981 "A Preliminary Report on the Mepkin Abbey Wreck, Cooper River, South Carolina: An Early 19th-Century River Trading Vessel." *Proceedings of the XXth Conference on Underwater Archaeology*, The Society for Historical Archaeology, Glassboro, New Jersey, USA.

Williams, Richard L. (series ed.).

1970 "Light and Film." *Life Library of Photography*, Time Life Books, New York, New York, USA.

Wood, Peter H.

1974 "*Black Majority.*" W. W. Norton and Company Inc., New York, New York, USA.

Wood, Virginia Steele.

1981 "*Liveoaking: Southern Timber for Tall Ships.*" Northeastern University Press, Boston, Massachusetts, USA.

1986 "A Connecticut Yankee's Field Report: Shaler Hillyer's Impressions of Petersburg and Elbert County, Georgia, in 1800." *The Georgia Historical Quarterly*, Vol. LXX, No. 2 pp. 280-287 Summer Issue. The Georgia Historical Society, Savannah, Georgia, USA.

Zierden, Martha, Calhoun, Jeanne, Hacker-Norton, Debbie.

1985 "Archdale Hall: Investigations of a Lowcountry Plantation." *The Charleston Museum Archaeological Contribution No. 10*, Charleston Museum, Charleston, South Carolina, USA.

Original Manuscripts and Records

Amherst, General Jeffrey.

"Correspondence of the Commander in Chief to Masters of Vessels." *The Amherst Papers, 1757-1863*, Call Number W.O. 34: Public Records Office, Kew Gardens, London UK.

Columbian Museum & Savannah Daily Gazette, Volume 1, Number 62, April 15th, 1817. Savannah Historical Society, Savannah, Georgia, USA.

Drayton, Dr. Charles.

1794 "*Diary of Dr. Charles Drayton 1793-1796.*" Original document, South Carolina Historical Society, Charleston, South Carolina, USA.

Marlboro County Estate Papers, Box E, Number 7 For Achilles Knight estate inventory, Marlboro County Courthouse, Bennettsville, South Carolina, USA.

Port Registry, Georgetown, South Carolina, USA. 1733 (Microfiche, South Carolina Department of Archives and History: Naval Office Shipping Ref:5/503-5/504).

Raper, Robert.

1759-1770 "*Letterbook.*" Copy on file at South Carolina Historical Society, Charleston, South Carolina, USA. Original document viewed at County Registrar's Office, Portsmouth UK.

The Rural South Carolinian, Files of the Charleston Library Society, Charleston, South Carolina, USA.

South Carolina Gazette, Files of the Charleston Library Society, Charleston, South Carolina, USA.

The Charleston City Gazette, Files of the Charleston Library Society, Charleston, South Carolina, USA.

Personal Communications

Alford, Michael, Curator, North Carolina Maritime Museum.

1991 Re: Design origins for local craft. Mr. Alford hypothesizes that the log raft used early in the Colony's exploitation of Naval Stores could have been the origin of subsequent log-built boats.

Cederlund, Carl Olaf, Swedish National Maritime Museum, Stockholm.

1991 Re: Stockholm Tar Boats. Dr. Cederlund is credited for directing the author to the study of these vessels in Finland as a possible precursor of the mountain boat.

Ferguson, Lamar, Retired carpenter, Santee Cooper Public Service Authority.

1985 Re: Building of the Mepkin Mud Barge and area barge history, two hour tape recording, author's files. Most significantly, Ferguson describes using the wreckage of an historic flat pulled from the canal beside the rice mill on Mepkin Plantation as the model for the mud barge.

Fleetwood, William Rusty, Tybee Island, Georgia, USA.

1992 Re: Calculations and data generated by computer from author's construction drawings for the Magnolia Plantation Barge built in Charleston, South Carolina.

Glascoc, Myrtle Director, Avery Research Institute, College of Charleston, Charleston, South Carolina, USA.

1990: Re: Evidence of extensive trade and agricultural skills imported from Africa with African slaves and also practiced by African-Americans on ante bellum plantations. The Avery Institute specializes on the gathering of data on the African and African-American experience in the South.

1992: Re: Studies by the Avery Research Institute into the Gullah and Geechee dialects of coastal island communities in South Carolina. In one instance an African tribal mourning song was handed down virtually intact from slaves imported from Sierra Leone to their modern descendants.

Hastie, Drayton, Owner, Magnolia Plantation, River Road, Charleston County, South Carolina, USA.

1992 Re: Current occupants of slave cabins on the plantation property. There were three occupants at the time of this conversation, all descendants of former slaves. They had returned to live in the cabins after retirement.

Hill, Mackie, Manager, Middleburg Plantation, East Branch, Cooper River, South Carolina, USA.

1991 Re: Origins of a glass plate negative of a chine-girder barge photographed in the rice canal at the plantation and reproduced here as Figure 7.

Hocker, Fred, Director, Institute of Nautical Archaeology, Texas Agricultural and Mechanical University, College Station, Texas, USA.

1991a Re: possible origins of pirogue style craft. Hocker felt that the coasting schooner was derived from the pirogue hull form, whereas in fact it is shown that the two vessels were different, and operated concurrently.

1991b Re: evidence that the vessel at Brown's Ferry had a transom stern rather than being a double ender. Alan Albright had recovered two frames from the site which clearly indicated the presence of a transom stern. Albright did not recognize their significance, and they were not shown to Dick Steffy, who initially thought the vessel was a double ender. The frames were identified by Hocker when he was principal investigator for an analysis of the conserved timbers some ten years later.

1992 Re: discussion of preliminary findings on Clydesdale vessel project, another coasting schooner found beneath remains of a rice field dike near the Savannah River, Savannah, Georgia, USA.

Hunley, Mrs. Ruth.

1989 Re: Personal genealogical research conducted on the Witherspoon family. Mrs. Hunley's research uncovered a narrative of the family's journey in a coasting schooner from Charleston to the ferry landing.

Judd, William, Charleston, South Carolina, USA.

1985 Re: His personal efforts starting in 1984 to document small craft wreckage in the Charleston area.

Linder, Suzanne, Ph. D.

1992 Re: Observations on studies conducted on historical records of Marlboro County, North Carolina concerning transportation of furs on the Pee Dee River.

Marsden, Peter, Archaeological Director, Museum of London.

1991 Re: discussion on overview of common flatboat construction designs in Europe. Marsden stated that transversely planked flats were not common in European flat or barge construction.

Michie, James, Archaeologist, Waccamaw Center for Regional Studies, University of South Carolina, Conway Extension.

1983 Re: a rice barge in the main canal at Wachesaw Plantation, Georgetown County South Carolina, USA was salvaged in 1970 for pine lumber which was then used to make furniture.

Millar, Michael M., Lieutenant Commander, US. Coast Guard and Chief, Maritime Safety Department, United States Coast Guard Marine Safety Office, Charleston, South Carolina, USA.

1995 Re: the requirements of the Coast Guard for the reconstruction of historic sailing vessels intended for ocean going use, research, sail training and passenger service.

Miller, Daryl, Missionary, Photographer, Columbia, South Carolina, USA.

1994 Re: Construction of dugout canoes by "bush Negroes" in Suriname. Telephone contacts with fellow missionaries in Suriname in 1994 confirmed that canoes were still being made in the region. Future plans are for the author and Mr. Miller to study these techniques in Suriname as further ethnoarchaeological research into African influences on North American small craft construction.

Newell, Mark (Author).

1990 "*Overview of Configuration of Underwater Components of Ante-Bellum Plantation Sites*" Internal Memorandum re Middleburg Plantation to

graduate student James Errante, Anthropology Department, University of South Carolina, Columbia, South Carolina, USA. The memorandum, was written in response to a request for guidance on the cultural material typically found in rivers, creeks, and canals off local plantations. MS on file at South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, South Carolina, USA.

Nylund, Rowena. Historian, South Carolina Department of Archives and History
1989 Re: statistical analysis of early eighteenth century newspaper advertisements concerning small craft

1990 Re: number of African-American captains in charge of eighteenth century water craft.

O'Neil, Nicola. Master Thesis student, Scottish Institute for Maritime Studies.
1989 Re: Correspondence on historical and modern methods of manufacture for Ghanaian dugout craft, based on studies for a Masters Thesis. Letter in author's files.

Porcher, Richard, Researcher, College of Charleston, Charleston, South Carolina, USA.

1986 Re: History of Friendfield tract of Hobcaw Barony, Georgetown County, South Carolina, USA.

Rooney, Kevin. Sport Diver, Charleston South Carolina USA.

1989 Re: The craft at Potatoe Ferry. According to Rooney, he investigated the area at the request of Mrs. Ruth Hunley and found the wreckage. He stated that he removed artifacts including ceramics which dated to 1800.

1990 Re: His discovery of a large aboriginal dugout in 70 feet of water in the Cooper River near Charleston, South Carolina, USA. According to Rooney, he obtained a carbon dating sample from the canoe which tested to 4,500 BP. No evidence of the sample or dating was ever produced.

Saltus, Alan. Archaeologist, Southeastern Louisiana University

1989 Re: Practice of building "temporary craft" to be broken up on arrival for lumber. This practice was common on the Mississippi River.

Shuping, Hampton. Sport Diver, Conway, South Carolina, USA.

1992 Re: Discovery of a large, European style dugout in the backyard of a new home on an historic plantation canal in Horry County. The dugout, a particularly fine example, was being used as a planter. Shuping provided a slide of the vessel, now in the author's files.

Steffy, Richard, Institute of Nautical Archaeology, College Station, Texas, USA.

1984 Re: Behaviour of certain types of wood used in southern ship building. Practice had shown that Southern Yellow Pine especially, behaved much the same way as full scale timber when used as small as 1:10. No studies had been done at this time on cypress and the question is still unanswered.

Tinker, Grant, Santee-Cooper Public Service Authority,

1991 Re: Construction of a barge on Mepkin Plantation, Cooper River, for repair of plantation dikes. Plantation was former hunting preserve of Henry Luce Booth of New York, New York USA.

Trout, William. President, American Canal Society.

1989 Re: Use of "nested" craft on American canals. Idea was proposed for ore barges on the Schuylkill Canal by Hazzard but never used.

Wood, Judy. Archaeologist, Corps of Engineers, Savannah, Georgia, USA.

1992 Re: History of the Clydesdale Plantation main river dike, Chatham County, Georgia.

Figures

Four Physiographic Provinces of South Carolina

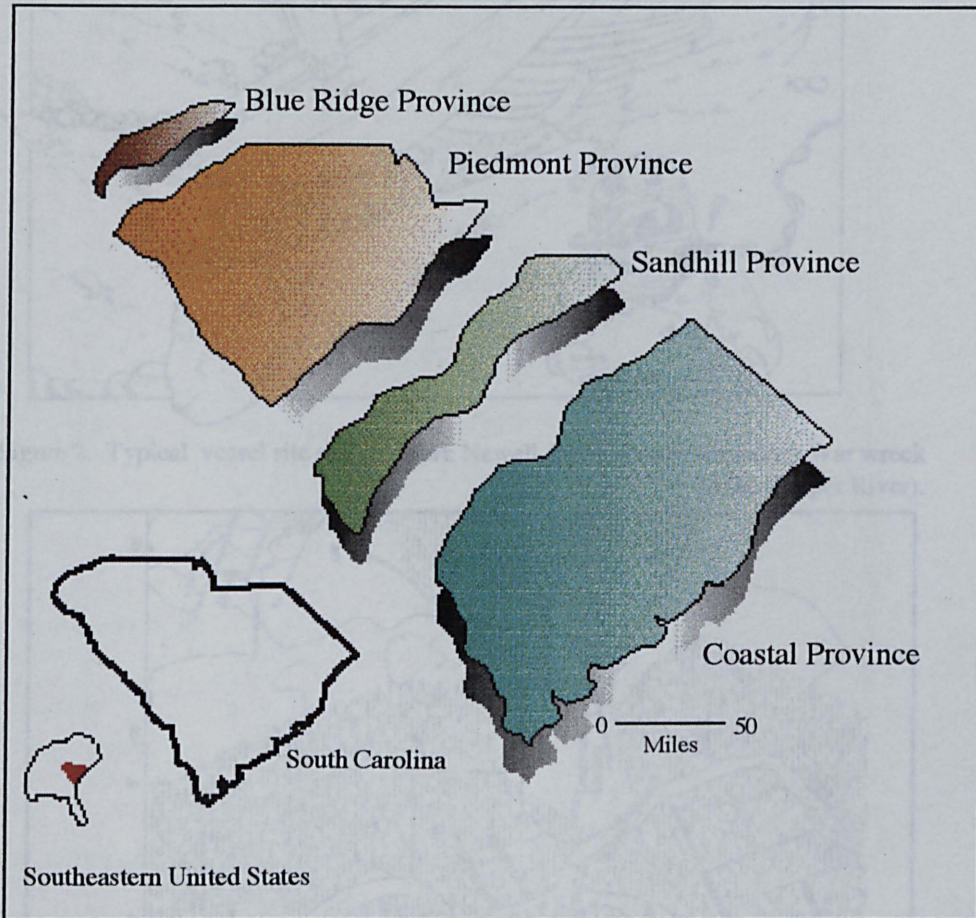


Figure 1: The four main physiographic Provinces of South Carolina (Newell, after Barry's *"Natural Vegetation of South Carolina,"* University of South Carolina Press).

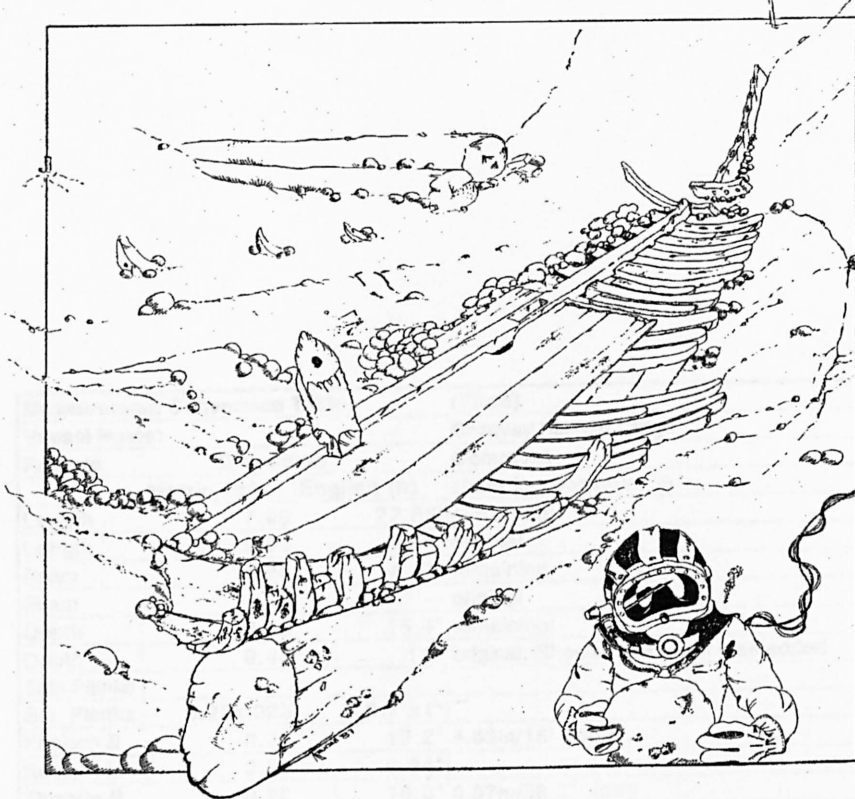


Figure 2: Typical vessel site sketch, Mark Newell (possible Revolutionary War wreck in the Cooper River).

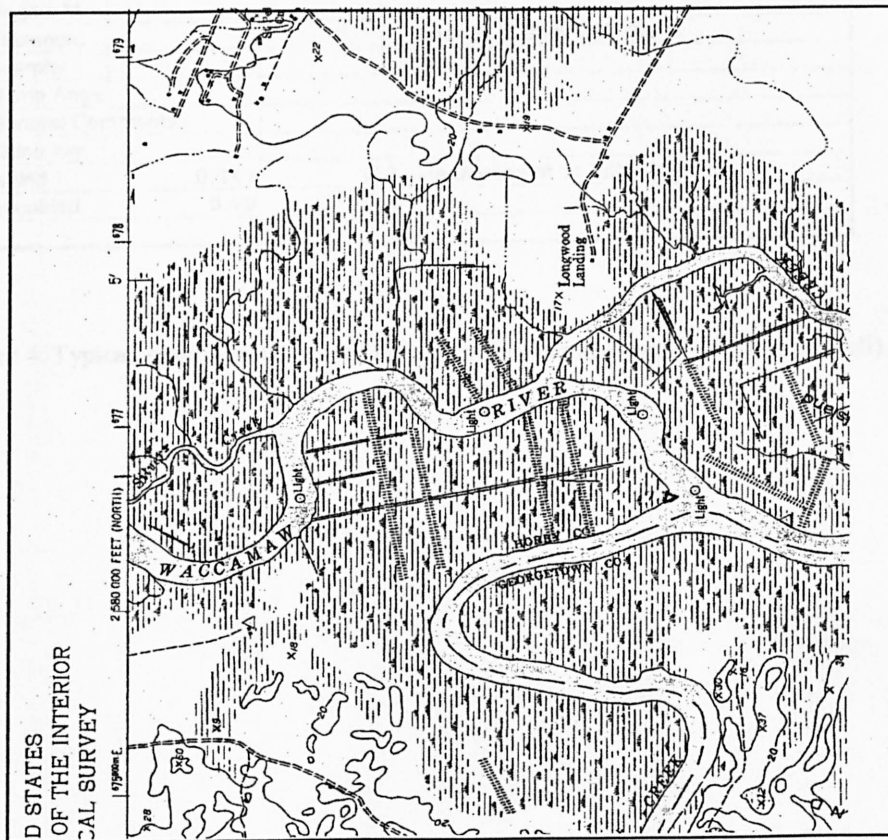


Figure 3: United States Geological Survey map section with coordinates.

Measurement Conversion Table		(Flats)	
Vessel Name:		Conway narrow barge	
Feature	Dimension		Comment
	Metric (m)	English (ft)	
Length	7.90	27.65'	chine log construction remaining:
Length	9.00	31.5'	original
Beam	1.26	4.41'	remaining
Beam			original
Depth	0.39	15.4"	remaining:
Depth	0.48	19"	original: Sheerstrake plank was added
Side Planks			
Bot. Planks	0.22x.025	8.7"x1"	
Keelson S	0.31	12.2"	4.53m/16' long
Keelson M	0.10	3.94"	
Thwarts S	0.26	10.3"	0.97m/38.2" long
Thwarts M	0.07	2.76"	
Header S			Chine rabbeted for a header plank
Header M			
Fasteners			treenail 0.03m/1.2" dia
Scarphs			
Ramp Angle			
General Comments:			
Chine log:			
sided	0.145	5.7"	Measurement at thickest point
moulded	0.39	15.4"	

Figure 4: Typical scantlings table used for data organization & analysis (Mark Newell).

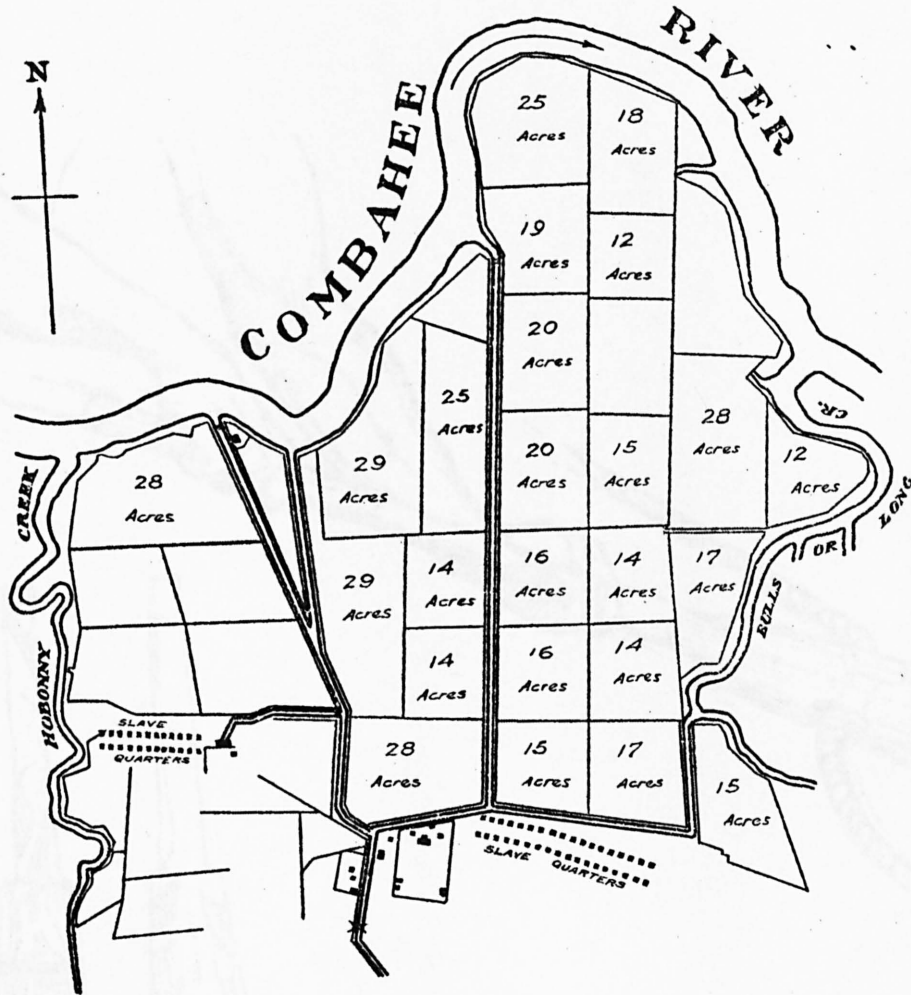


Figure 5: Doar's map of Combahee Plantation, a typical tidal rice plantation showing canal system. (from "Rice and Rice Planting," David Doar, 1936, Charleston Museum.)

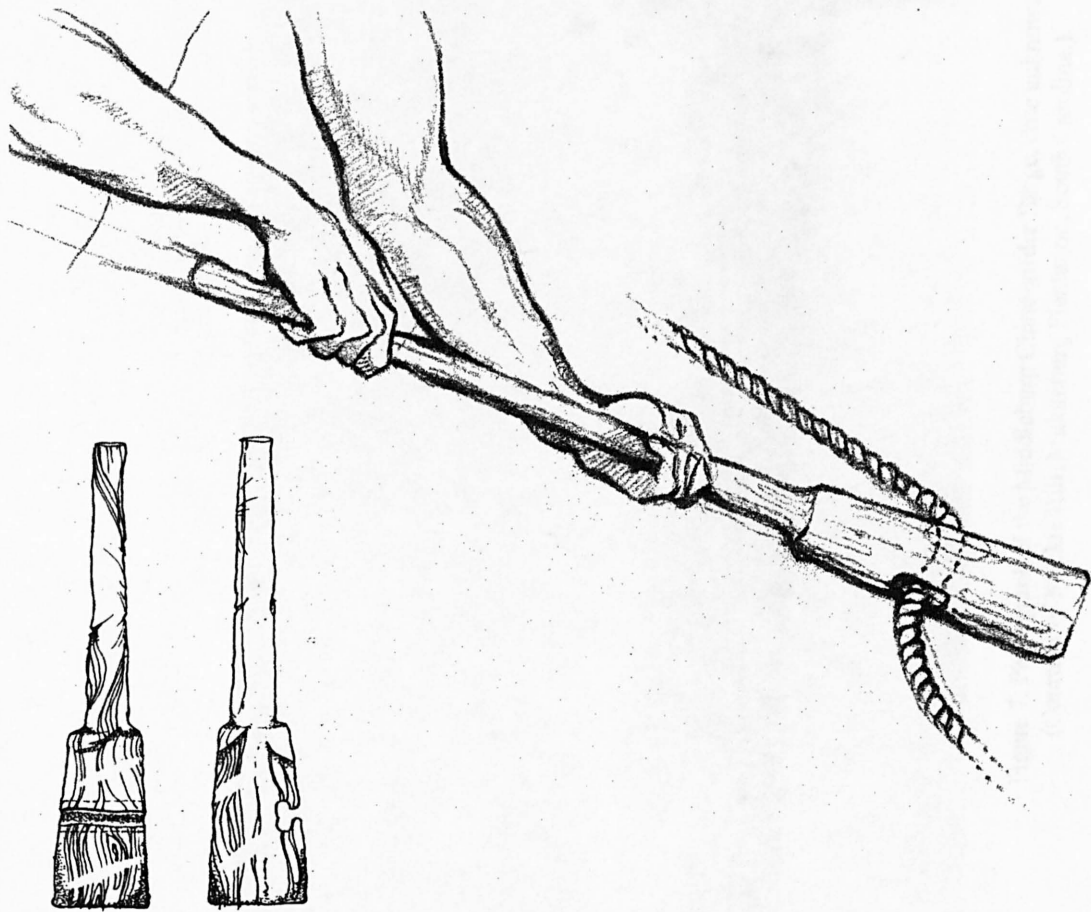


Figure 6: Drawing of a 'ferry bat' used to gain purchase on ferry craft rope (Christine Newell).
Inset: Author's sketch of bats. See Fig 41 below for enlarged detail.

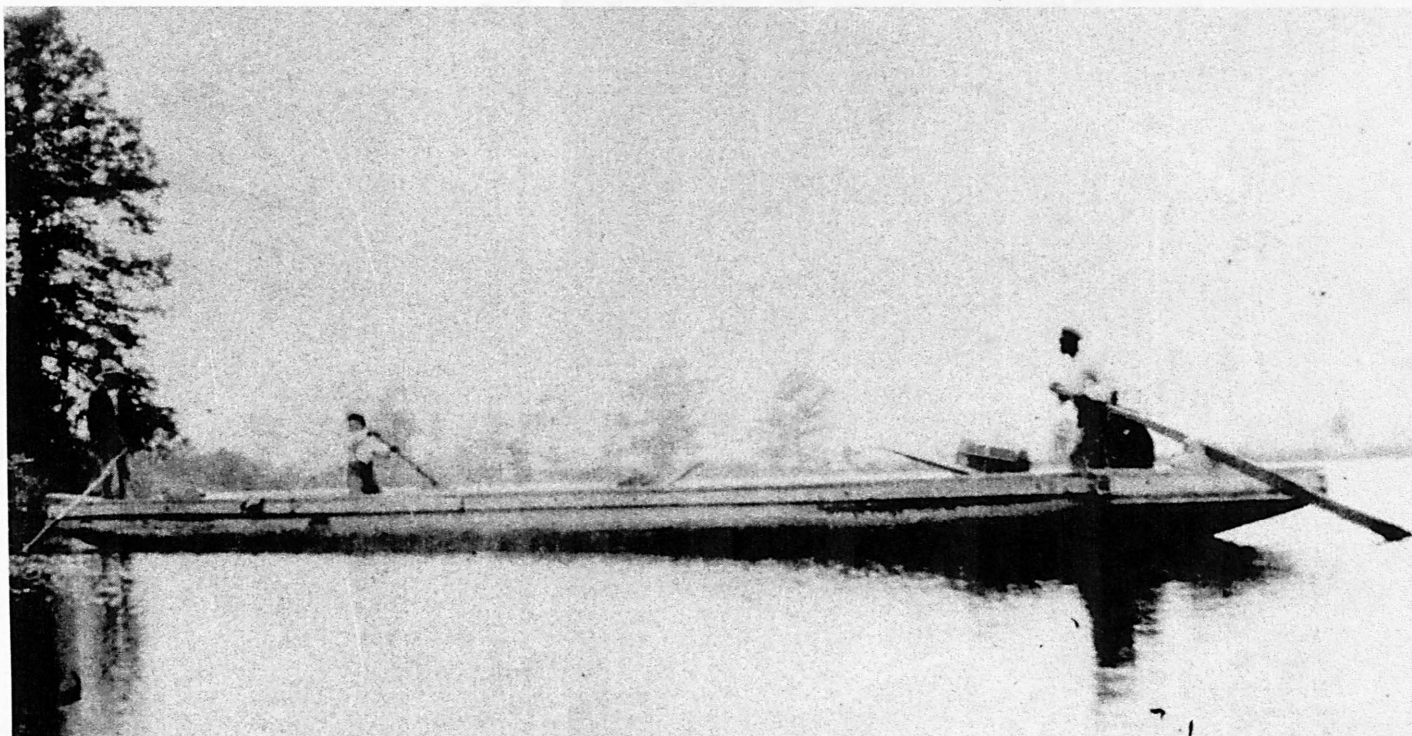


Figure 7: Photograph of the Middleburg Chine-girder Barge, date unknown.
(Courtesy of Mackie Hill, Middleburg Plantation, South Carolina.)

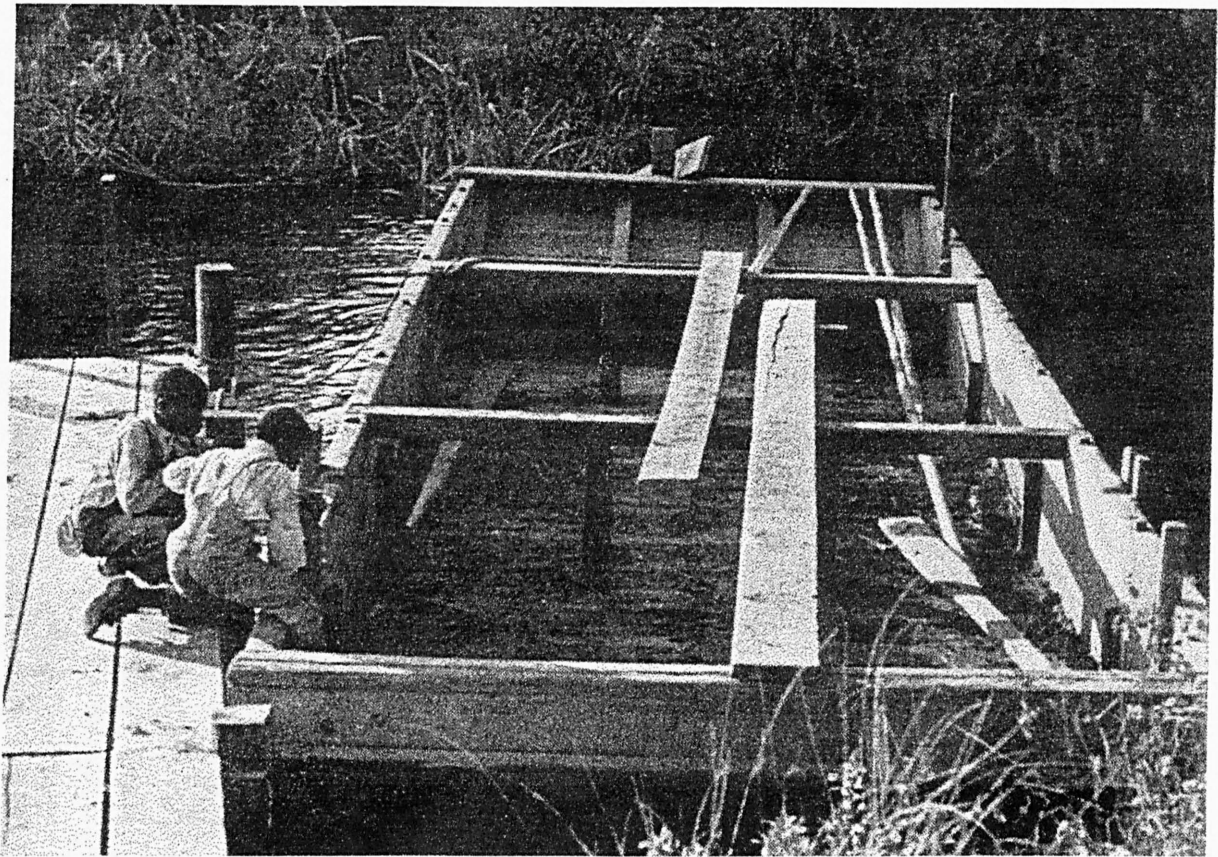


Figure 8: Plank barge photographed on the Combahee river showing use of planks resting on centre braces for 'walking' the barge. Note poles (Opposite page 87, Heywood's "*Seed from Madagascar*," UNC Press).

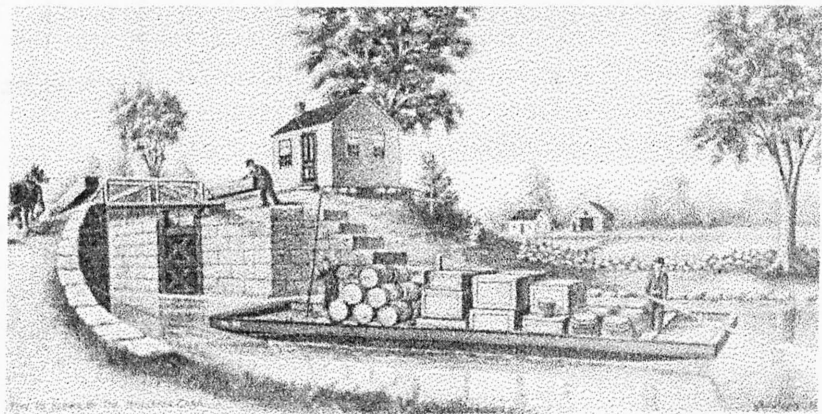


Figure 9: Flat being used on the Middlesex Canal (from "*The Old Middlesex Canal*," Clarke, 1974. Permission of Centre for Canal Technology, Easton, PA.)

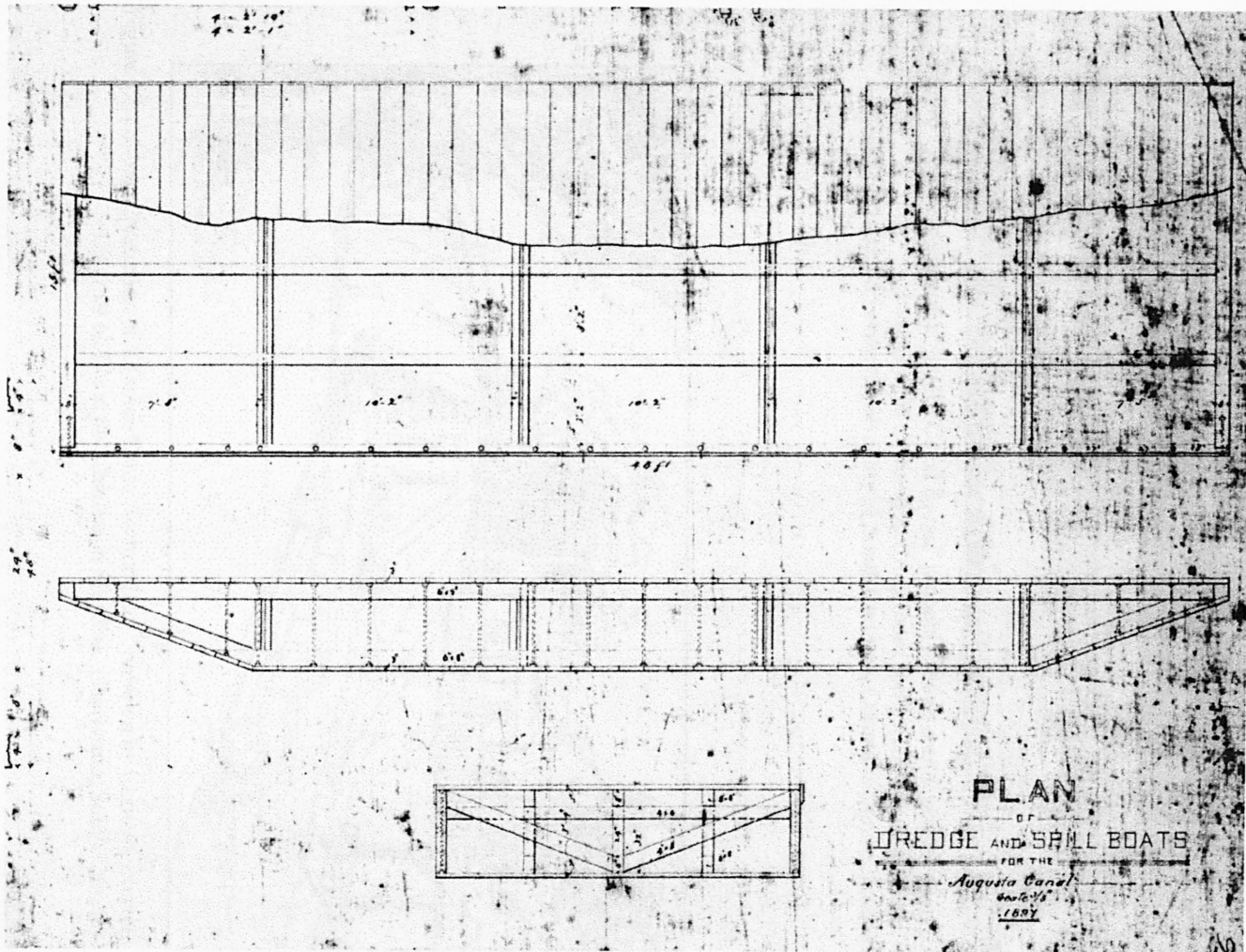


Figure 10: Detail of original carpenter's drawings for an Augusta Canal Barge (courtesy of City of Augusta Engineer's Office).

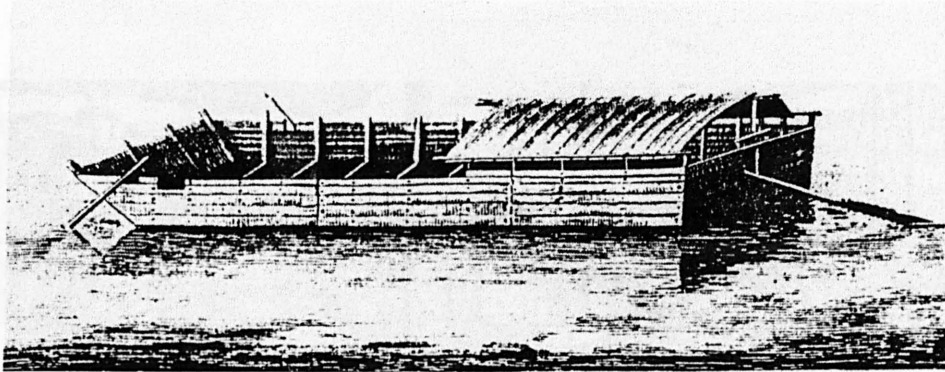


Figure 11: Illustration of a “Santee Canal Barge” probably shows a craft broken apart for lumber at its destination (from loose picture files, Rice catalog file Caroliniana Library, University of South Carolina, Columbia South Carolina).

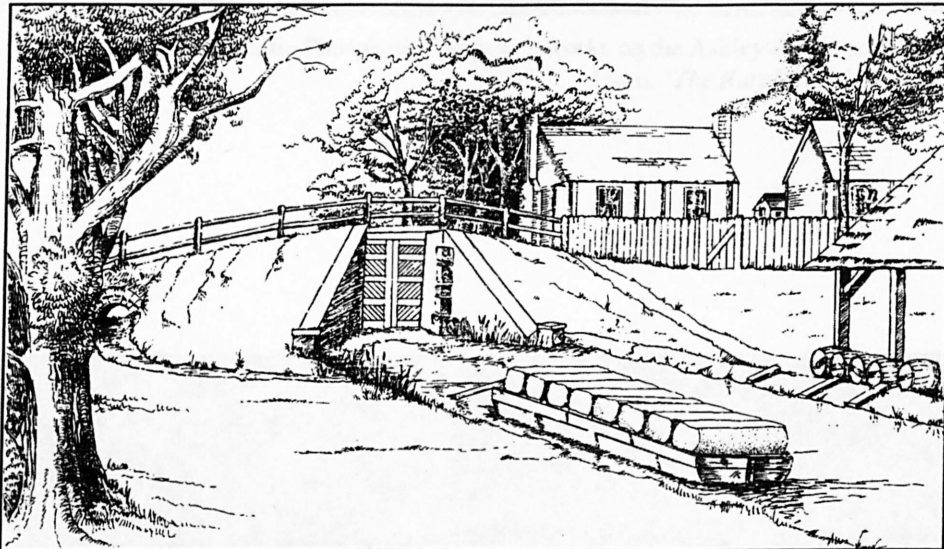


Figure 12: Gibbes' illustration of a Santee Canal “Cotton Box,” redrawn by Christine Newell. Original on file at the Charleston Museum, Charleston, South Carolina.

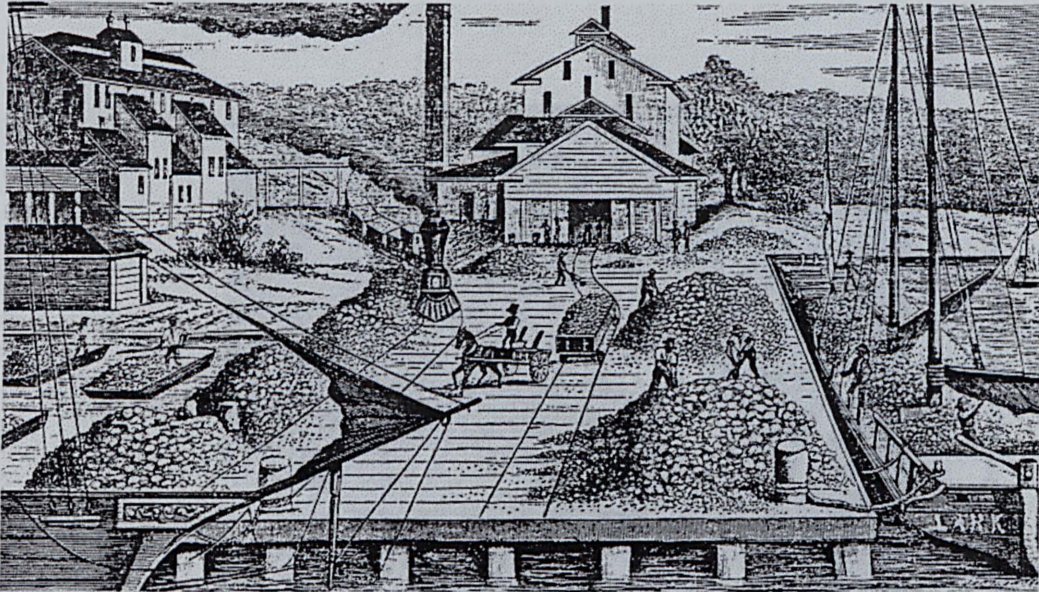


Figure 13: The Atlantic Phosphate Company's works on the Ashley River, near Charleston.
From "*The Rural Carolinian* " of 1871.

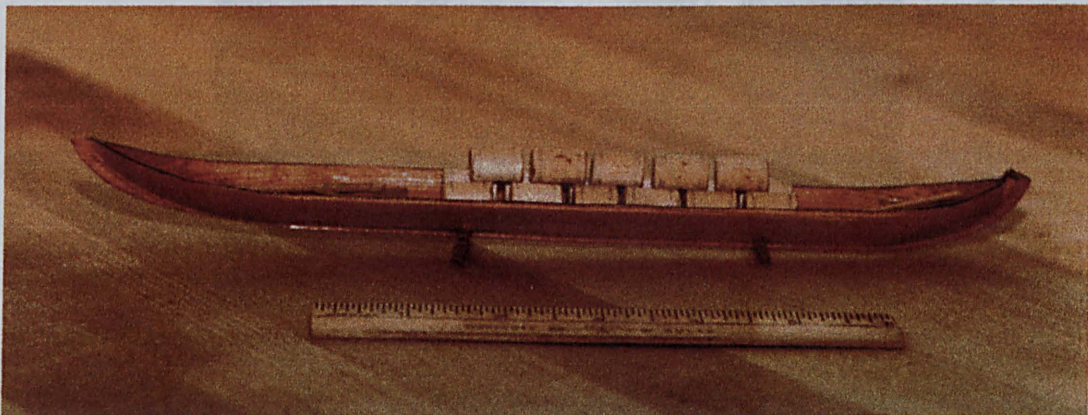


Figure 14: Model of Stockholm Tar boat photographed at the Oulu City Museum, Finland
at the author's request by Mr. Coburn Freer (permission of Oulu City Museum).

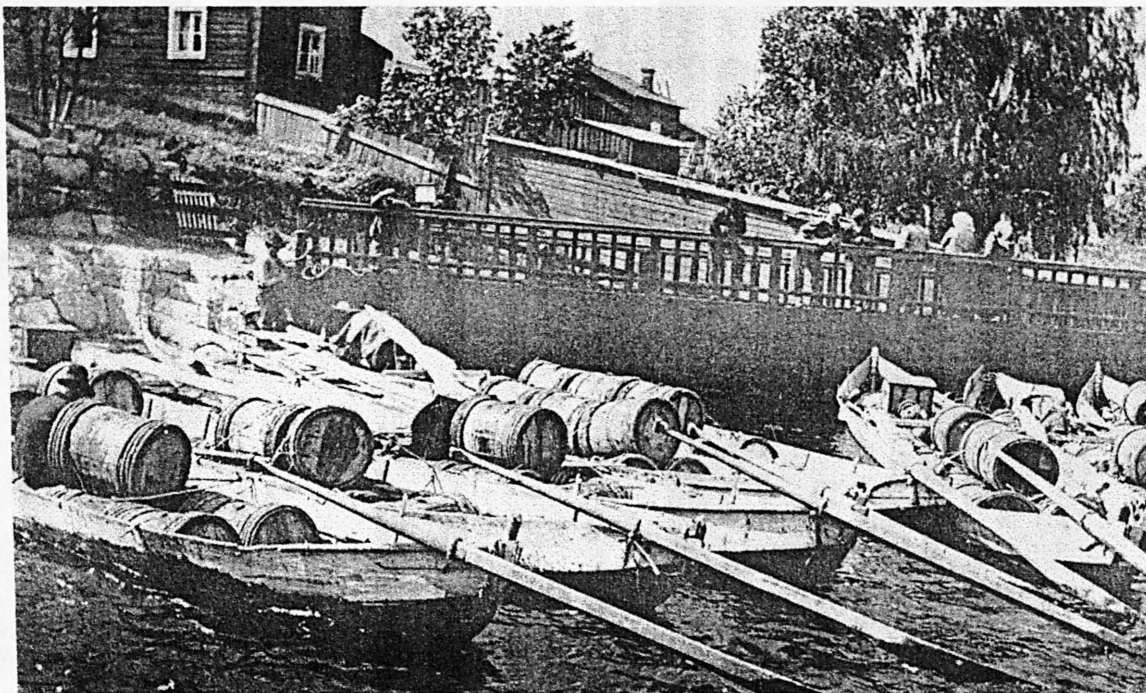


Figure 15: Stockholm tar boats with cargo loaded (courtesy of Maritime Museum of Finland).

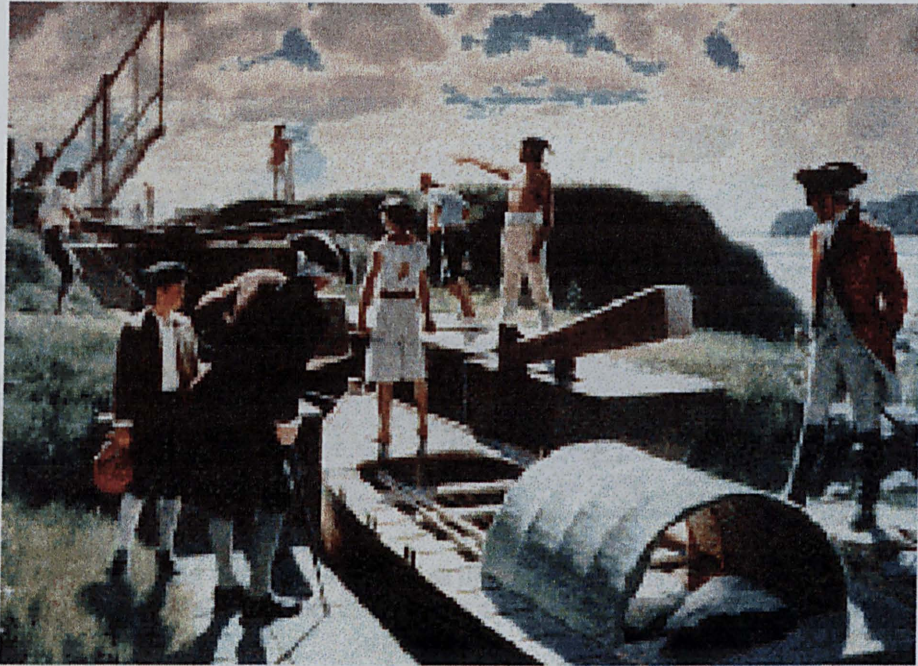


Figure 16: Artist's impression of a Durham boat in a canal lock (courtesy New York State Museum).

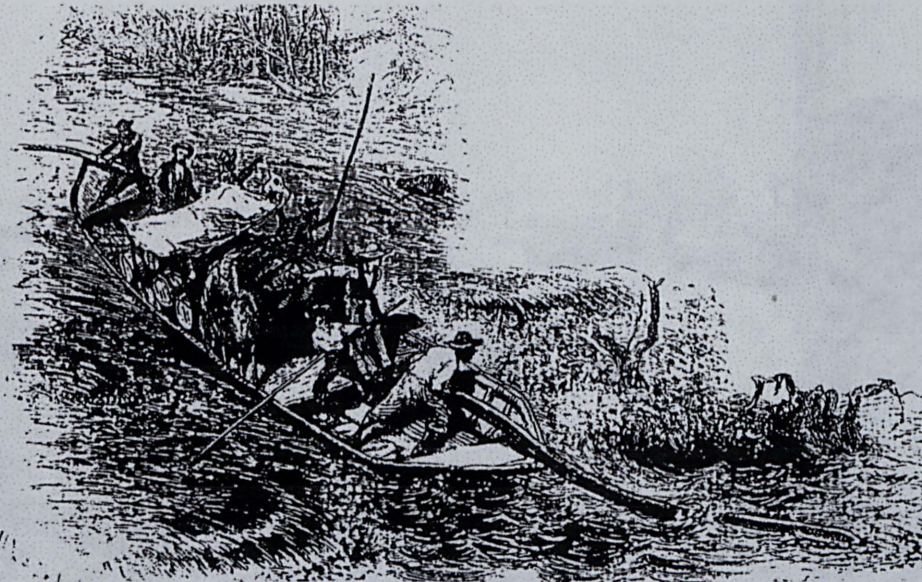


Figure 17: Bateau descending the New River in Western Virginia. Illustration from King's "Southern States of North America," in Trout 1986.

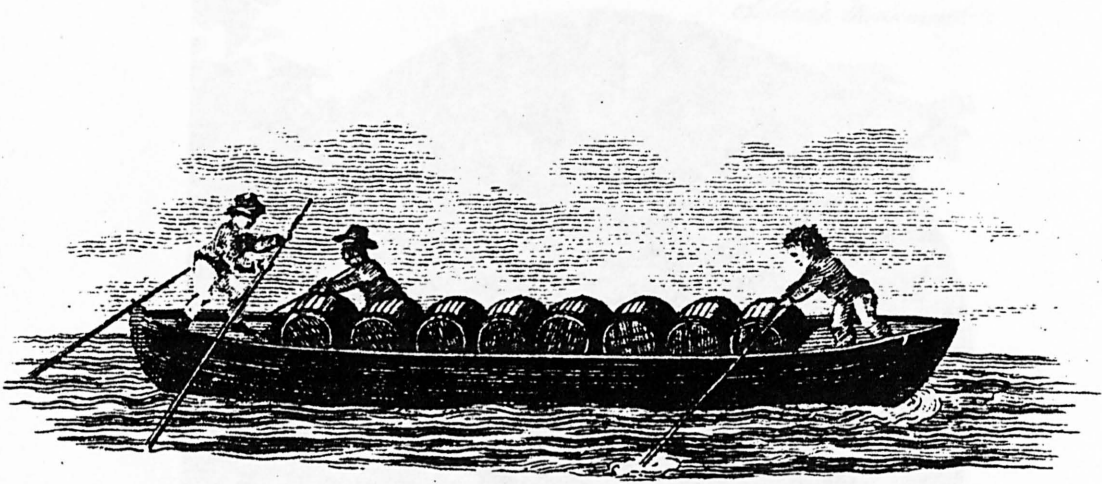


Figure 18: James River Tobacco Boat as illustrated in William Tatham's 1800 essay on Tobacco ("An Historical and Practical Essay on the Culture and Commerce of Tobacco").



Figure 19: Petersburg boats photographed on the Augusta Canal, 1875 (courtesy The Augusta Richmond County Museum).

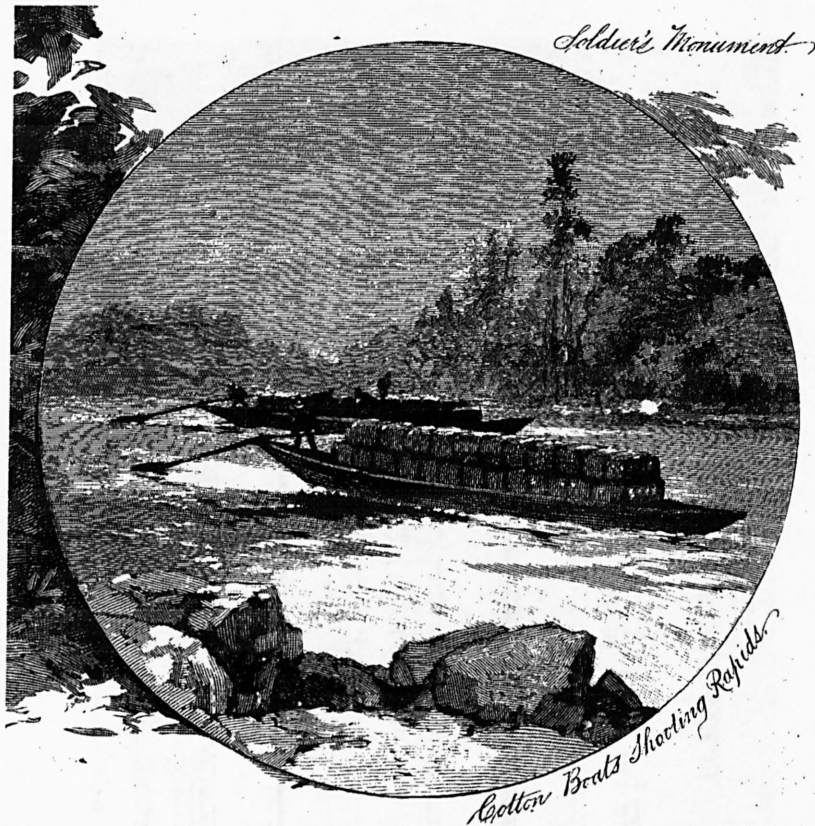


Figure 20: "Cotton Boats shooting the Rapids above Augusta," (from an 1880 print, Special Collections Room, Augusta State University).

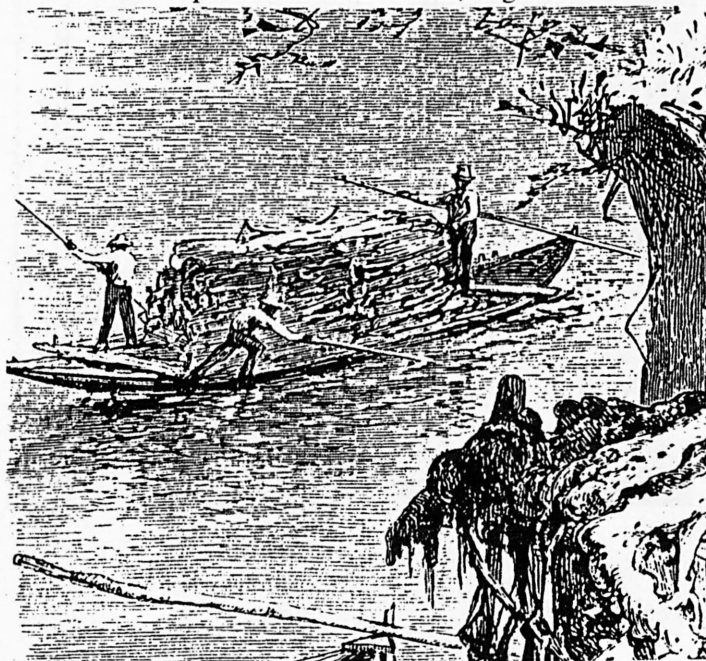


Figure 21: Small pole boats below Augusta. These craft probably operated at Sandbar Ferry (from an 1880 print, Special Collections Room, Augusta State University).

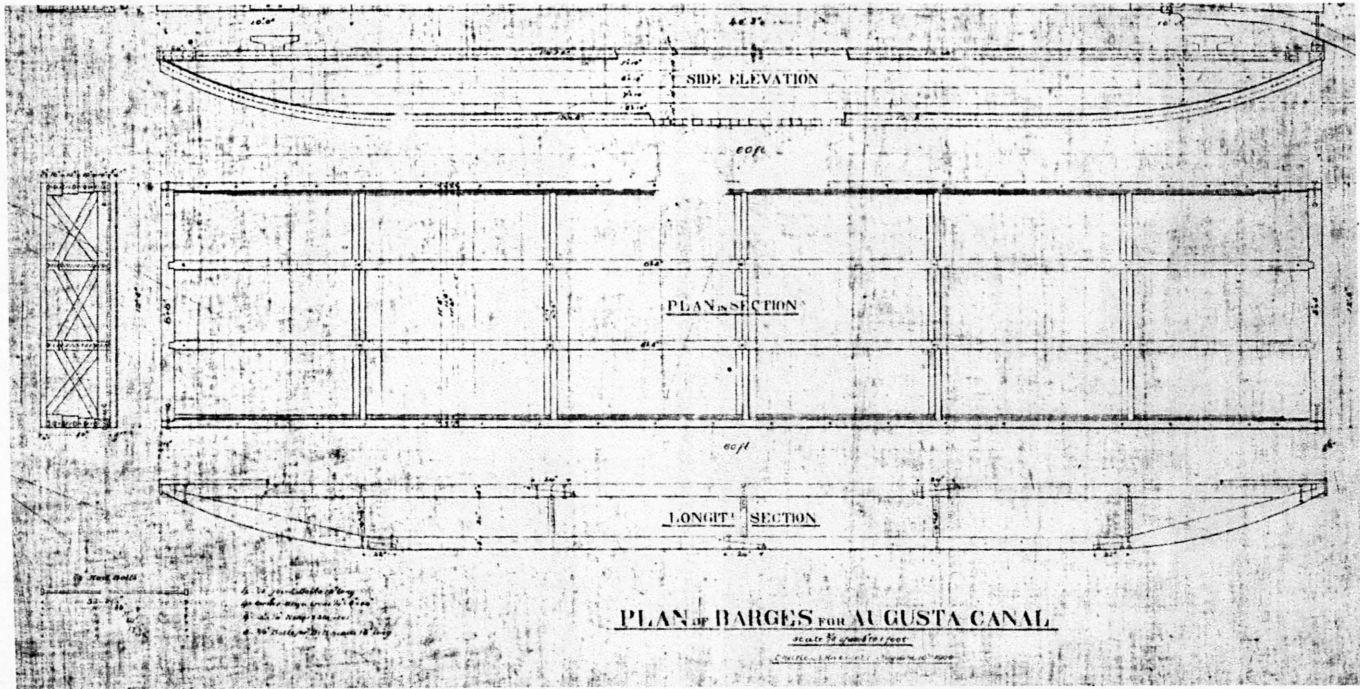


Figure 22: Maxwell's 1900 drawing showing a barge design for the Augusta Canal. Note the curved ramps (courtesy of the City Engineer's Office, Augusta, Georgia).

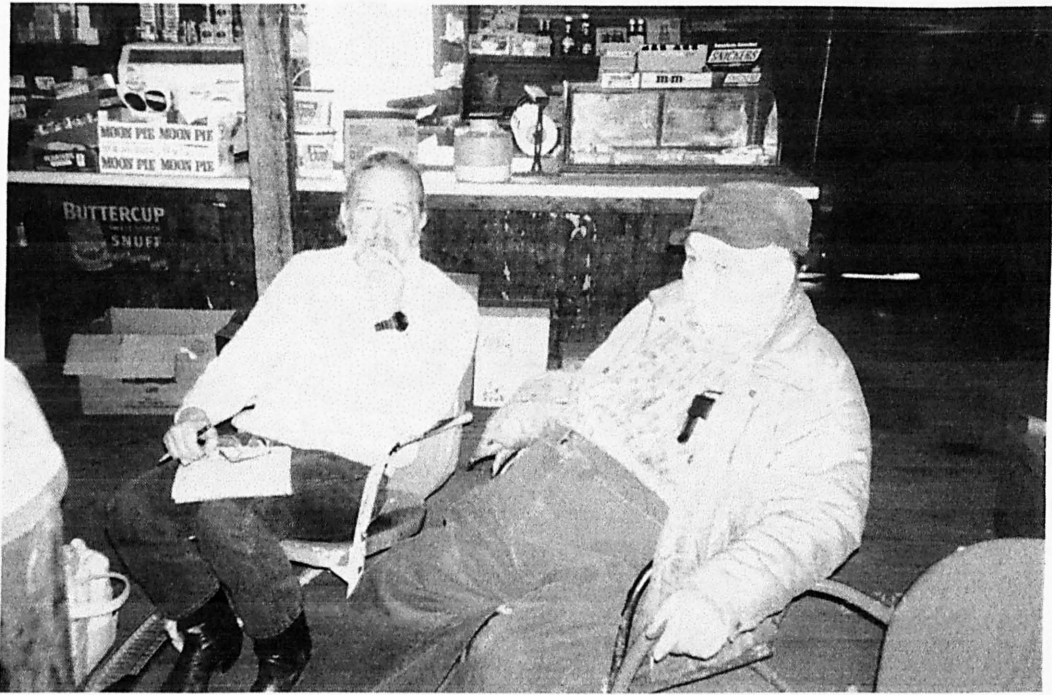


Figure 23: Author (left) and Buck Balchin talk Petersburg boat history (photo: Christine Newell).

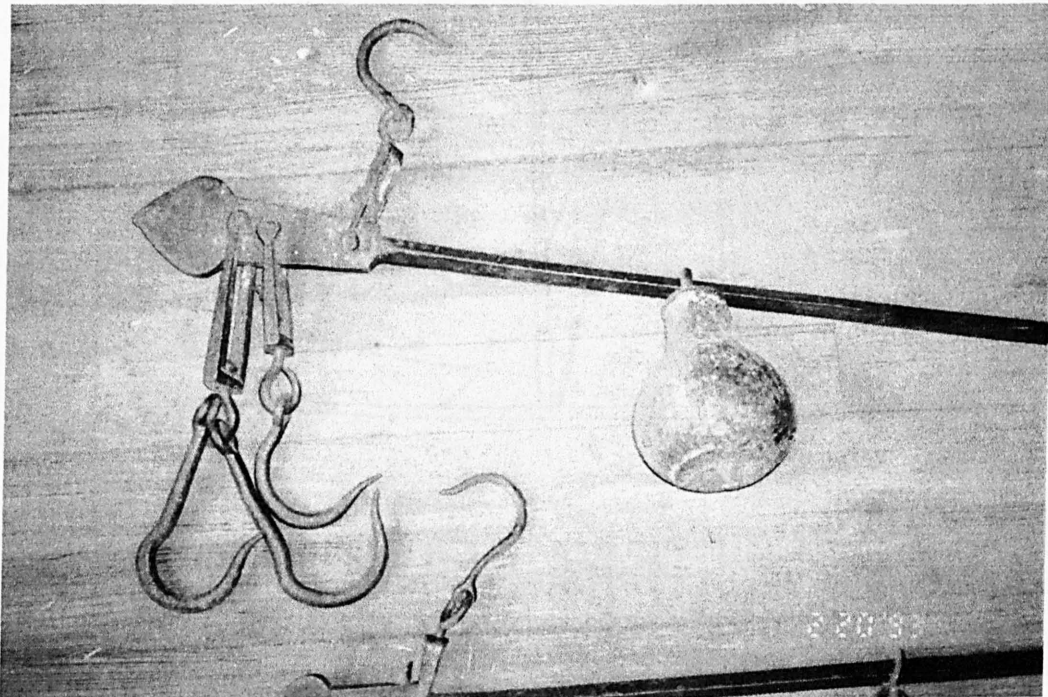


Figure 24: Freight scales used on Balchin's Petersburg Boat (photo: Mark Newell).

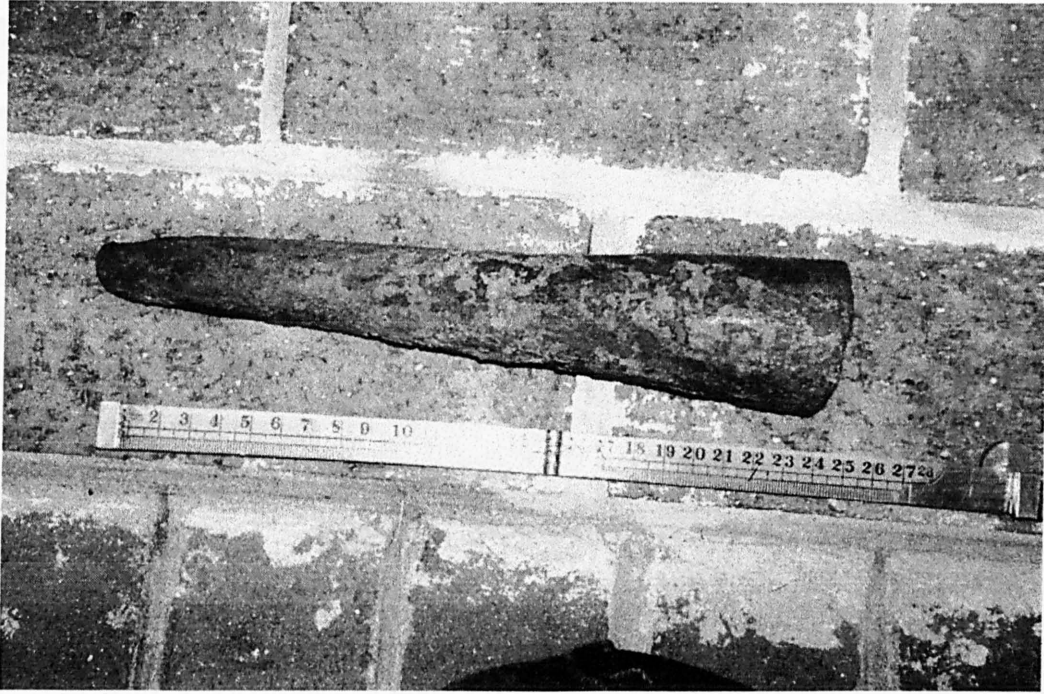


Figure 25: Iron Pole tip recovered at Petersburg by Mr. Roger Childs (photo: Mark Newell).

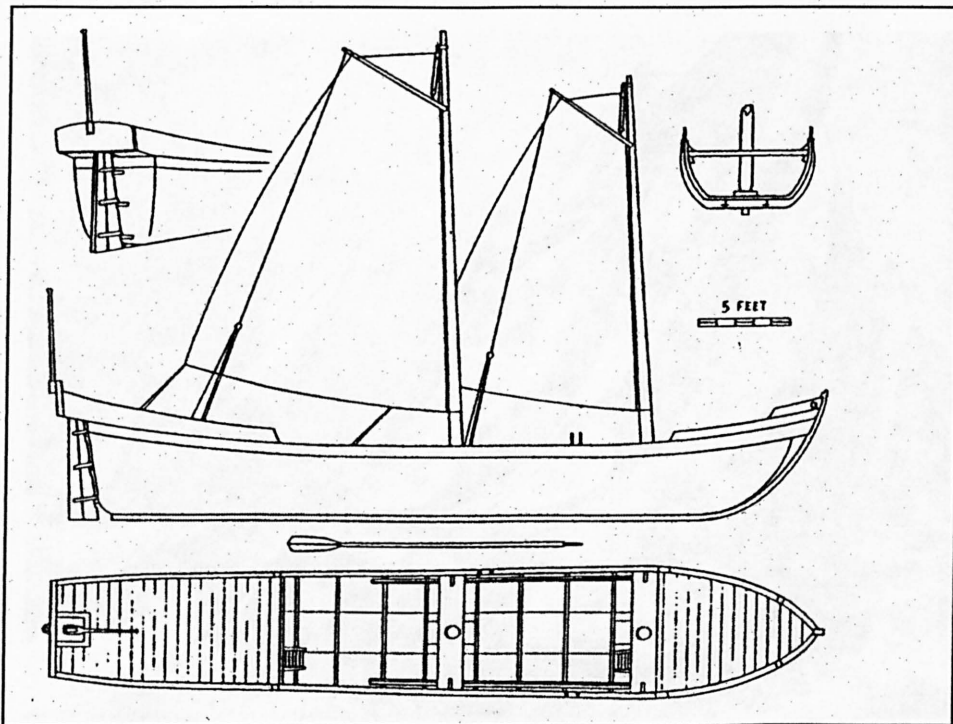


Figure 26: Artist's impression of a pirogue from Iver's Publication, (Darby Erd, South Carolina Historical Society).



Figure 27: A General view of Charleston harbour in 1762 showing a variety of small craft and rigging types. From an old print, possession of Charleston Historical Society.



Figure 28: Nineteenth century illustration of craft similar to 'Transom vessel' from "Man on the Ocean" 1874, (London).

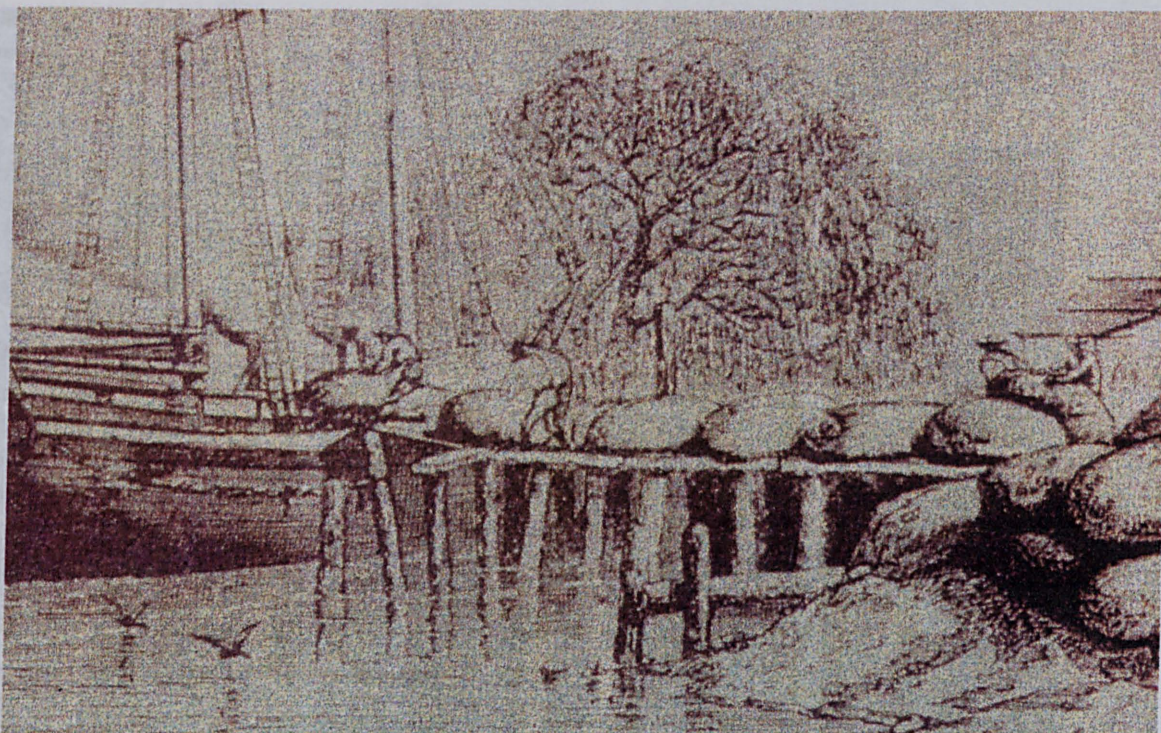


Figure 29: Sacks of rice being loaded onto a schooner (South Caroliniana Library, loose picture files).

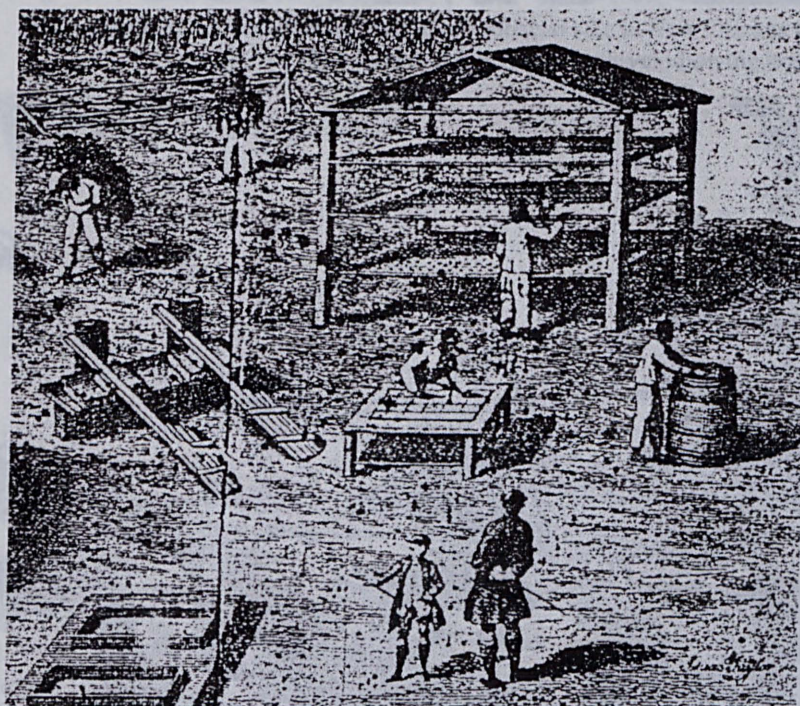


Figure 30: At right, barrel of indigo being prepared for shipment (Mouzon's Map of South Carolina 1775).

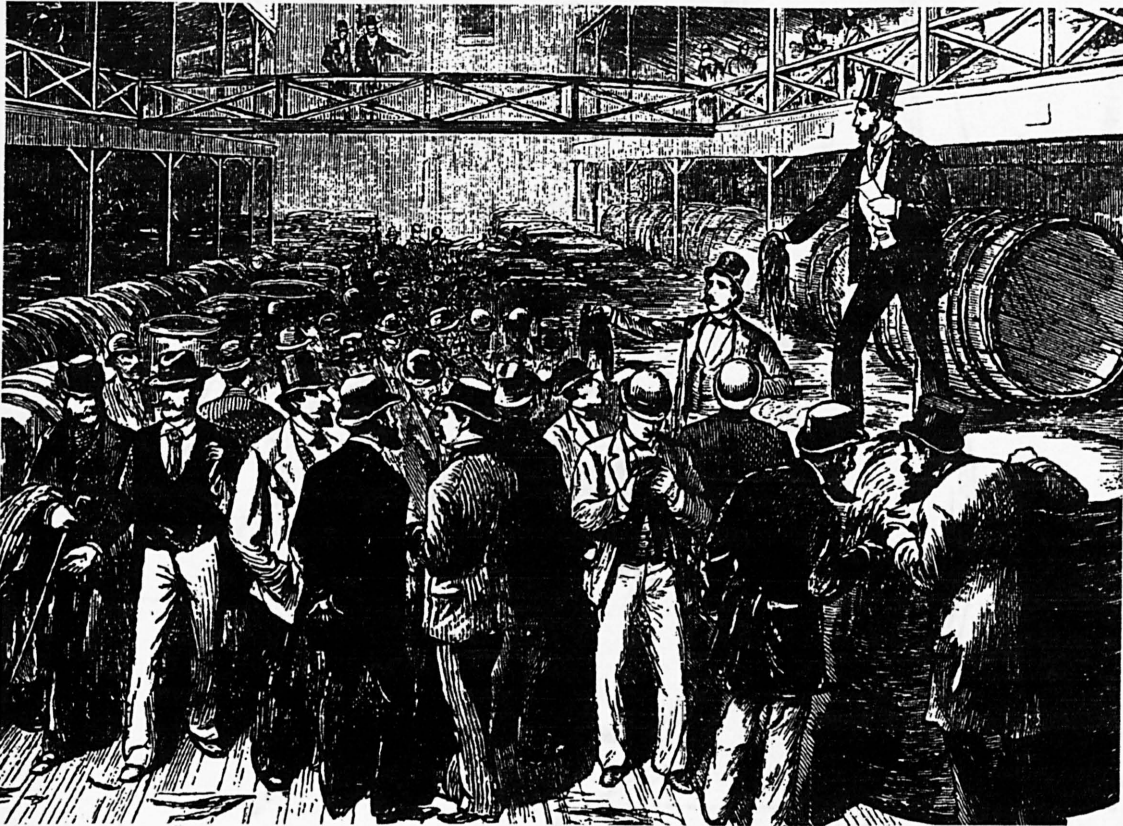


Figure 31: A mid-nineteenth century tobacco sale in New Orleans from the Hart Picture (Hart 1977) Archives showing hogsheads.

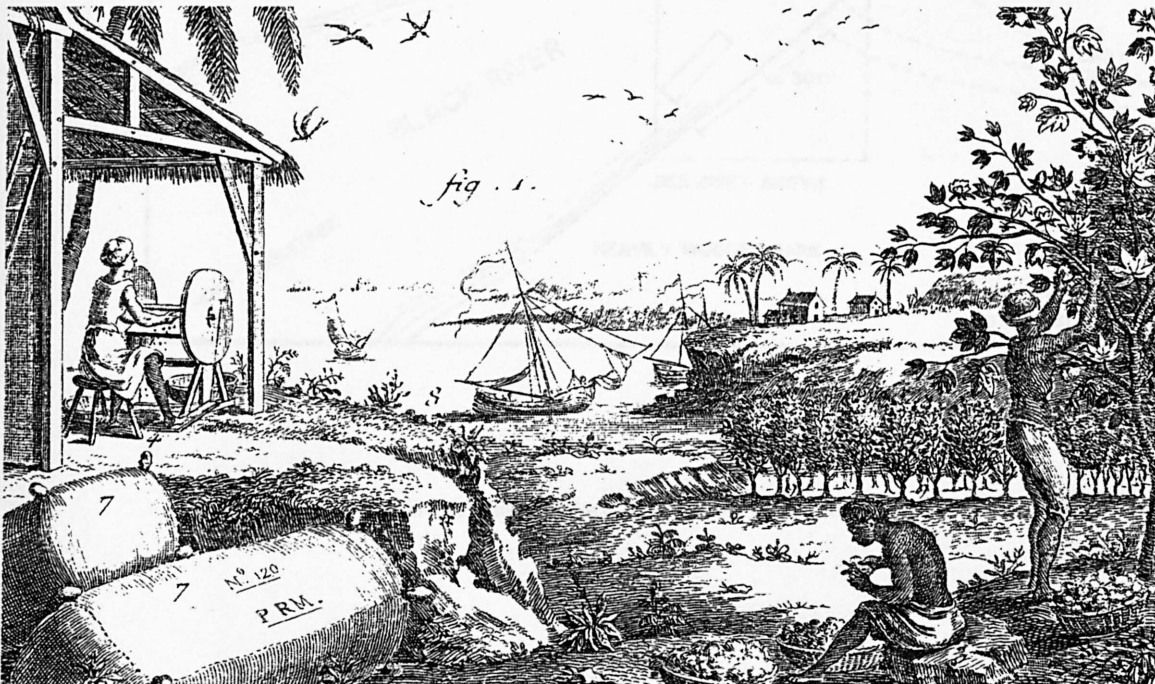


Figure 32: Diderot's illustration of cotton processing on a Caribbean plantation. Note the "long bales" common in the south prior to mechanical cotton presses (in Gillispie 1959).

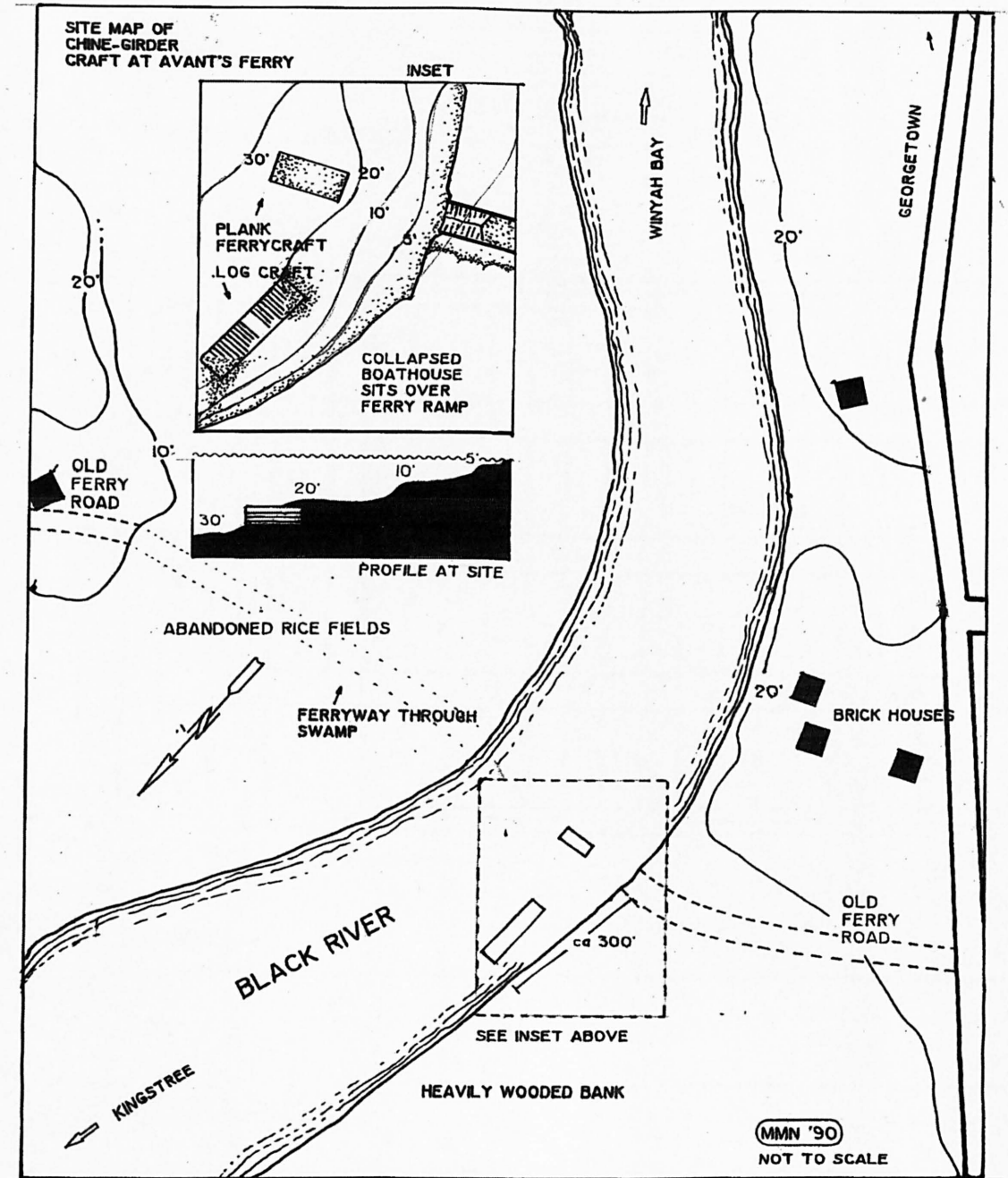
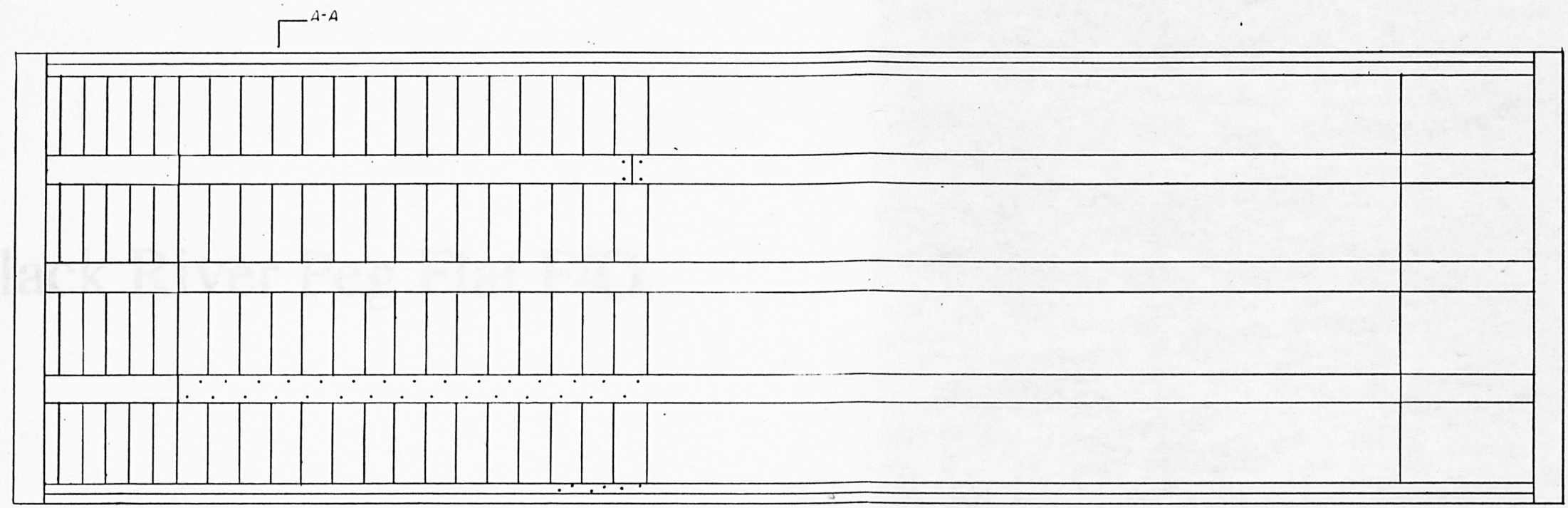
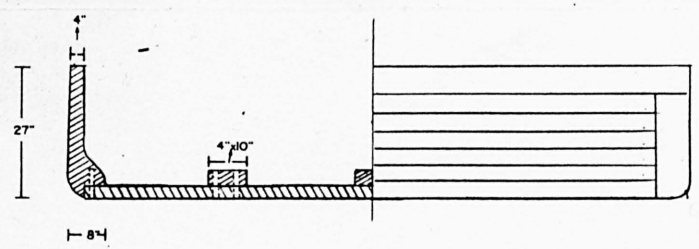


Figure 33: Author's site map of Black River Peg Flat. Note road to ferry crossing.

River Peg Flat F/O

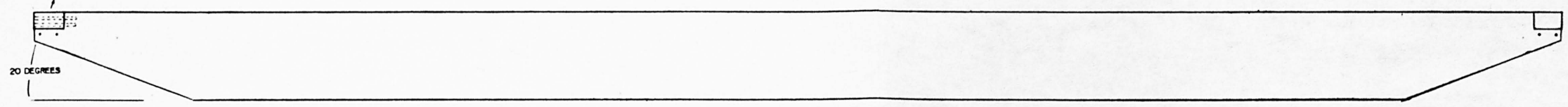
Figure 34: Author's plan, elevation, and section of Black River Peg Flat.



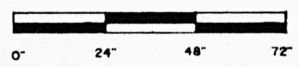
3"x10" PLANKING TYPICAL

PLAN

NOTE 4 TREENALS
FASTEN HEADER LOG



ELEVATION



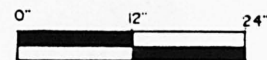
CHINE LOG
CRAFT
AT AVANT'S FERRY
BLACK RIVER

Figure 34: Author's plan, elevation, and section of Black River Peg Flat.

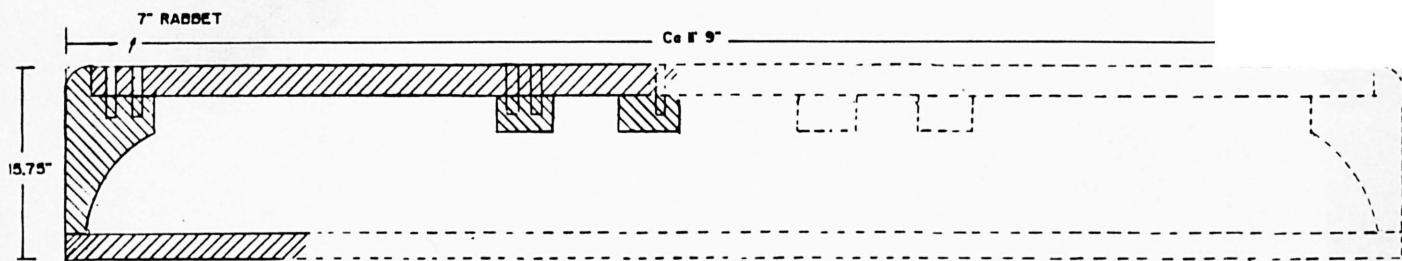
Pee Dee Plan & Elev

Pee Dee Reconstruction

Figures 35 and 36: Author's plan and elevation of the Pee Dee River Ferry flat and reconstruction sketch of Pee Dee River Ferry flat.



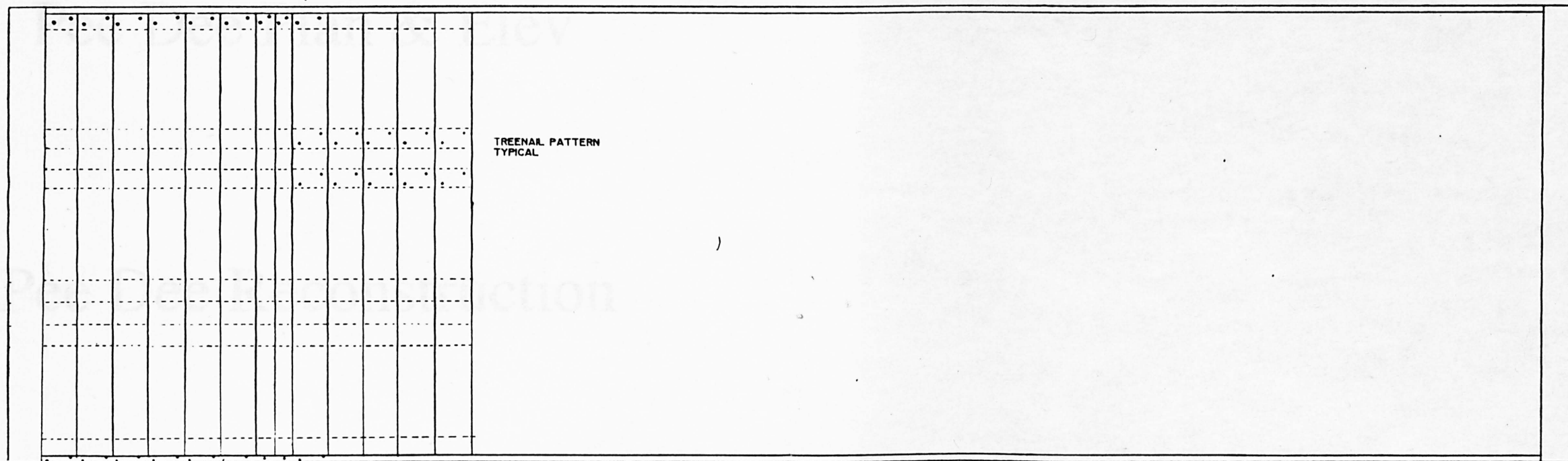
SECTION "A-A"



NOTE CHINE LOG APPEARS REVERSED

RECONSTRUCTION OF BURIED PORTION

A
|

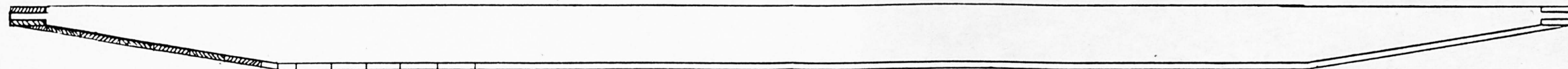


TREENAL PATTERN TYPICAL

TREENAL PATTERN TYPICAL

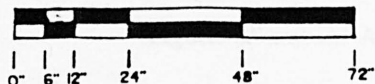
PLAN

A
|



ELEVATION

NOTE COMPOSITE HEADER LOG ASSEMBLY



PEE DEE RIVER
FERRY BARGE
NEWELL 1985

Potatoe Ferry F/O

Figure 37: Author's plan, elevation, and cross section of Potatoe Chine-girder Craft.

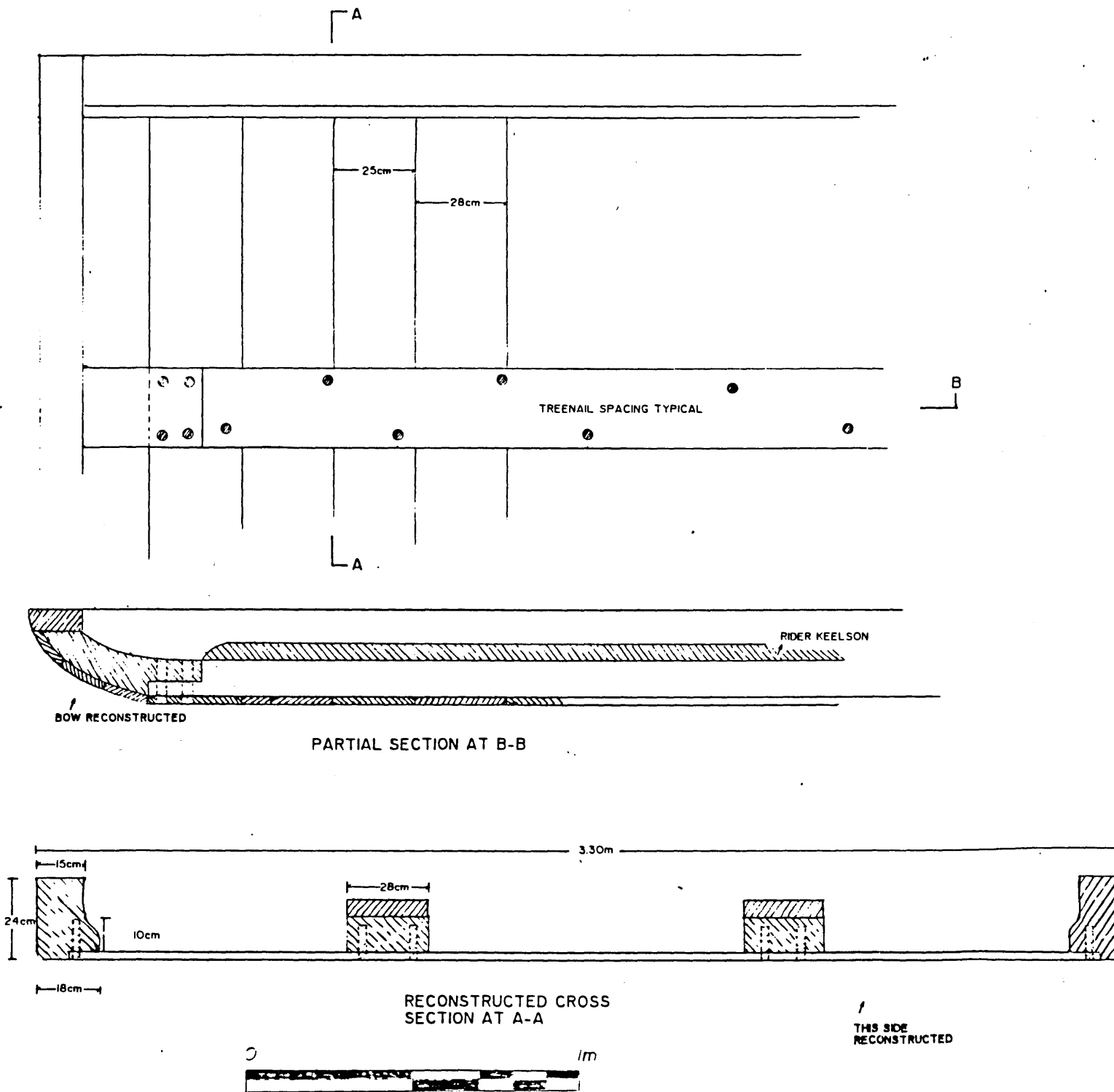


Figure 37: Author's plan, elevation, and cross section of Potatoe Chine-girder Craft.

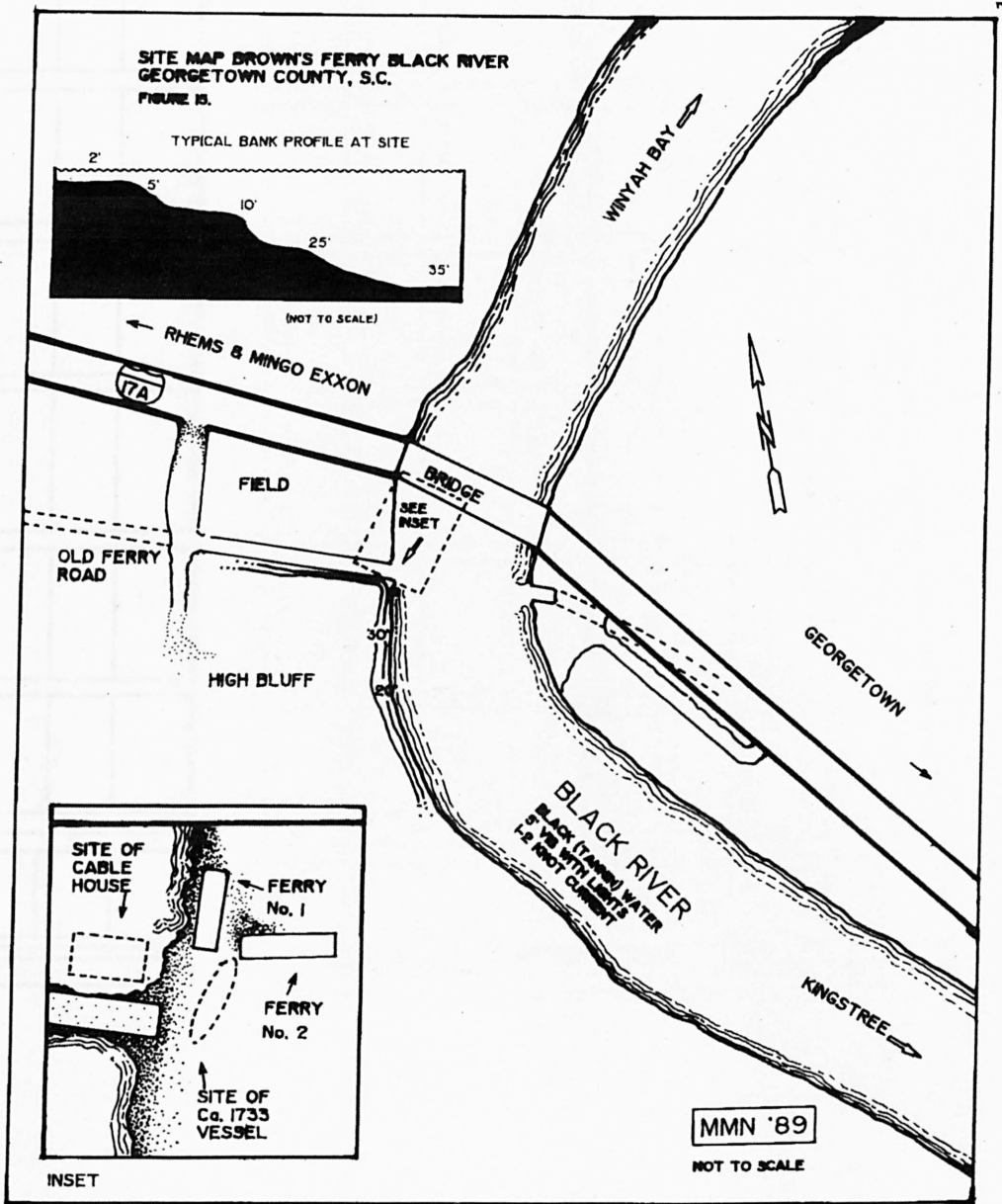
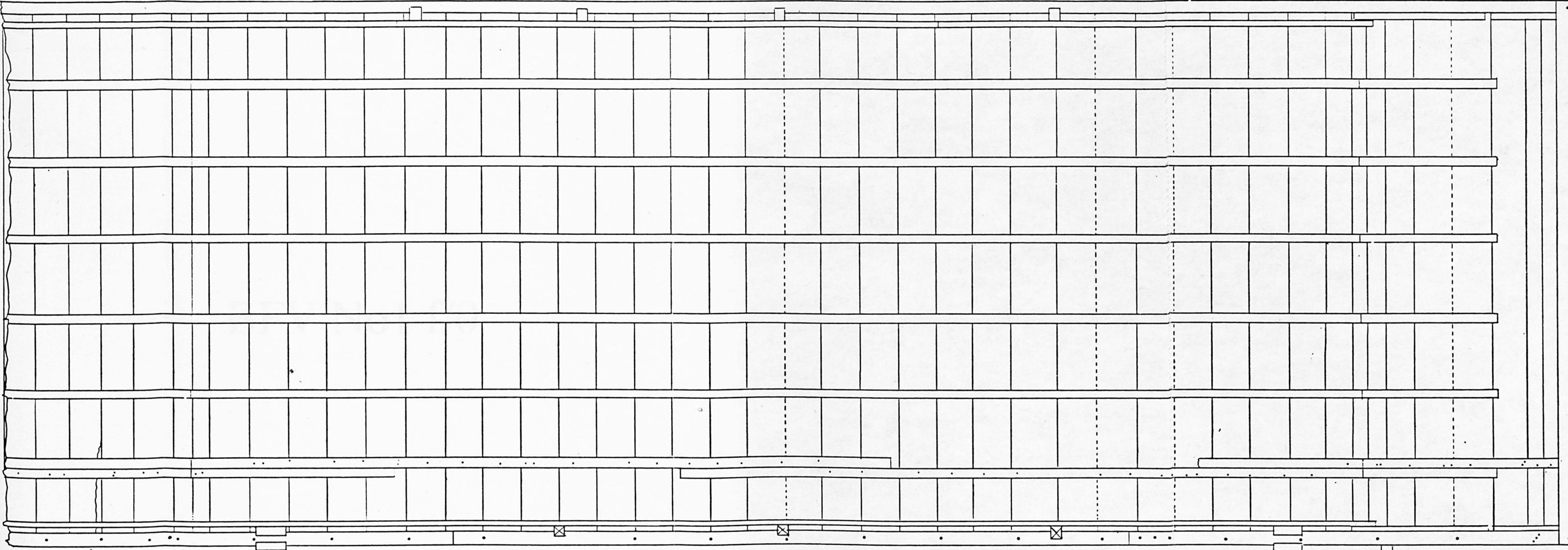


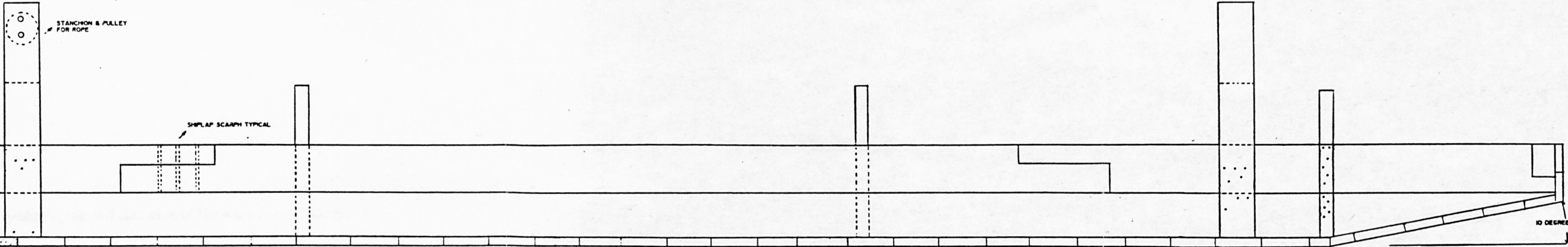
Figure 38: Author's site map of Brown's Ferry Crossing on Black River showing ferries Nos. 1 & 2.

BFV No1 f/0

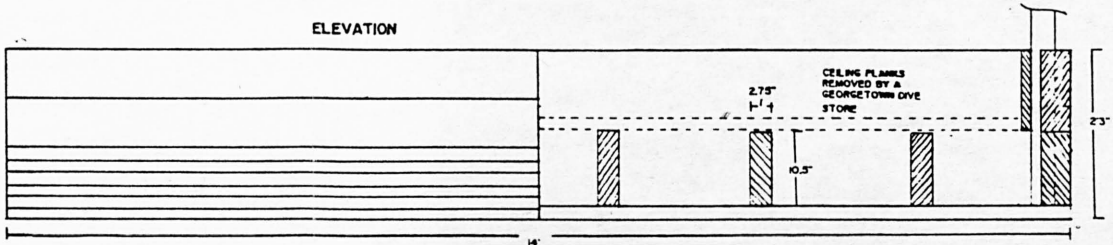
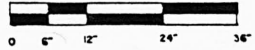
Figure 39: Author's plan and elevation of Brown's Ferry Craft No. 1.



PLAN



ELEVATION



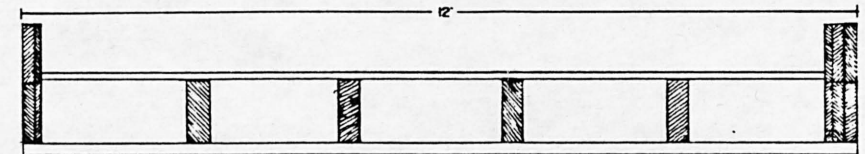
FERRY CRAFT No. 1
 BROWN'S FERRY
 BLACK RIVER
 GEORGETOWN COUNTY, S.C.
 NEWELL 1984
 NEWELL-ECU CREW 1985

BFV No2 f/0

Figure 40: Author's plan and elevation of Brown's Ferry Craft No. 2.

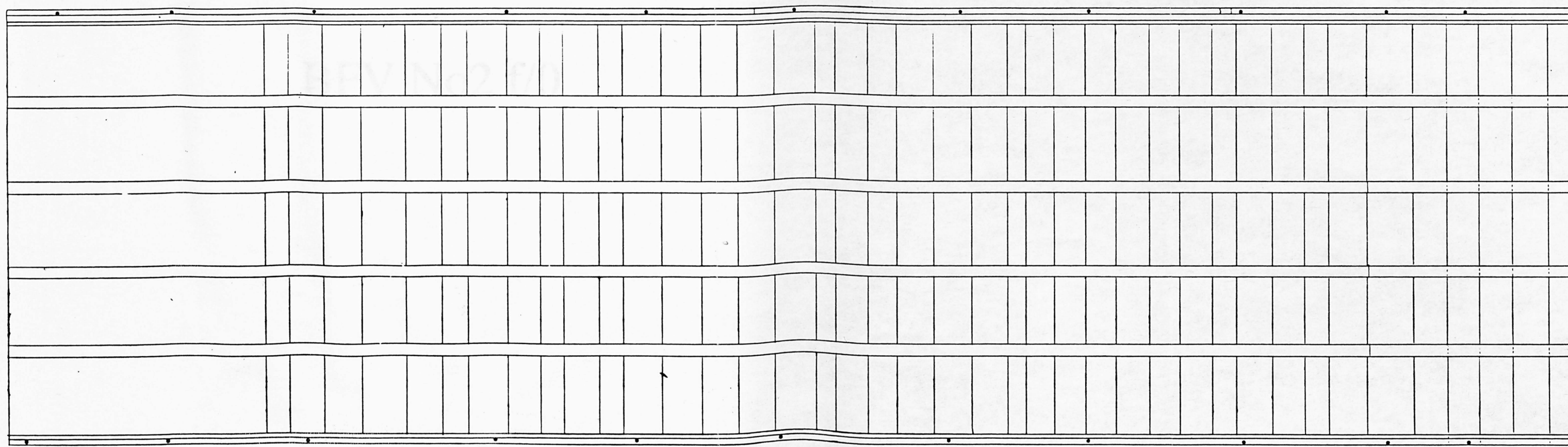
FERRY No.2
BROWN'S FERRY
BLACK RIVER, S.C.

NEWELL, 1983-87
& ECU FIELD SCHOOL 1985



CROSS SECTION
AT "A-A"

A



A

"FERRY BAT" RECOVERED FROM BROWN'S FERRY

BLACK RIVER, 1985

ONE OF FIVE RECOVERED.
CUT FROM HICKORY AND OAK

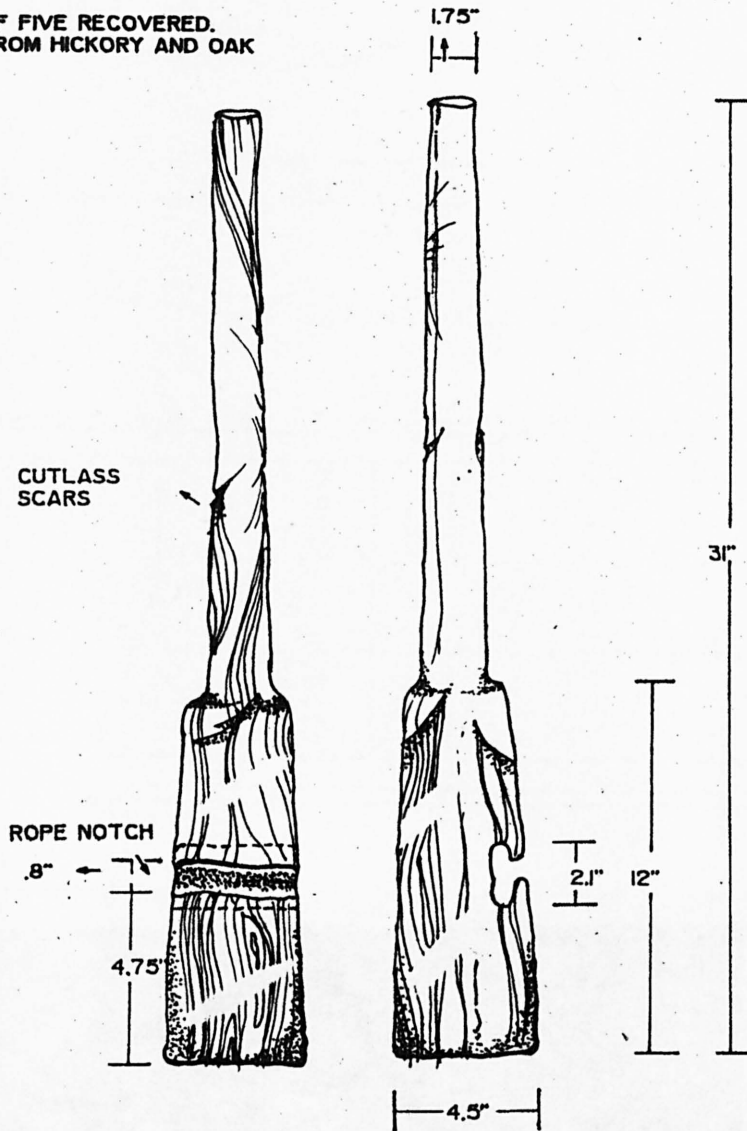


Figure 41: Ferry Bats drawn by author from collection of five recovered at Brown's Ferry, Black River, South Carolina.

Conway Flat f/o

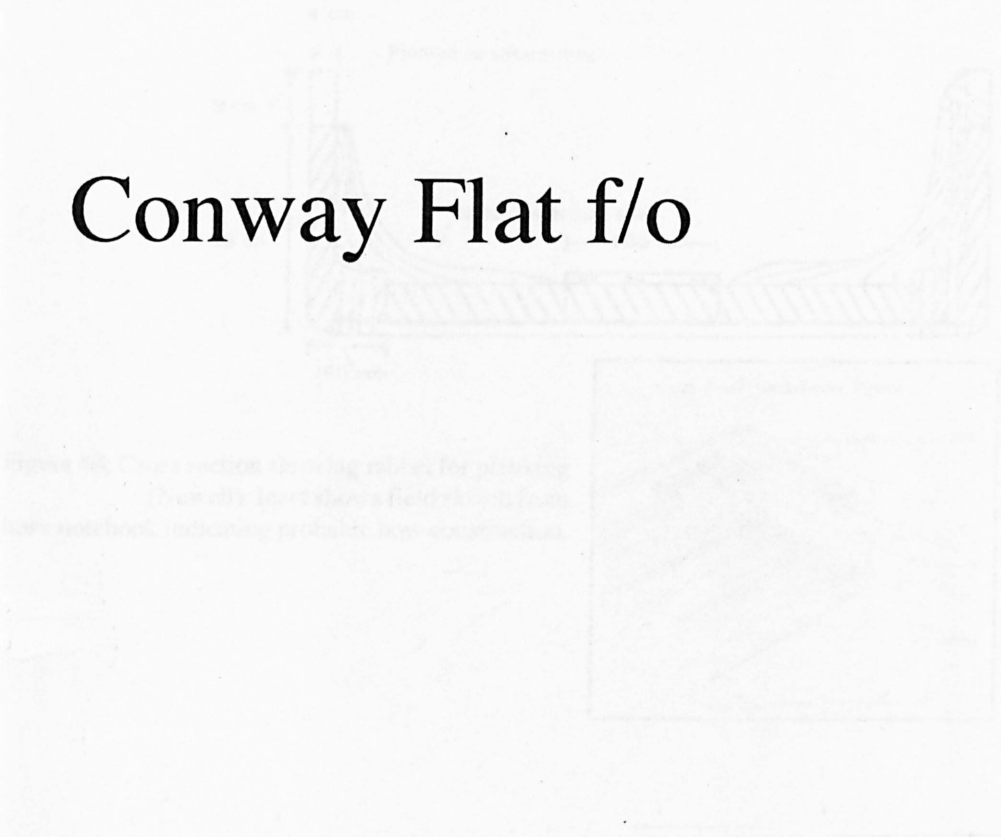


Figure 42: Plan and side elevation of Conway Narrow Flat. This was the first 'narrowbarge' documented in South Carolina (Drawing: Mark Newell).

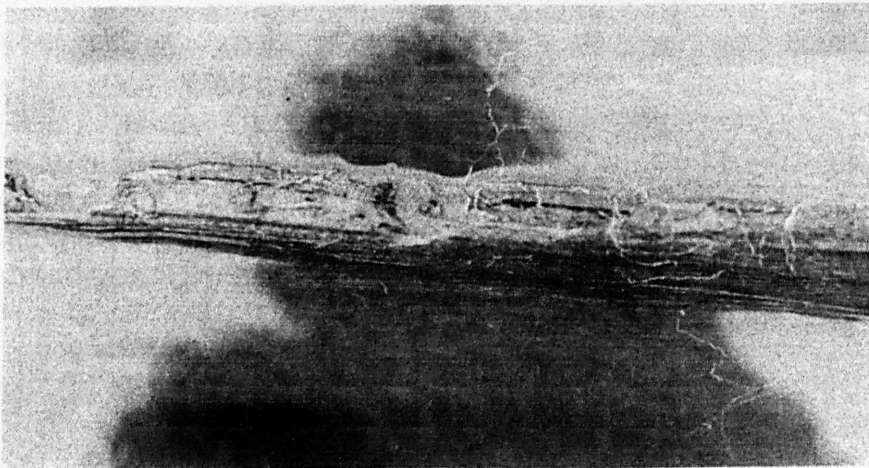
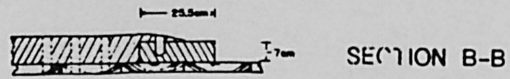
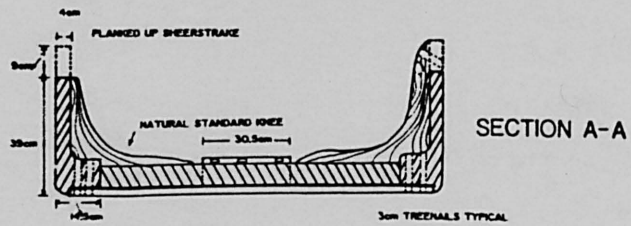
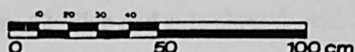
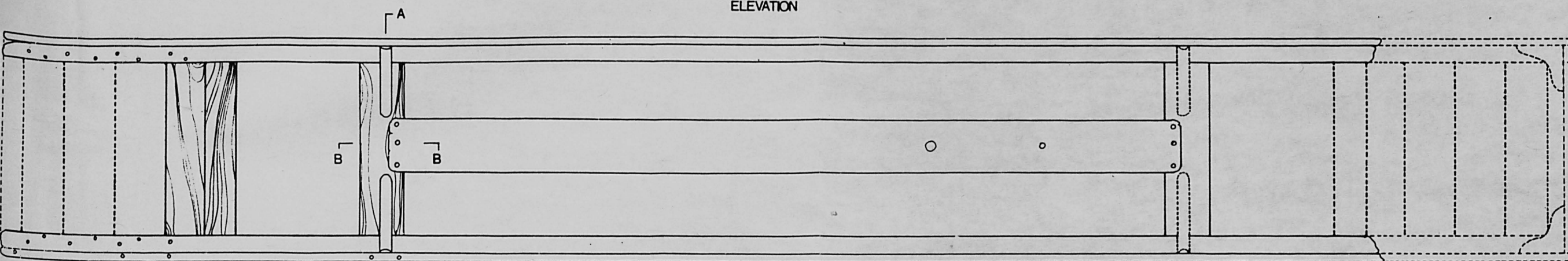
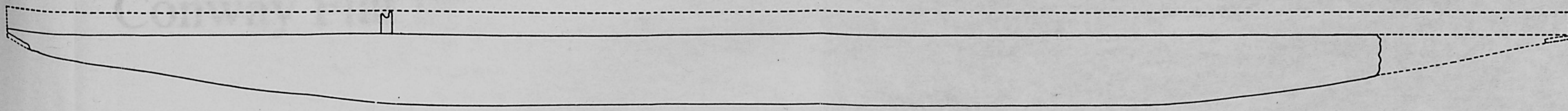


Figure 43: Photograph of lightly indented treenail hole in top edge of gunwhale of the Conway Narrow Flat (photo: Mark Newell).



CONWAY S.C.	DRAWING MARK H. NEWELL SCAA	SHEET 1 of 1
DESCRIPTION Waccamaw narrow barge		
LOCATION: HENRY COUNTY MUSEUM CONWAY, S.C.		
SCALE	DATE 04-12-91	PROVENIENCE
REFERENCES	"PRELIMINARY DOCUMENTATION OF A CHINE LOG FLAT AT CONWAY, S.C." RESEARCH MANUSCRIPT SERIES No. 522	



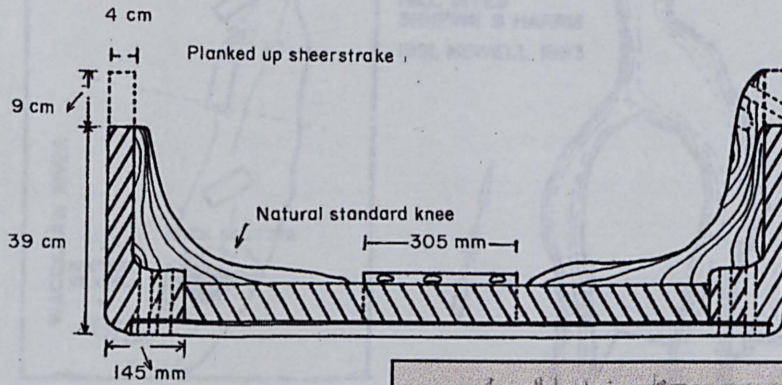


Figure 44: Cross section showing rabbet for planking (Newell). Inset shows field sketch from author's notebook indicating probable bow construction.

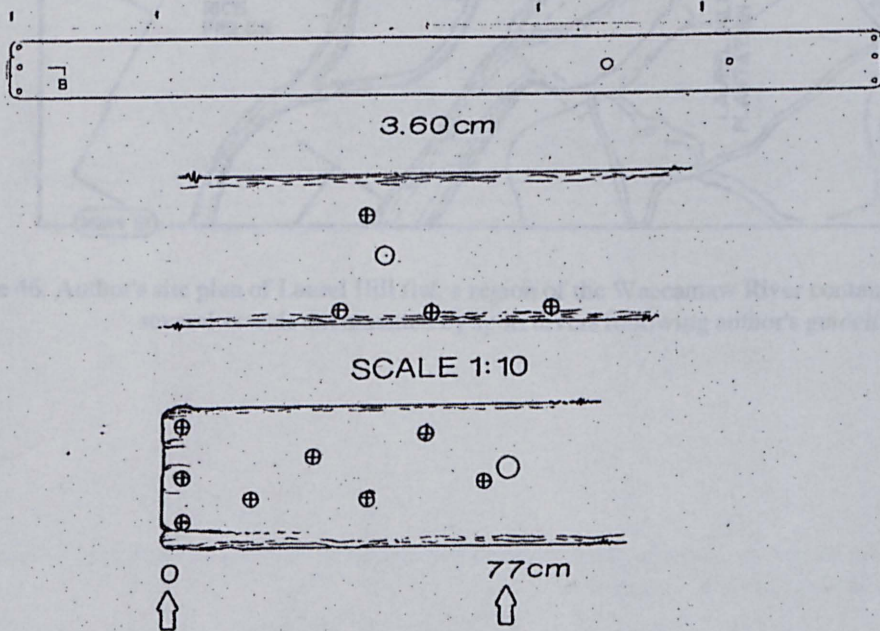
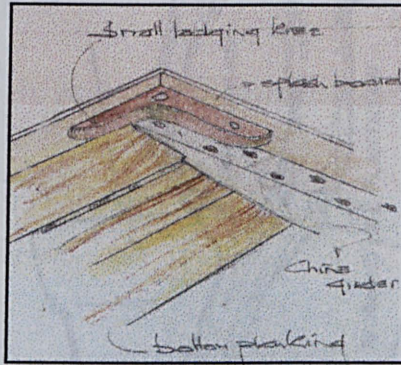


Figure 45: Fastening patterns at two locations on the keelson drawn by author. There is currently no explanation for the random patterning on upper sketch.

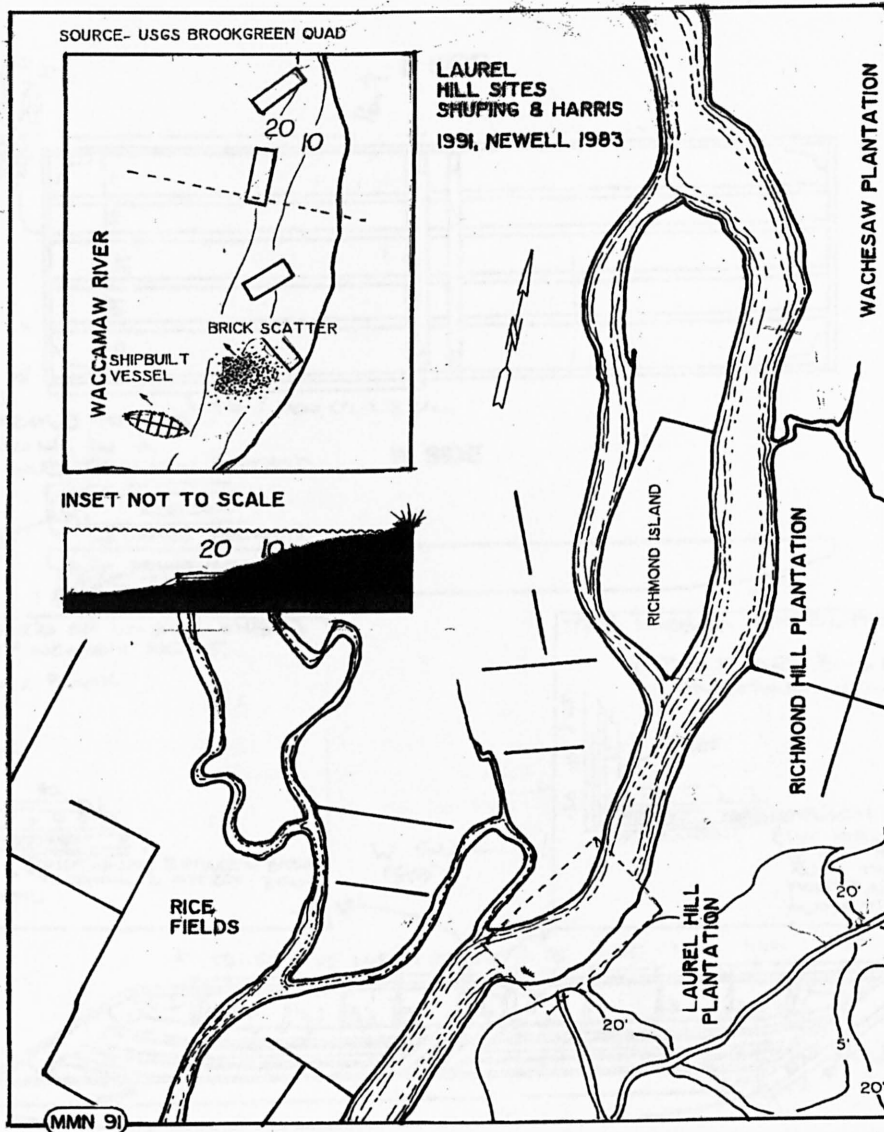


Figure 46: Author's site plan of Laurel Hill flat, a region of the Waccamaw River containing several vessels documented by sport divers following author's guidelines.

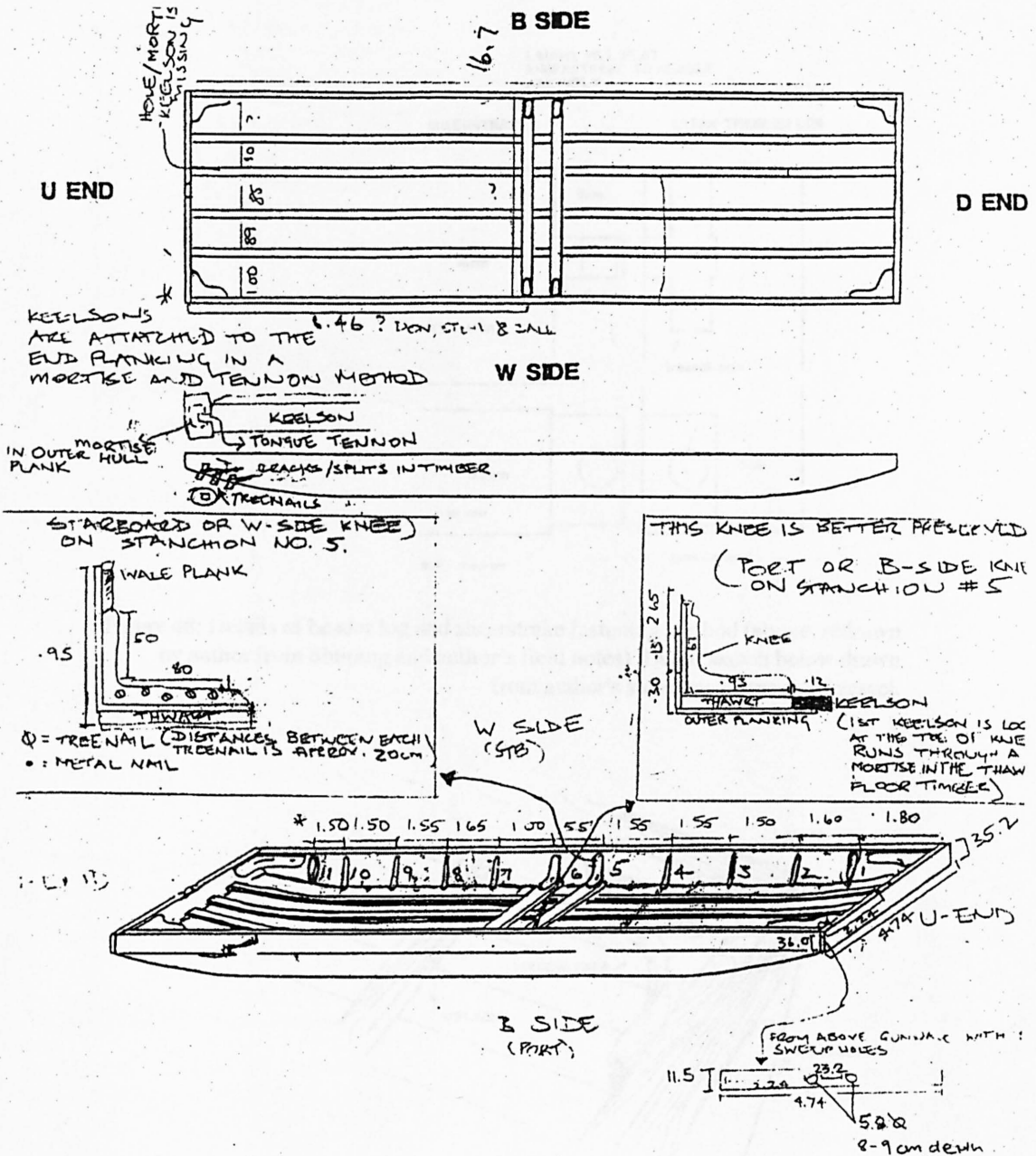


Figure 47: Hampton Shuping's impression of Laurel Hill flat from his field notes, giving an indication of the quality of some avocational recording.

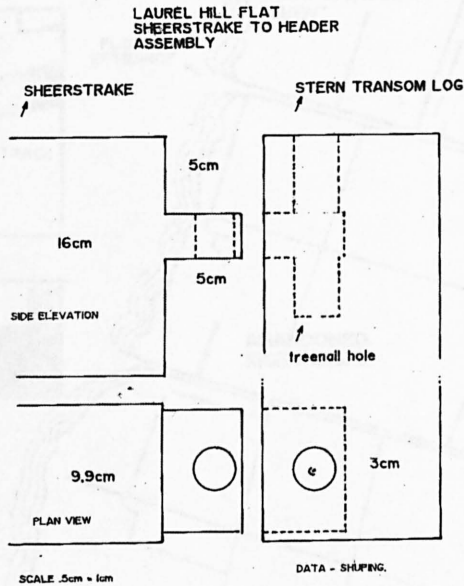
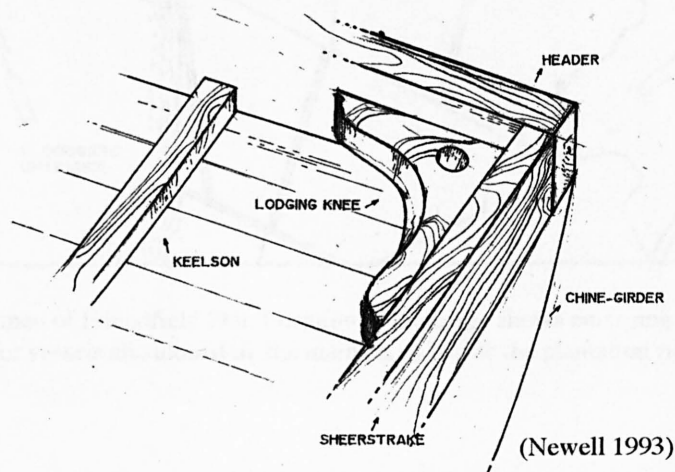


Figure 48: Details of header log and sheerstrake fastening method (above, redrawn by author from Shuping and author's field notes). Detail sketch below drawn from author's subsequent survey of vessel.



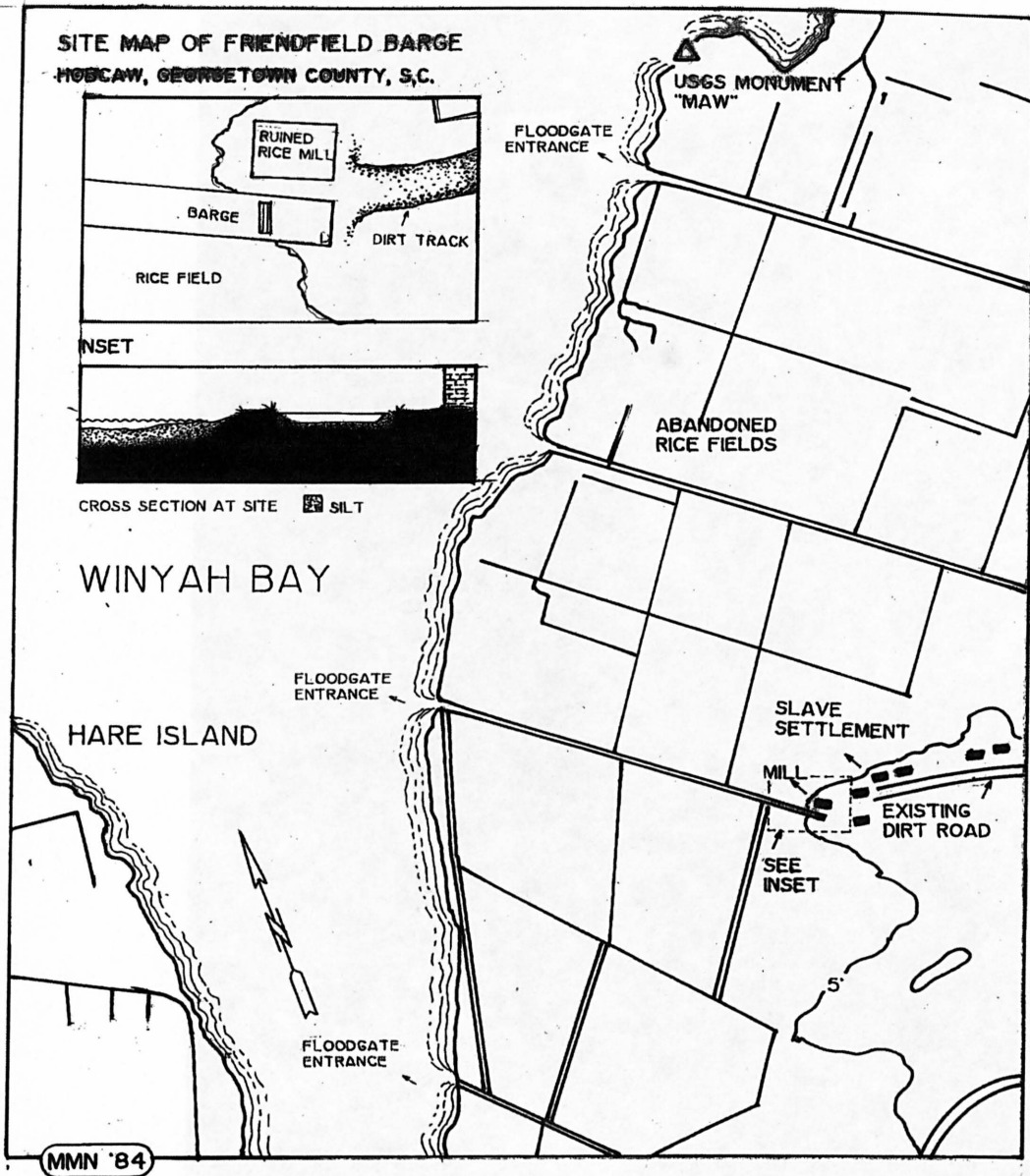


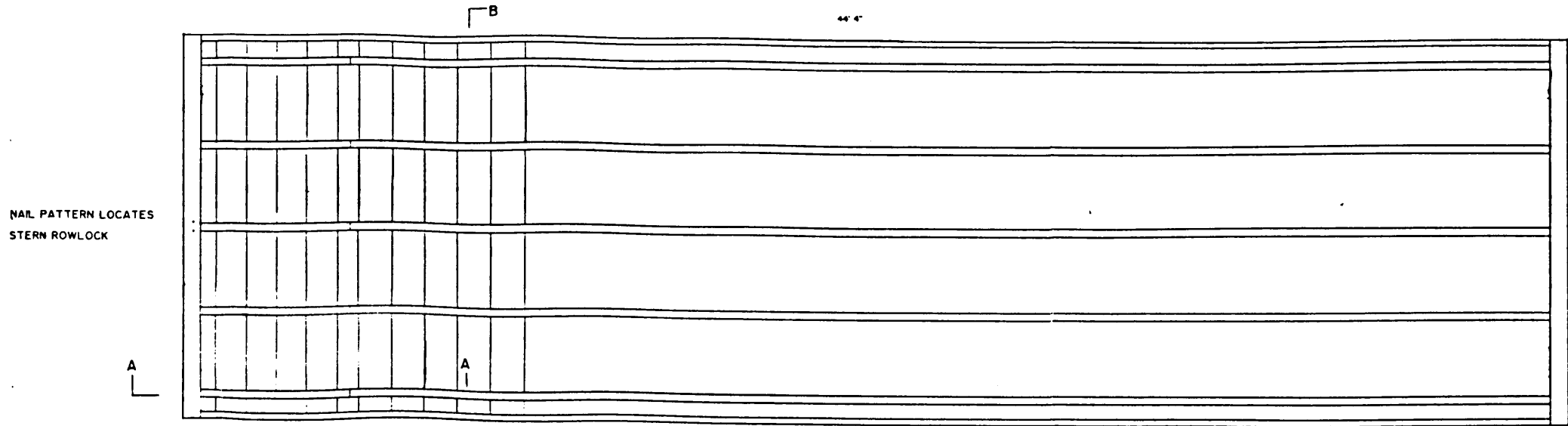
Figure 49: Author's site map of Friendfield Flat. Location of the barge shows emerging pattern for vessels abandoned in the main canal beside the plantation rice mill.



Figure 50: Semi-liquid mud over Friendfield Flat ensured good preservation and extremely difficult excavation for the author (photo: Ashley Chapman).

Friendfield f/o

Figure 51: Author's plan and elevation of Friendfield Flat. Note outer stringers were not actually chine stringers supporting the chine strake.



NAIL PATTERN LOCATES STERN ROWLOCK

44' 4"

A

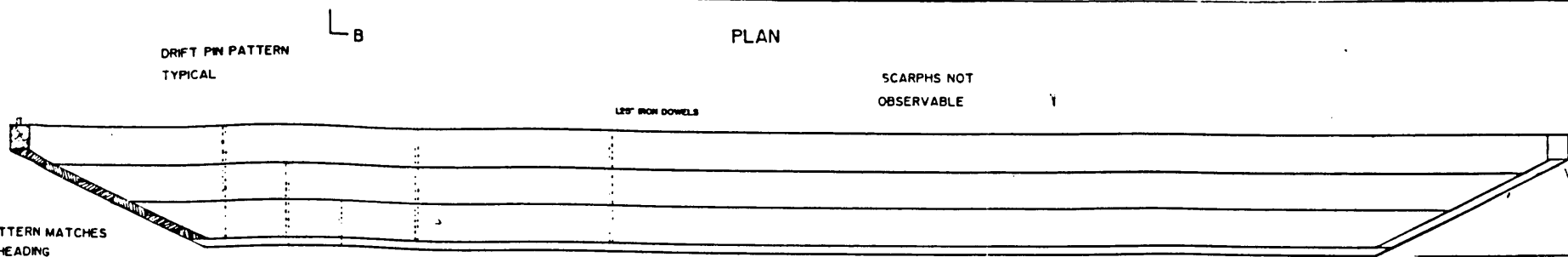
A

B

PLAN

DRIFT PIN PATTERN TYPICAL

SCARPHS NOT OBSERVABLE

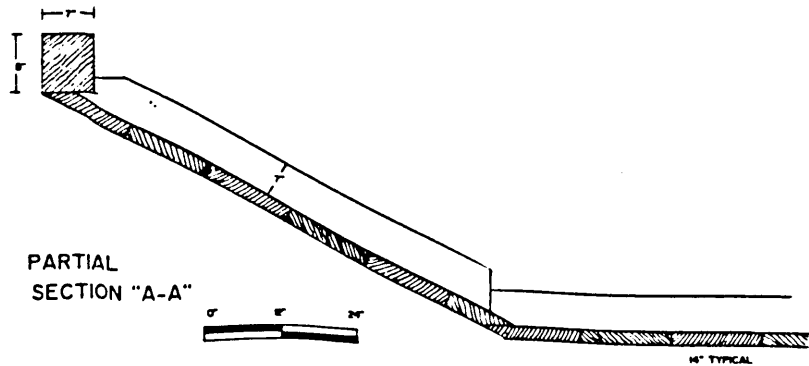


PLANKING PATTERN MATCHES CANAL BULKHEADING

1/2" IRON DOWELS

30 DEGREES

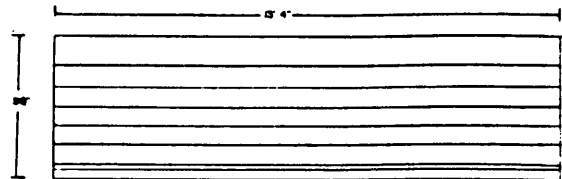
SIDE ELEVATION



PARTIAL SECTION "A-A"

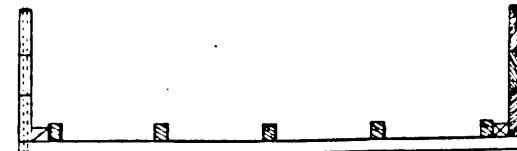


1/4" TYPICAL



STERN ELEVATION

SECTION "B-B"



LOCATION: RICE MILL CANAL
FRIENDFIELD PLANTATION
HOBCAW BARONY
GEORGETOWN COUNTY, S.C.

DOCUMENTATION: NEWELL AND CHAPMAN

FRIENDFIELD PLANTATION BARGE

NEWELL 1985



Figure 52: Photograph of tool marks on inboard side of Trent River Barge (photo: Mark Newell).

Mud Barge f/o

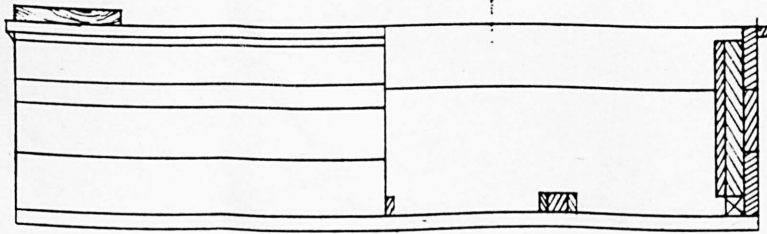
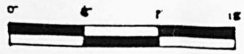
Figure 54: Author's plan drawing of Mepkin Plantation Mud Barge. Possibly the last wooden plantation barge built on the Cooper River, South Carolina.

MEPKIN ABBEY "MUD BARGE" COOPER RIVER S.C.

NEWELL 1983

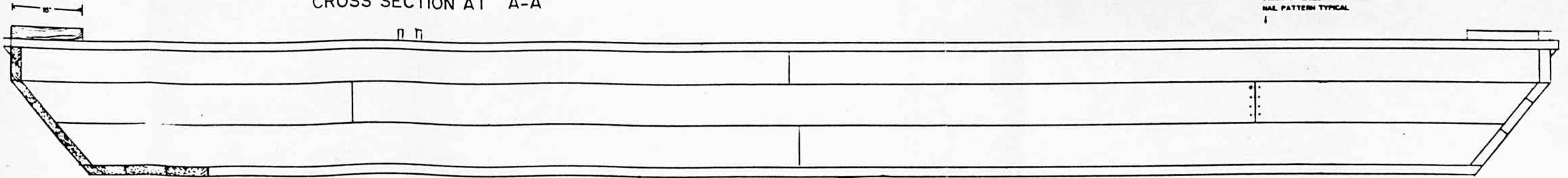
SCALE

LOCATION- RICE MILL CANAL
MEPKIN PLANTATION
BERKELEY COUNTY, S.C.

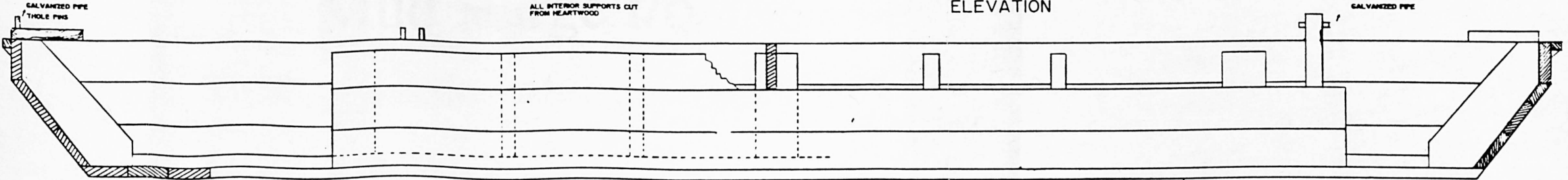


CROSS SECTION AT "A-A"

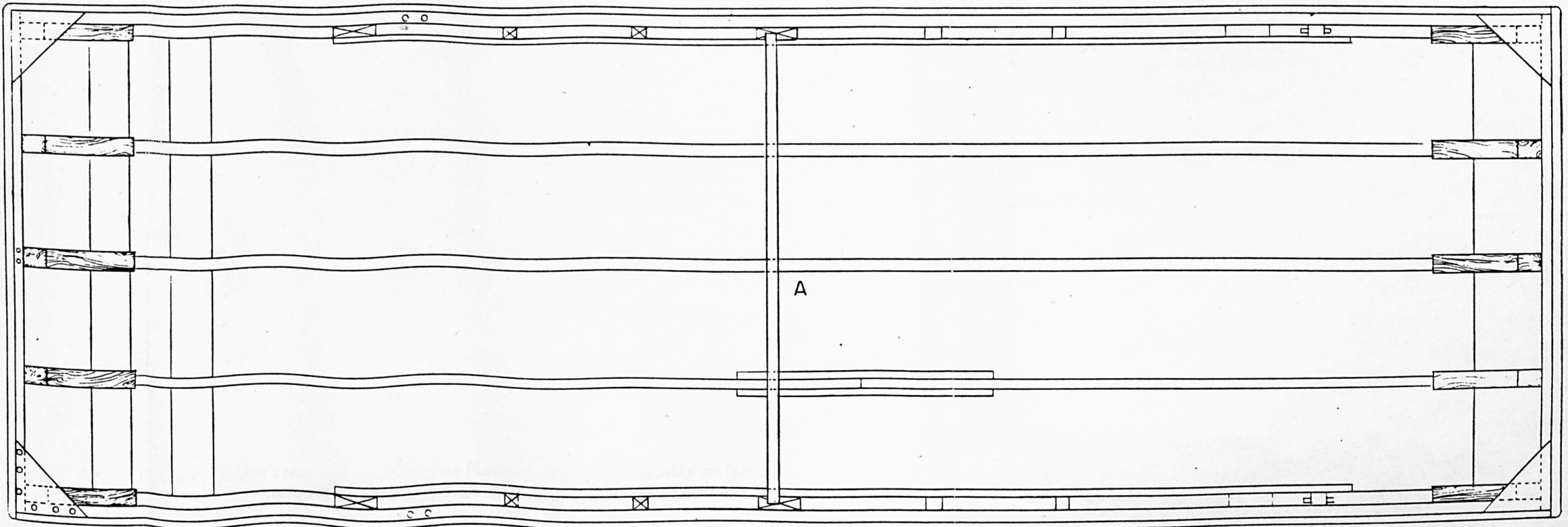
PLANKS BUTT ON
FRAMING PIECES
NAE. PATTERN TYPICAL



ELEVATION



CROSS SECTION AT "B-B"



PLAN

CORNER NAE. PATTERN
TYPICAL

NOTE FASTENING WITH

SISTERED BUTT JOINT ON
KEELSONS TYPICAL

A

B



Figure 55: Photograph of large wire nails used to fasten corner fillets (photo: Mark Newell).

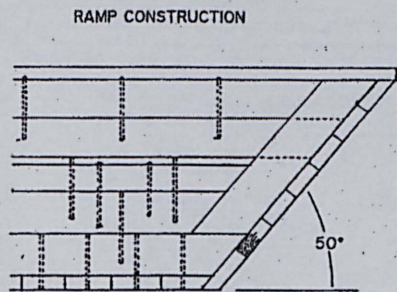
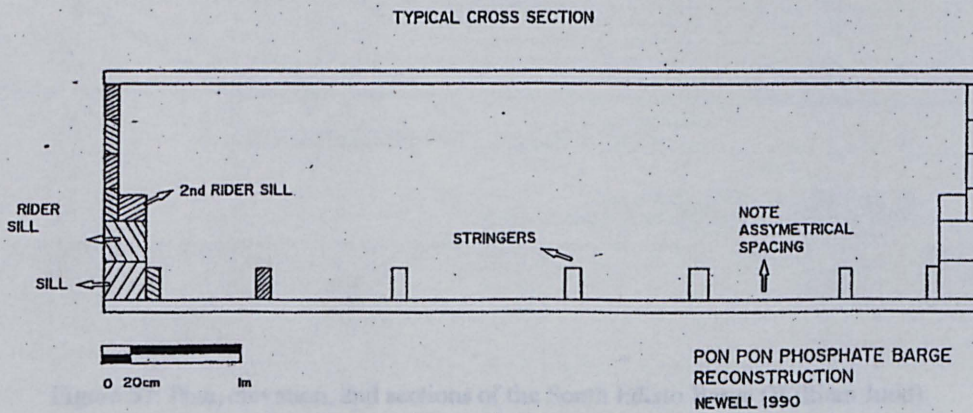
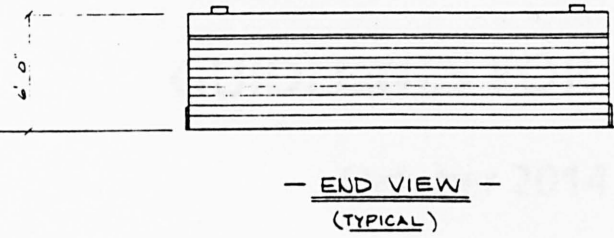
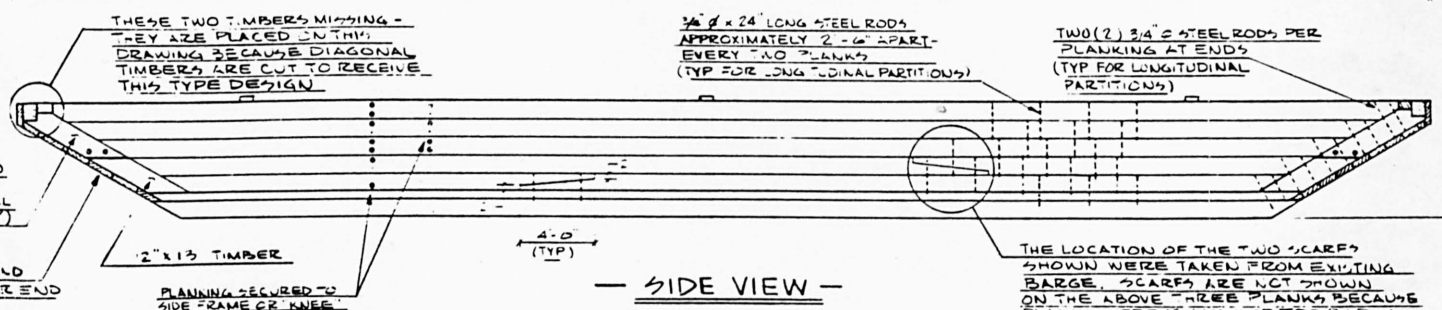
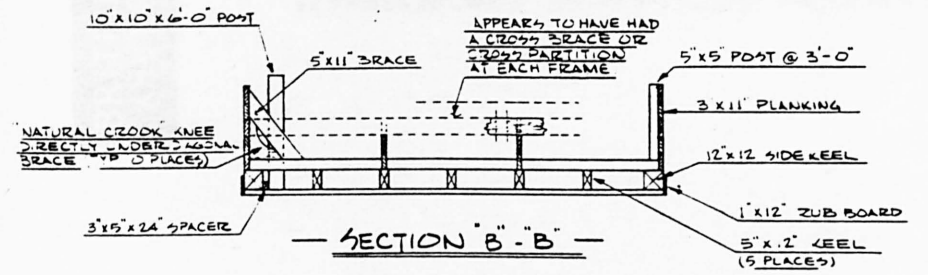
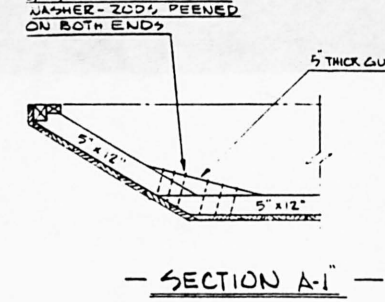
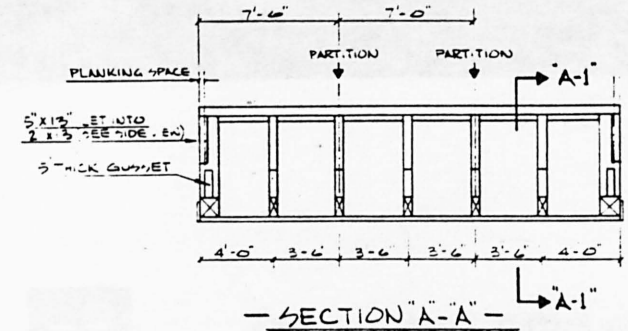
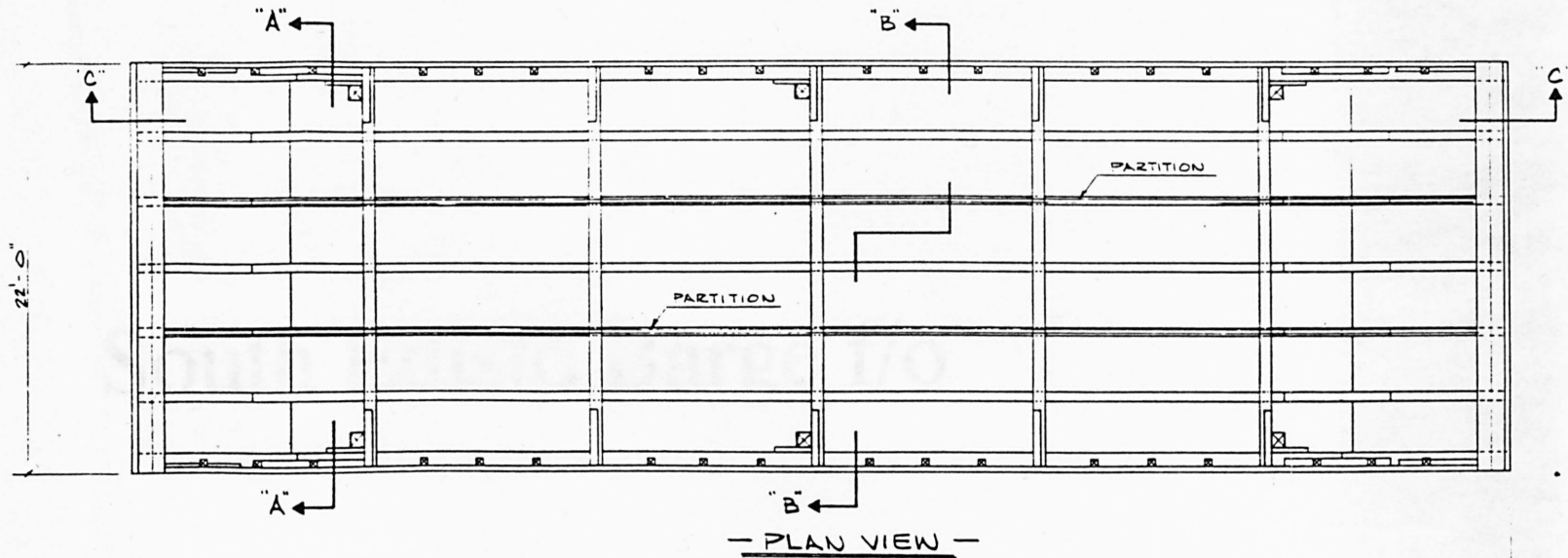


Figure 56: Detail of bow assembly and cross section of Pon Pon Phosphate Barge (photo, Mark Newell).



South Edisto Barge f/o

Figure 57: Plan, elevation, and sections of the South Edisto Barge (William Judd).



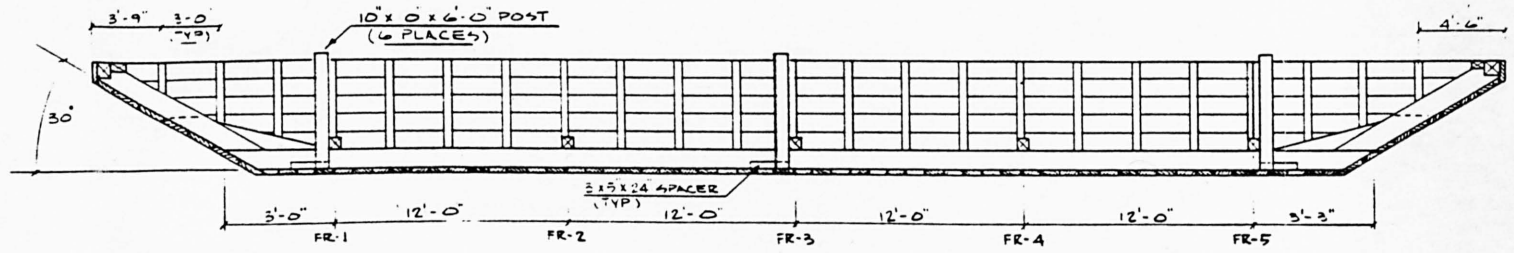
3"x13" TIMBER LET INTO OUTBOARD SIDE OF 2"x13" TIMBER. TYPICAL ALL FOUR CORNERS (?)

3"x12" PLANKING - 19 ELD

3"x12" PLANKING - OTHER END

PLANKING SECURED TO SIDE FRAME KEELS WITH TWO (2) 3/4" DIA RODS W/ WASHER EACH END AND ENDS PEENED (SOME CASES 1/2" DIA RODS (1) AND ONE (1) SPIKE.

THE LOCATION OF THE TWO SCARFS SHOWN WERE TAKEN FROM EXISTING BARGE. SCARFS ARE NOT SHOWN ON THE ABOVE THREE PLANKS BECAUSE PLANKS WERE MISSING OR TOO BADLY DETERIORATED TO LOCATE.



— BARGE No 1 —

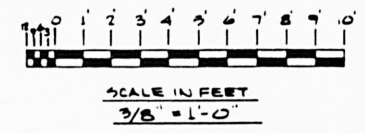
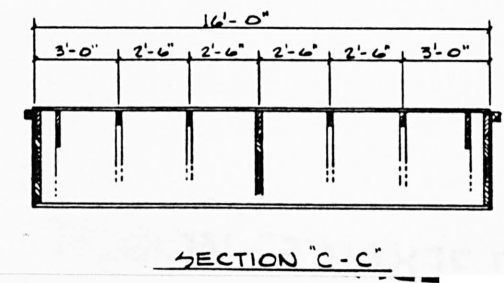
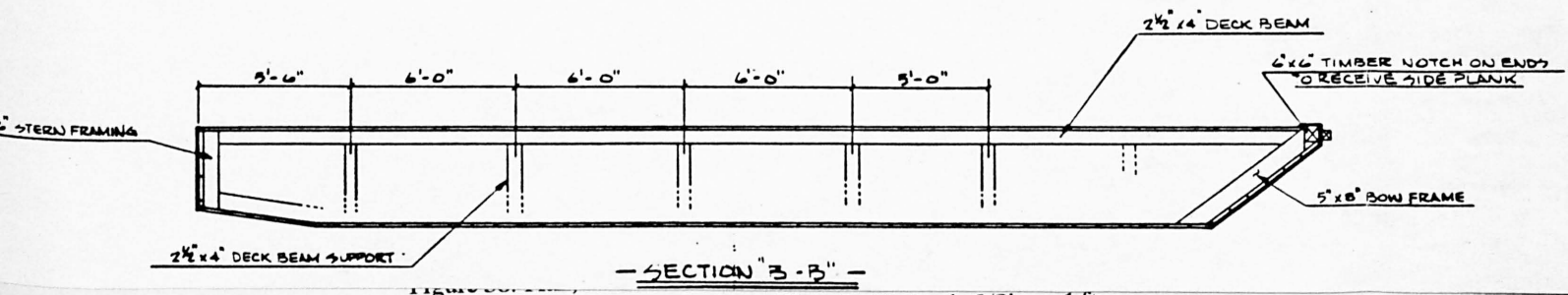
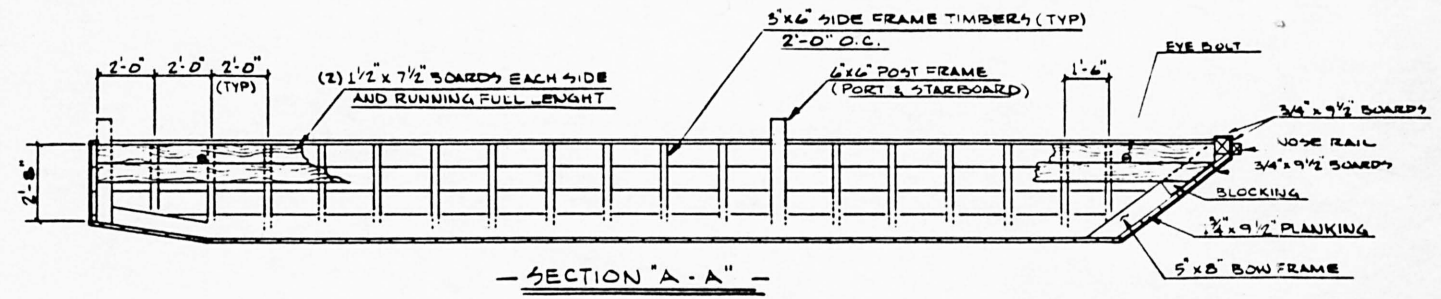
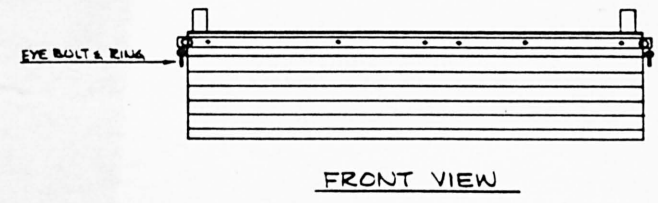
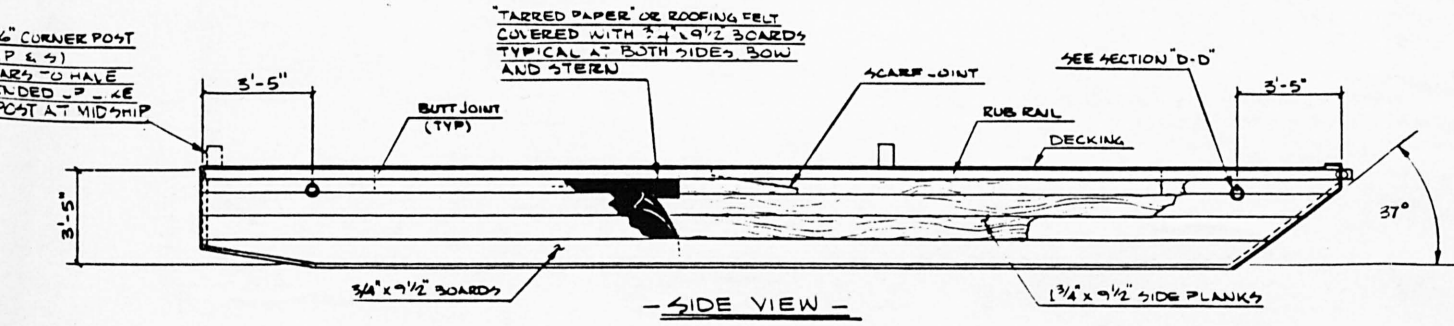
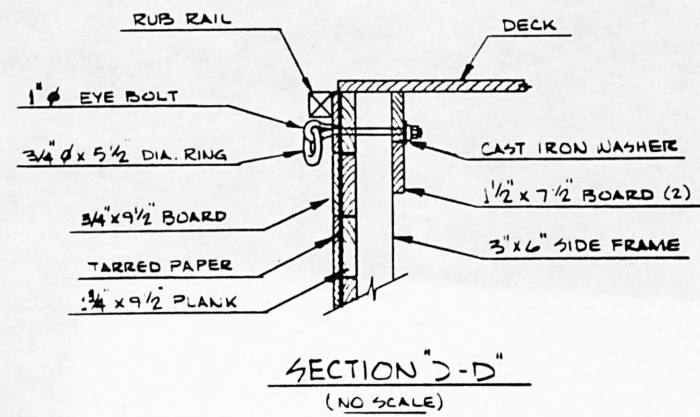
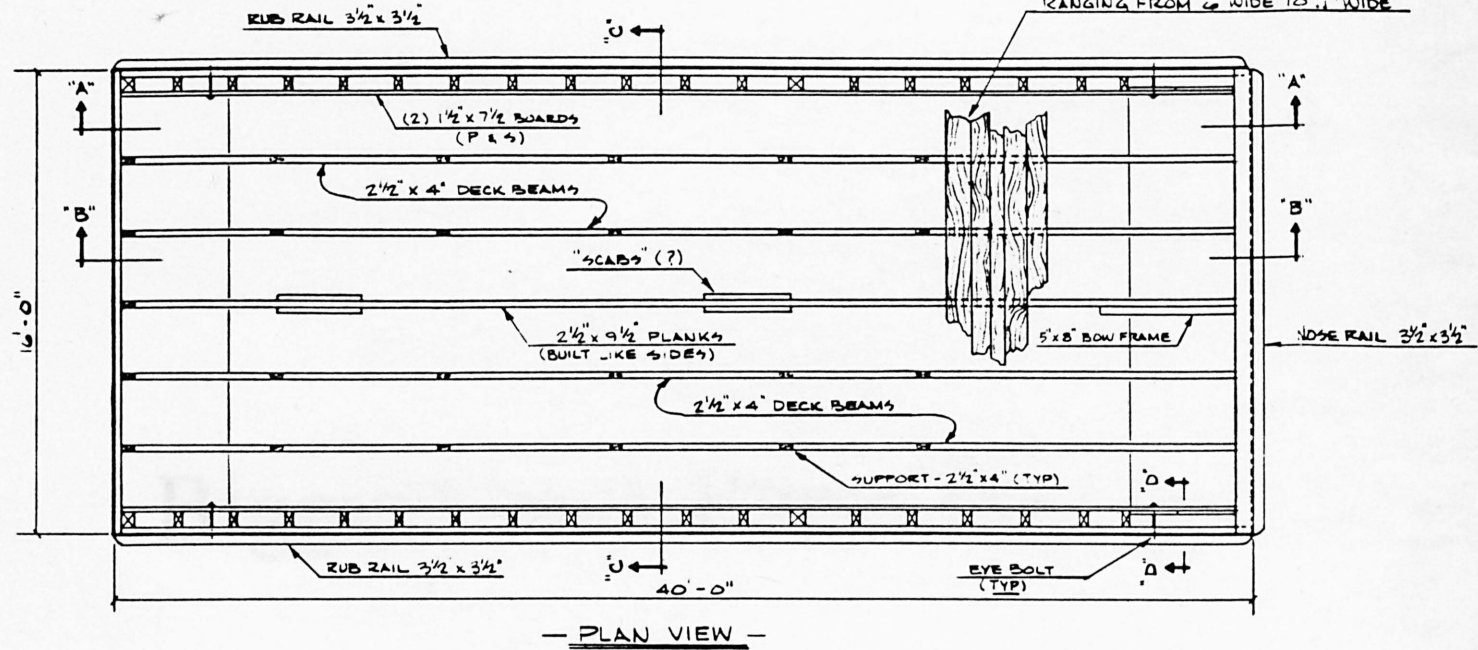


MEASURED OCTOBER, 1983 AND DRAWN FEBRUARY, 1985 BY WILLIAM R. JUDD

— SECTION "C-C" —

Biggin Creek Barge f/o

Figure 58: Plan, elevation, and sections of the Biggin Creek Barge
(William Judd). Scale 3/8in. = 1 ft.



BIGGIN CREEK FLAT BOAT
 STONEY LANDING, MONCK'S CORNER,
 MEASURED & DRAWN NOVEMBER, 1981
 WILLIAM R. JUDD

(William Judd). Scale 3/8in. = 1ft.



Figure 59: Sections of the Malcolm Boat eroding from mudbank in 1985 (photo: Mark Newell).



Figure 60: Exposed sections of the vessel are sandbagged by author (foreground) and USC staff (photo: Carl Naylor).

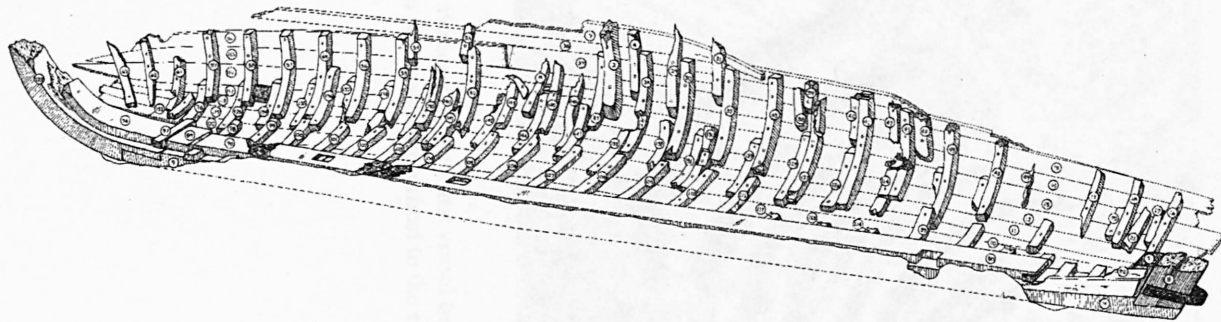


Figure 61: William Judd's drawing of the Malcolm Boat wreckage as excavated by author and USC staff.

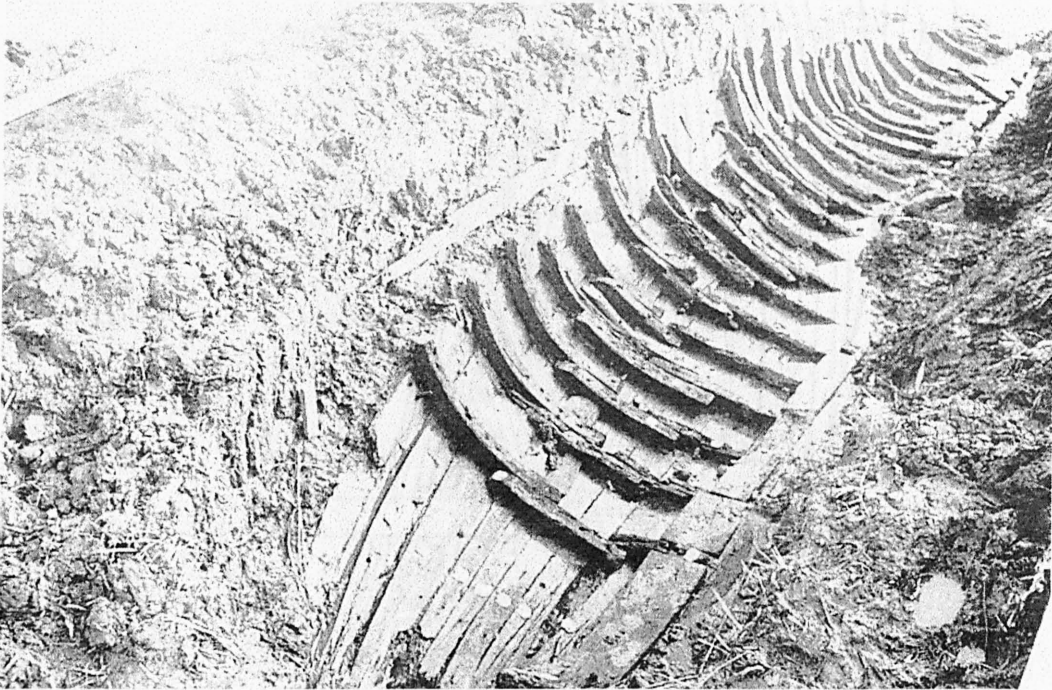


Figure 62: Interior of excavation revealed that vessel had been driven into a small slough prior to abandonment. Midship section was complete almost to the sheerstrake (photo: Mark Newell).

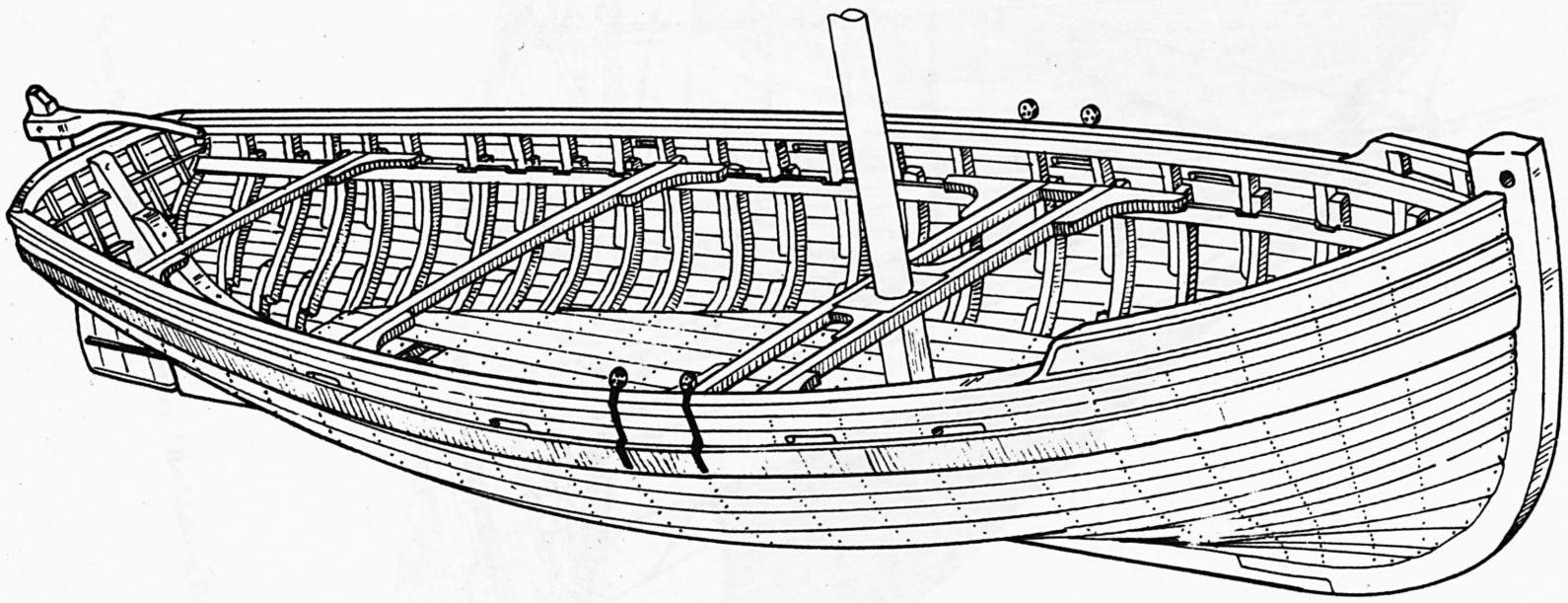


Figure 63: William Judd's drawing of the Malcolm Boat hull reconstruction based on Figure 61.

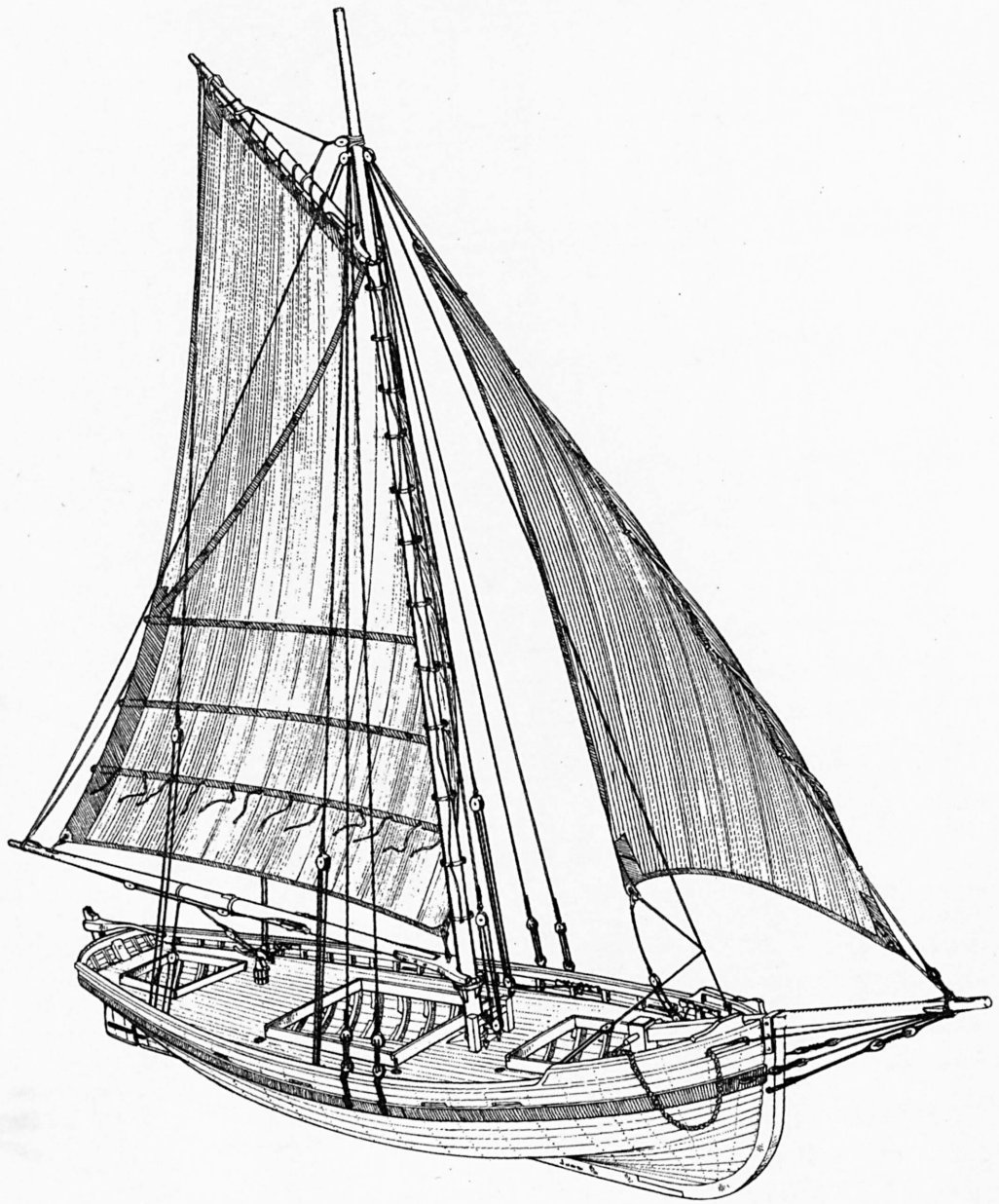
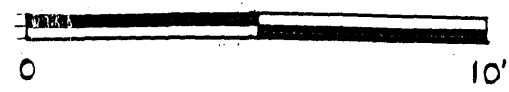
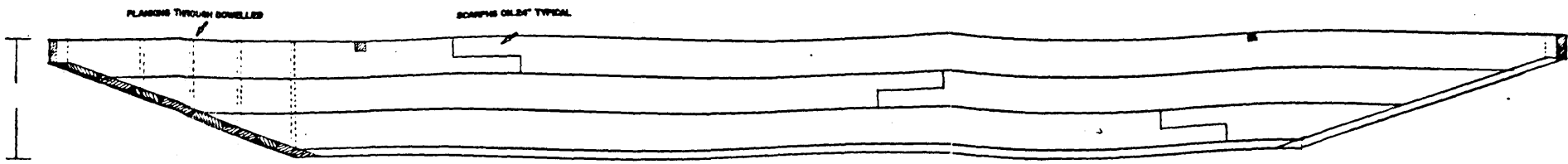
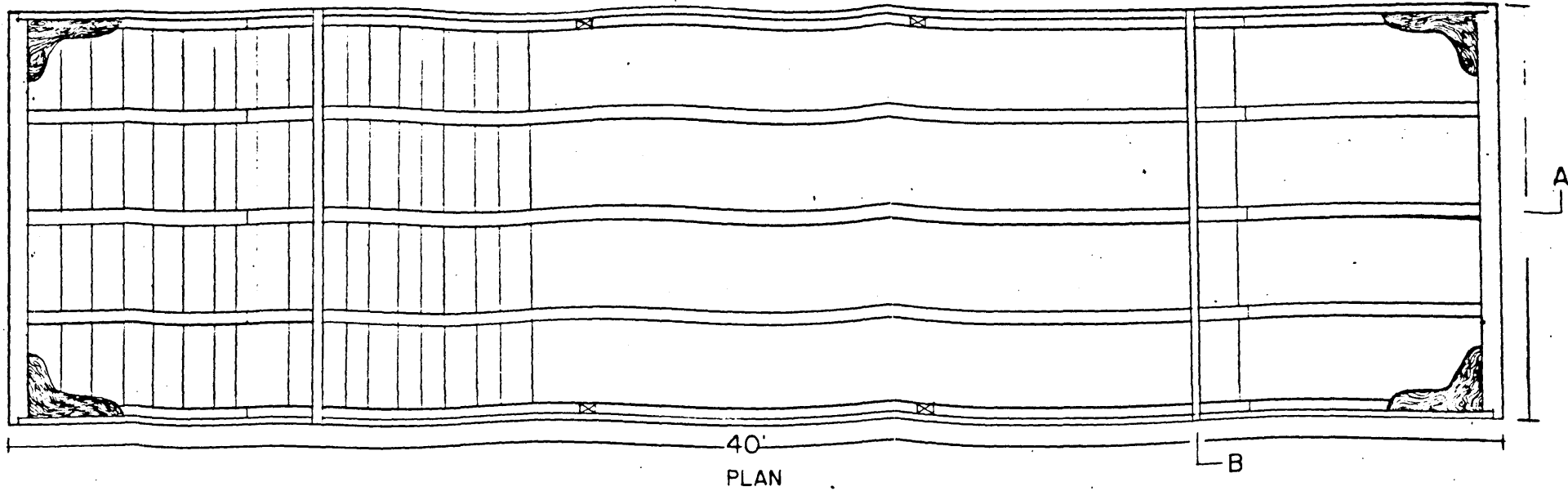


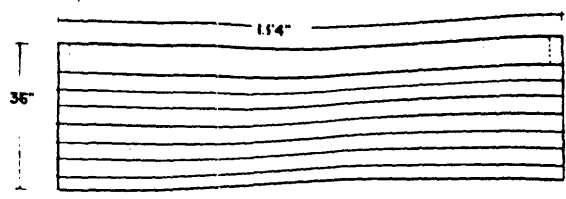
Figure 64: William Judd's impression of the Malcom Boat's original appearance.

Magnolia Barge f/o

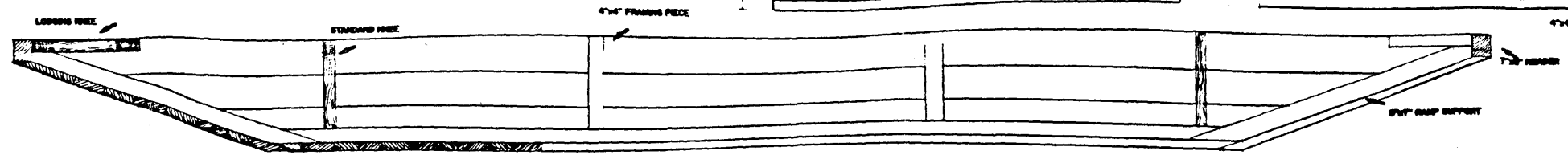
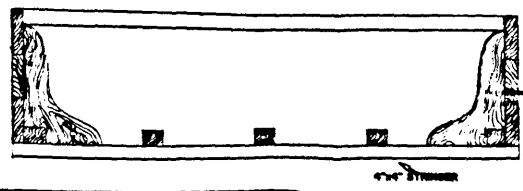
Figure 65: Author's plan and elevation of the Magnolia Barge (scale 1"=1m), an experimental project.



ELEVATION



SECTION AT "BB"



SECTION AT "AA"

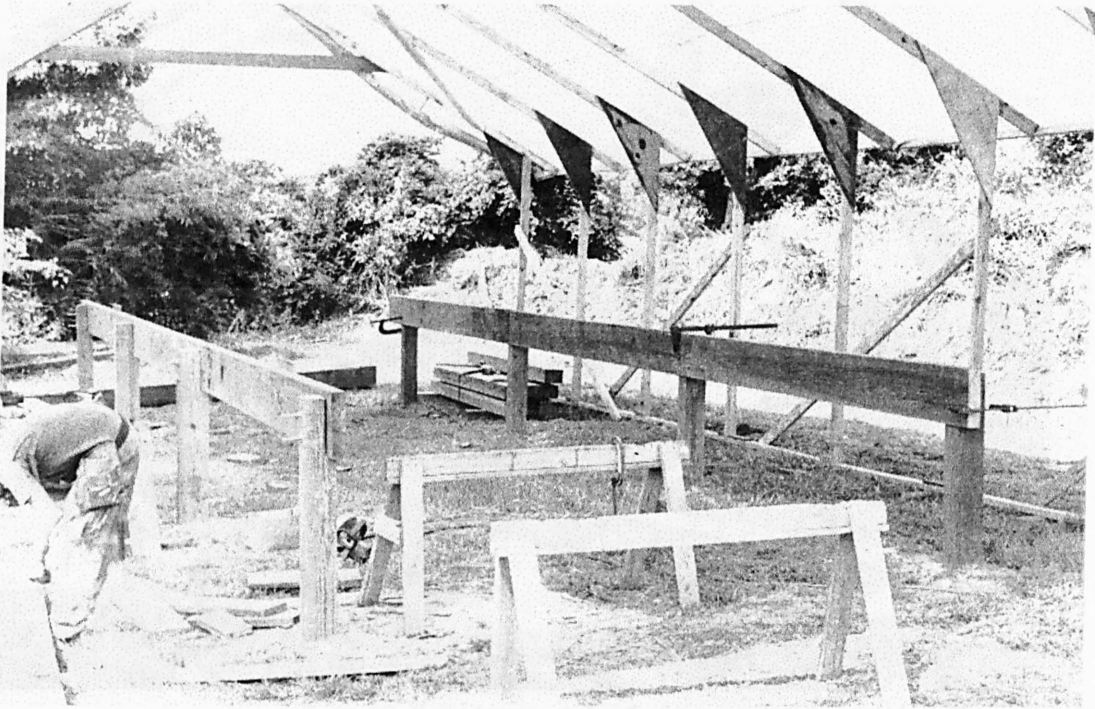


Figure 66: The completed strongback with top rails (photo: Mark Newell).

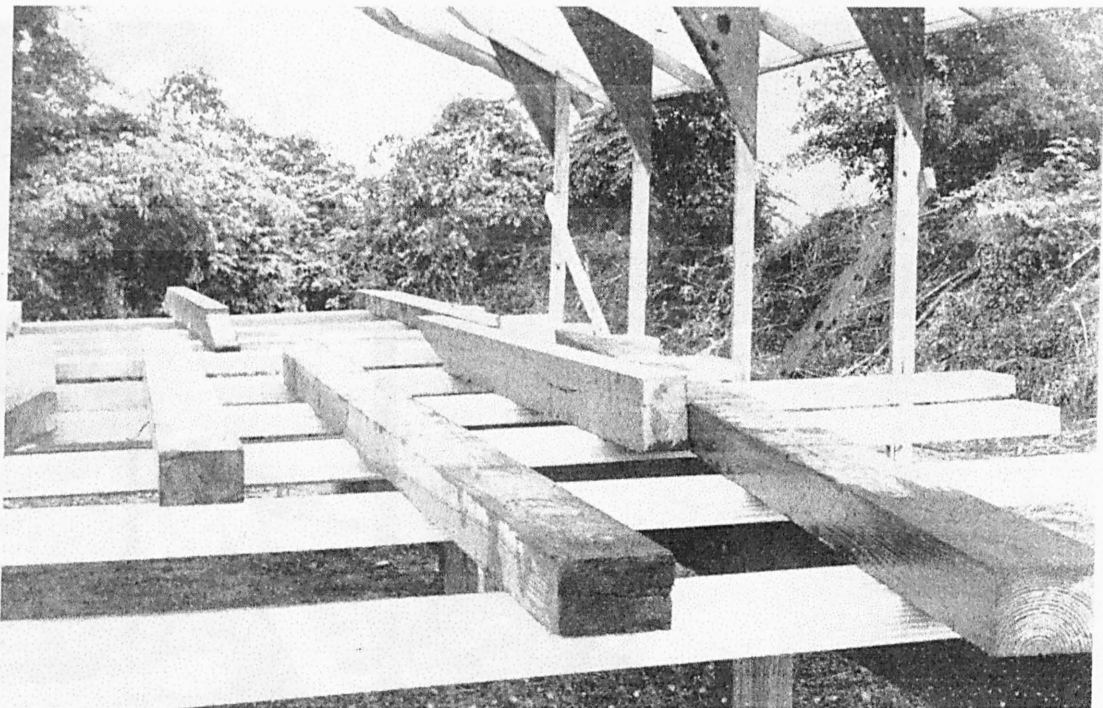


Figure 67: Stringer sections prior to assembly. Note shiplap scarphs (photo: Mark Newell).

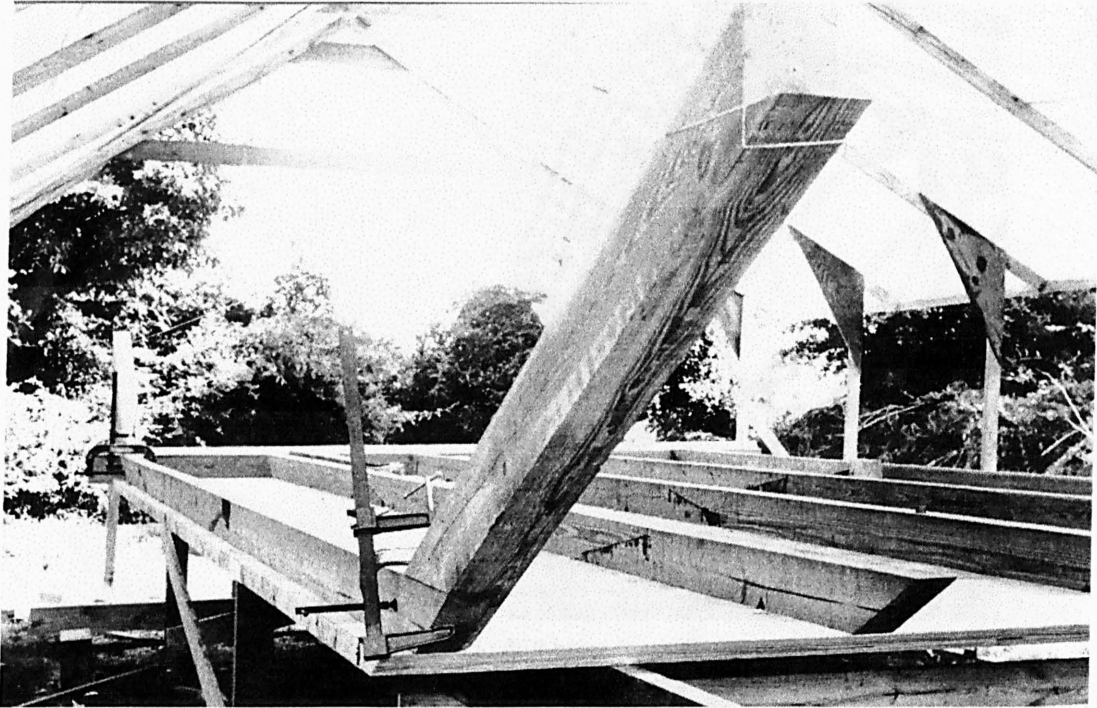


Figure 68: Raised supports for the barge ramps (photo: Mark Newell).

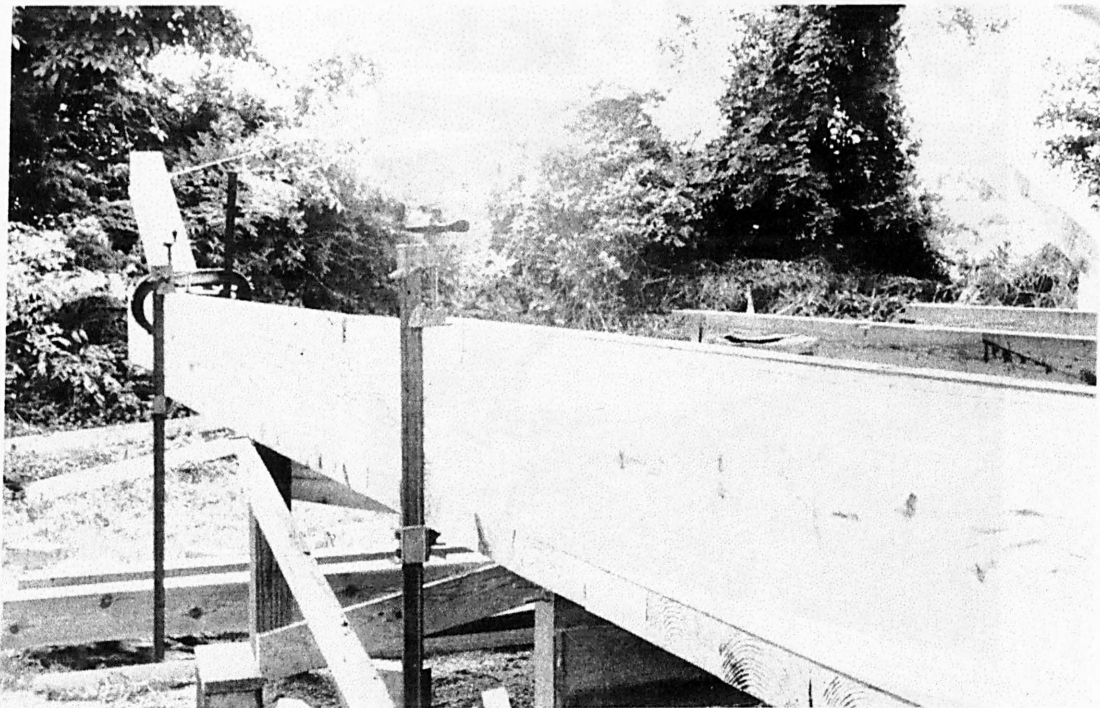


Figure 69: First chine strake installed. Note scarp joint behind nearest clamp (photo: Mark Newell).



Figure 70: Power augur being used to drill holes for drift pins (photo: Mark Newell).

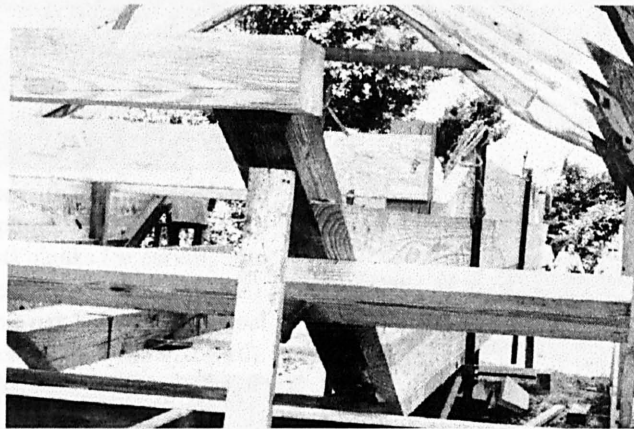


Figure 71: Header logs installed on ramp supports (photo: Mark Newell).

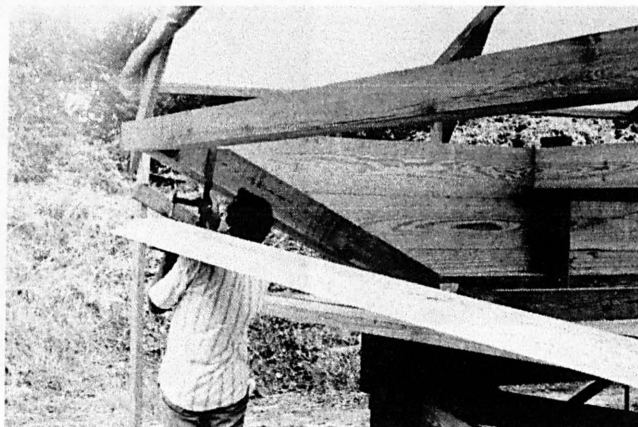


Figure 72: Ramp planks are installed on the bow ramp (photo: Mark Newell).

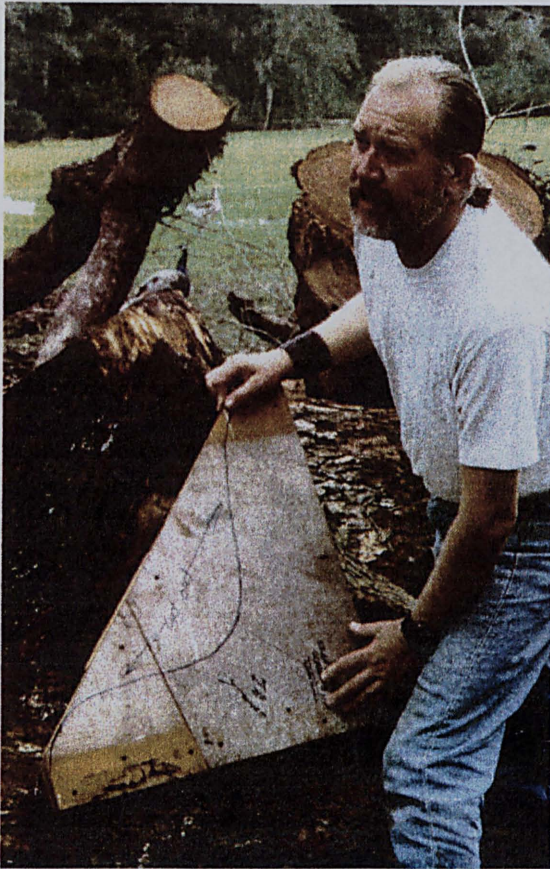


Figure 73: Above left, author with template for barge knees (photo: Rusty Fleetwood).



Figure 74: Above right, author cuts blanks for carving into knees (photo: Rusty Fleetwood).

Figure 75: Right, live oak knee nearing final finishing stages (photo: Mark Newell).

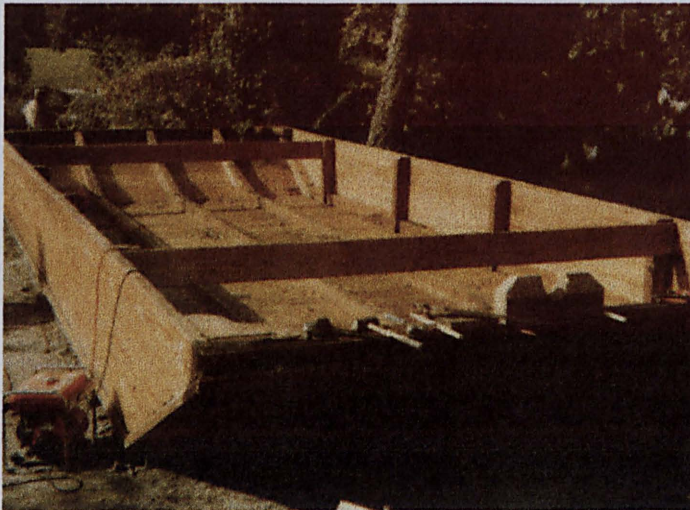
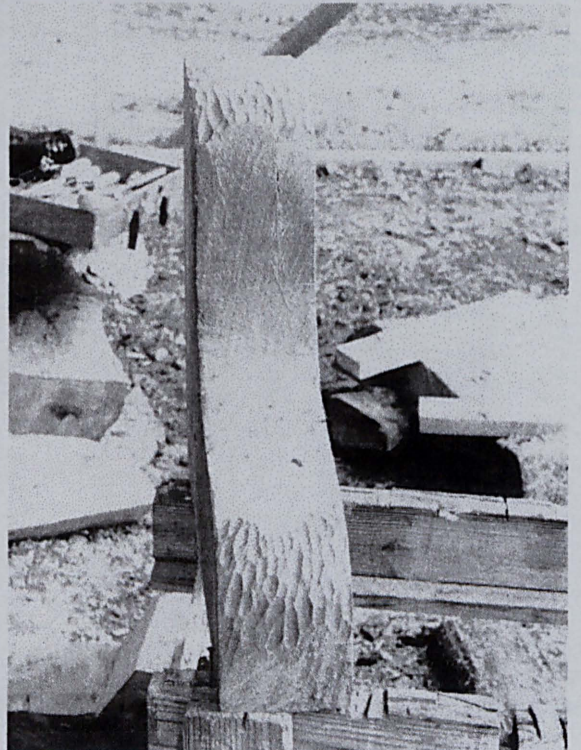
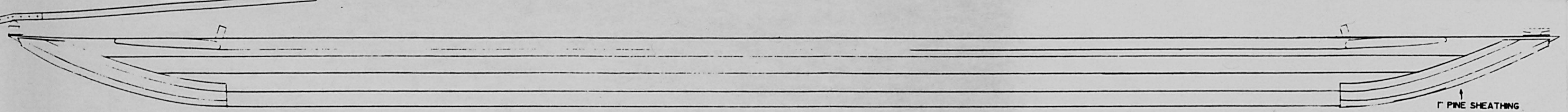


Figure 76: Above left, the completed Magnolia barge. A shelter was later built to protect the barge from the weather (photo: Mark Newell).

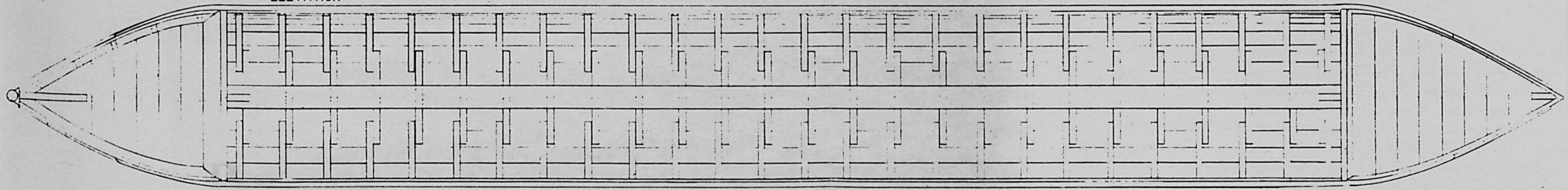
Petersburg foldout

Figure 77: Author's construction plan for the reconstruction of a Petersburg boat was based on archival evidence.

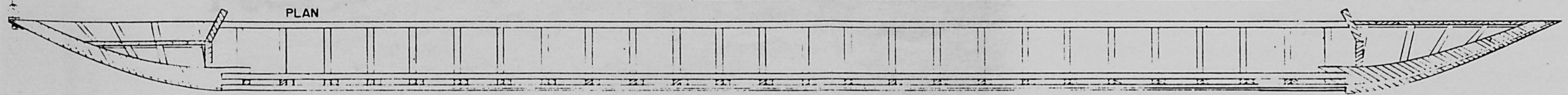


ELEVATION

1" PINE SHEATHING

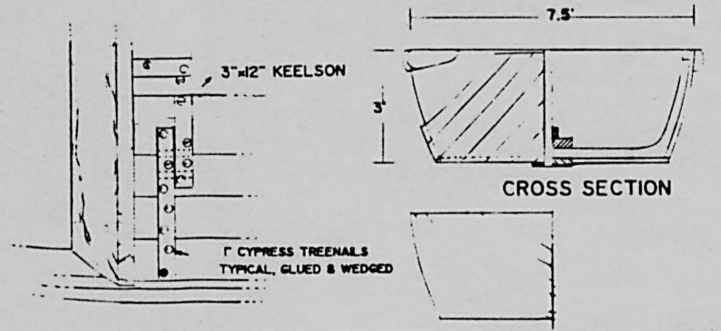


PLAN

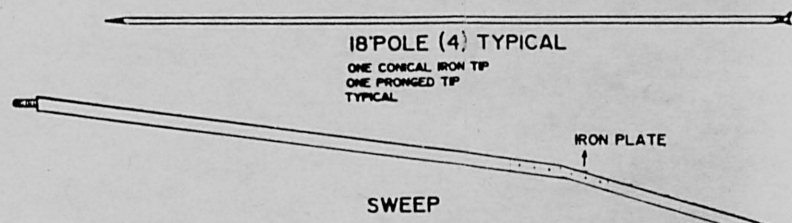


LONGITUDINAL SECTION

FORWARD DECK IS FLUSH WITH GUNWHALE



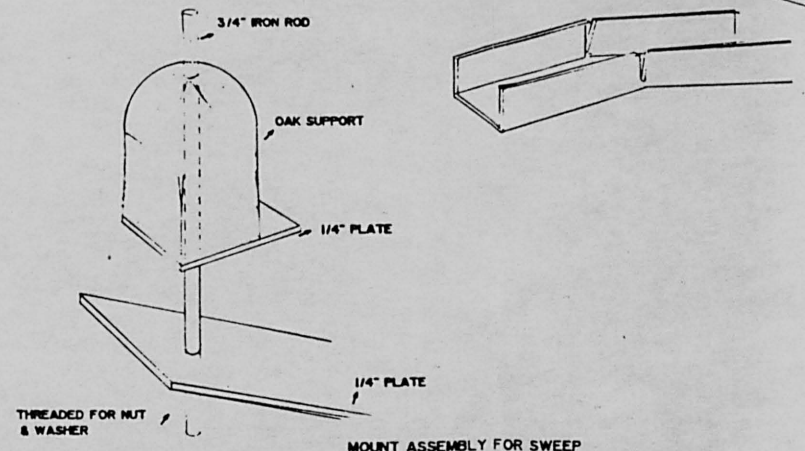
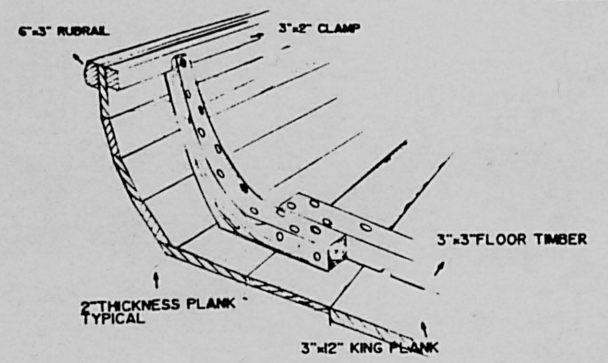
CROSS SECTION



18' POLE (4) TYPICAL
ONE CONICAL IRON TIP
ONE PRONGED TIP
TYPICAL

IRON PLATE

SWEEP



MOUNT ASSEMBLY FOR SWEEP

IRON SHEATHING

PETERSBURG BOAT
SAVANNAH RIVER, SC/GA
RECONSTRUCTION FROM
ARCHIVAL ACCOUNTS,
DRAWINGS & PHOTOS

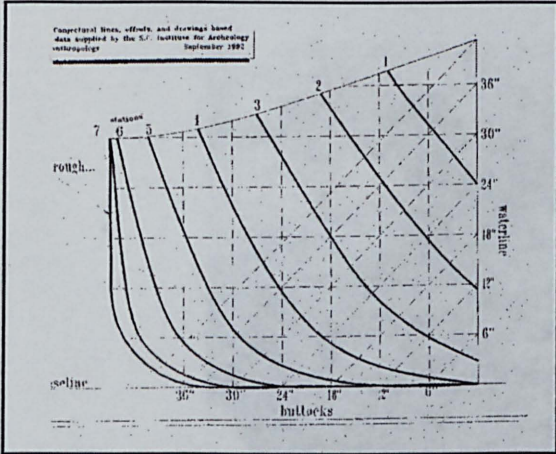


Figure 78: CAD-CAM system's impression of the Petersburg cross section with rounded chine (Rusty Fleetwood).

Figure 79: below Model of the Petersburg Boat, used to determine nature of chine, straking plan, and hull form. The rounded chine was later changed to a hard chine consistent with archival evidence (photo: Rusty Fleetwood).

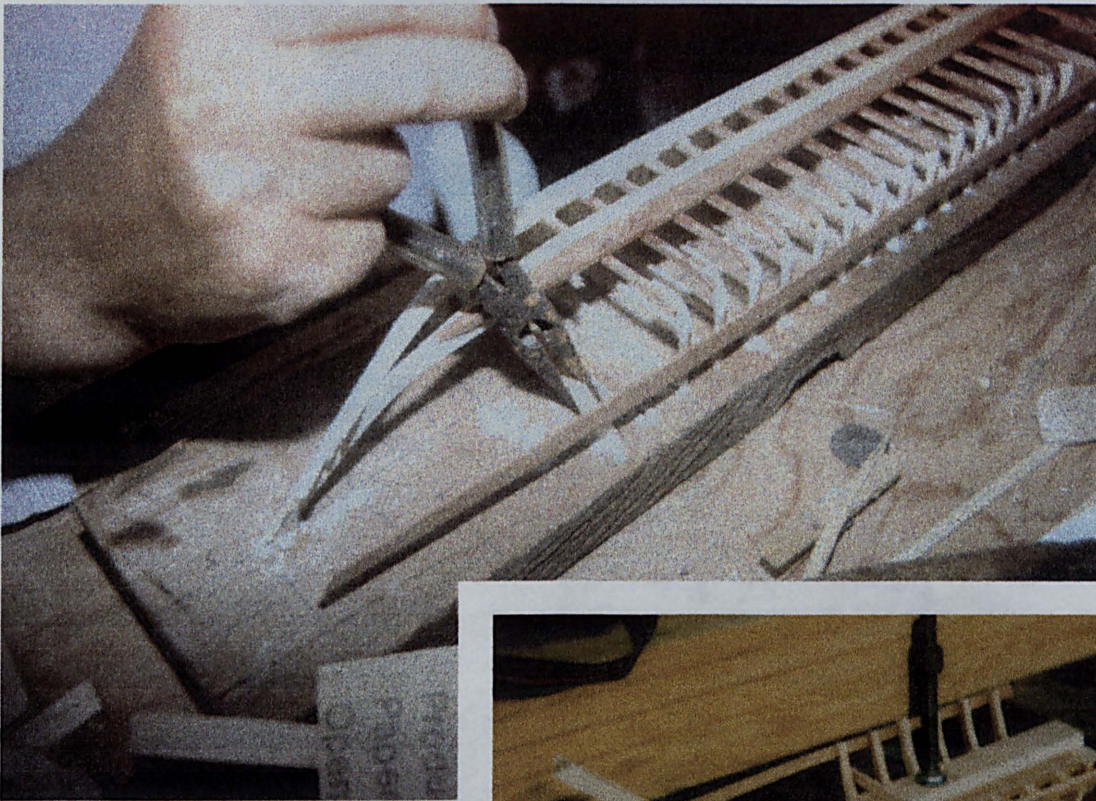


Figure 79b right 'shipyard' model used to determine final details of bow structure and the degree of rocker at each end (photo: Mark Newell).

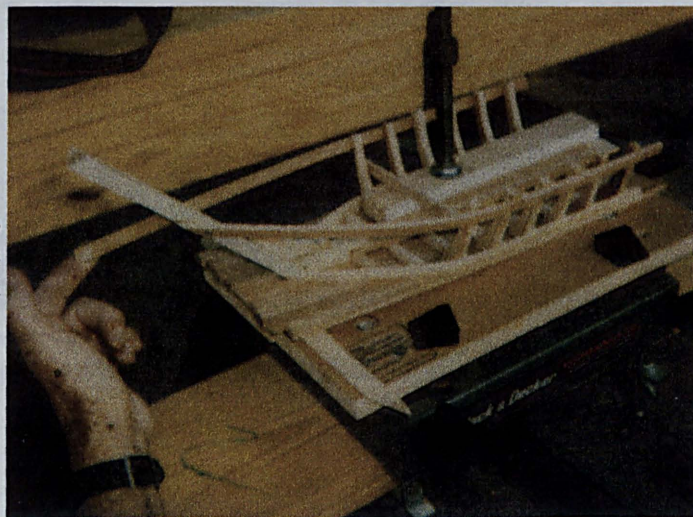




Figure 80: Partially carved stem knee for Petersburg Boat with author's tools used for the task (photo: Danielle Seward).

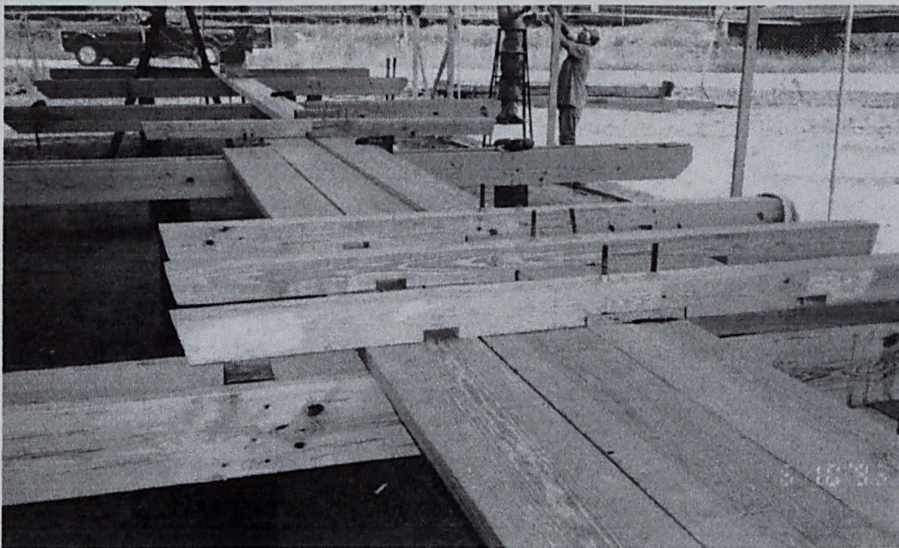


Figure 81: The keel plank and floor assembly of the Petersburg boat in early stage of construction (photo: Mark Newell).

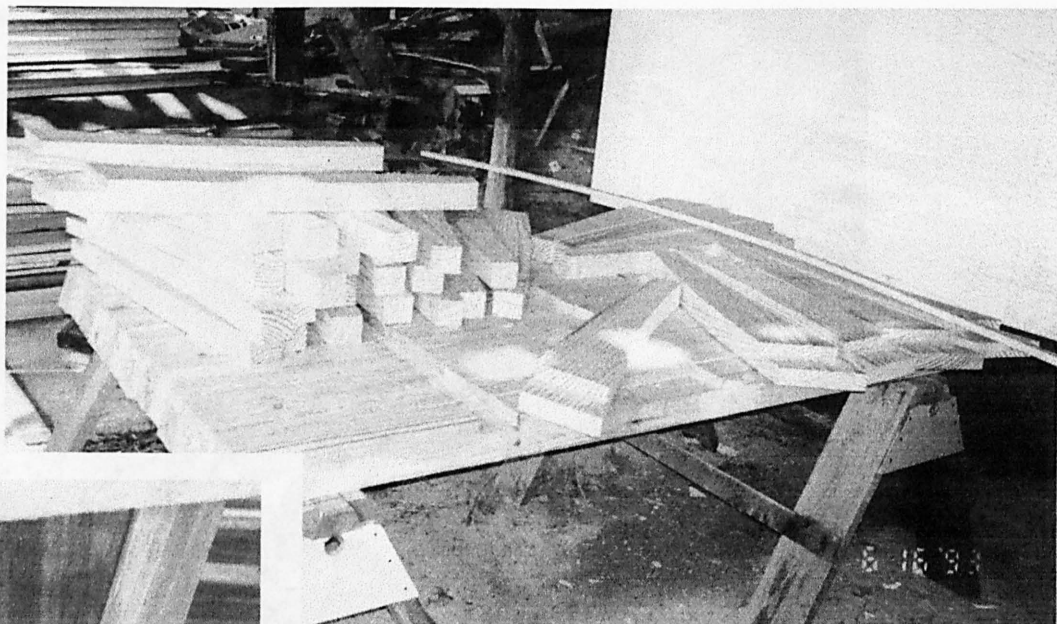


Figure 82: Above, pre-cut pine frames for centre section of the vessel (photo: Mark Newell).

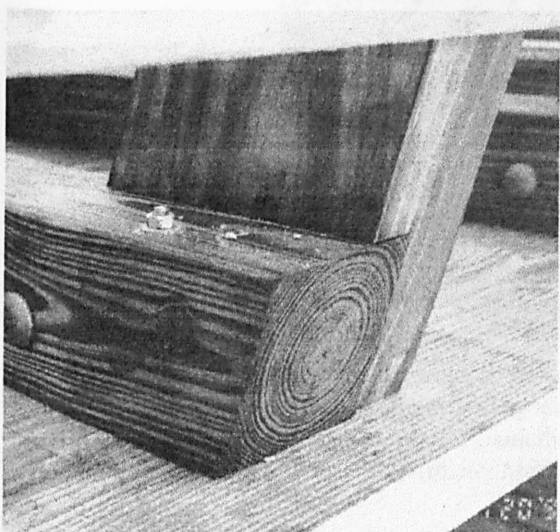


Figure 83: Inset left and below, small standard knee of pine was used to reinforce frame and floor at chine (photo: Mark Newell).

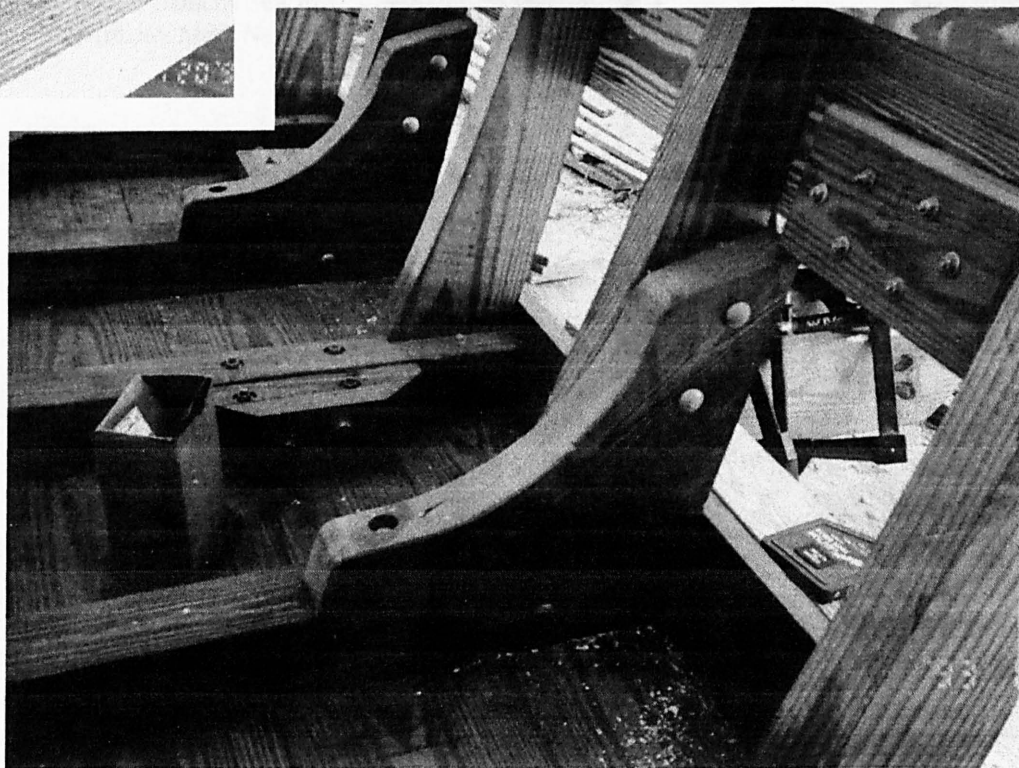




Figure 84: Above foregripe and stem knee assembly are unclamped by author after being bolted to stempost (photo: Danielle Seward)
Insert - detail of assembly (photo: Mark Newell).





Figure 85: Untrimmed hood ends of the bow planking attached to stempost (photo: Mark Newell).

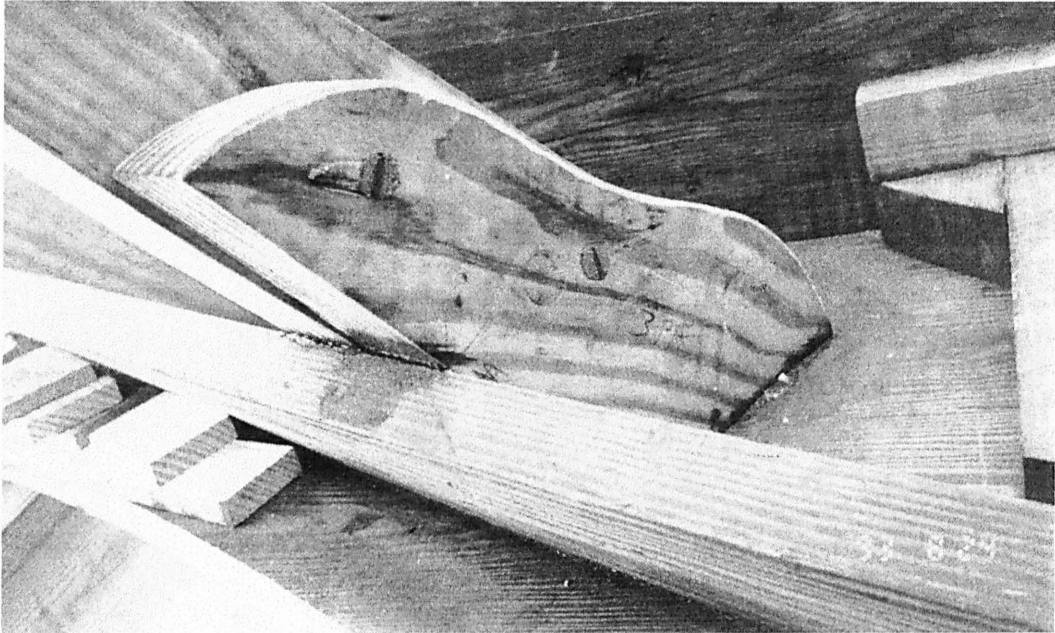


Figure 86: Close up view of knees used to anchor floating cant frames (photo: Mark Newell).

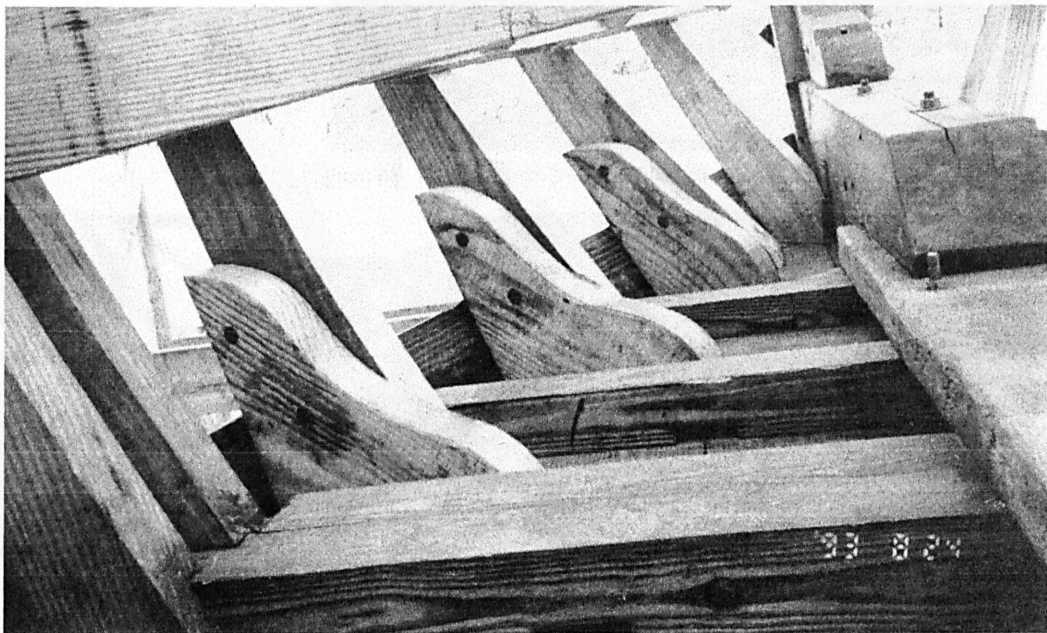


Figure 87: View of framing for bow showing floating cant frames (photo: Mark Newell).

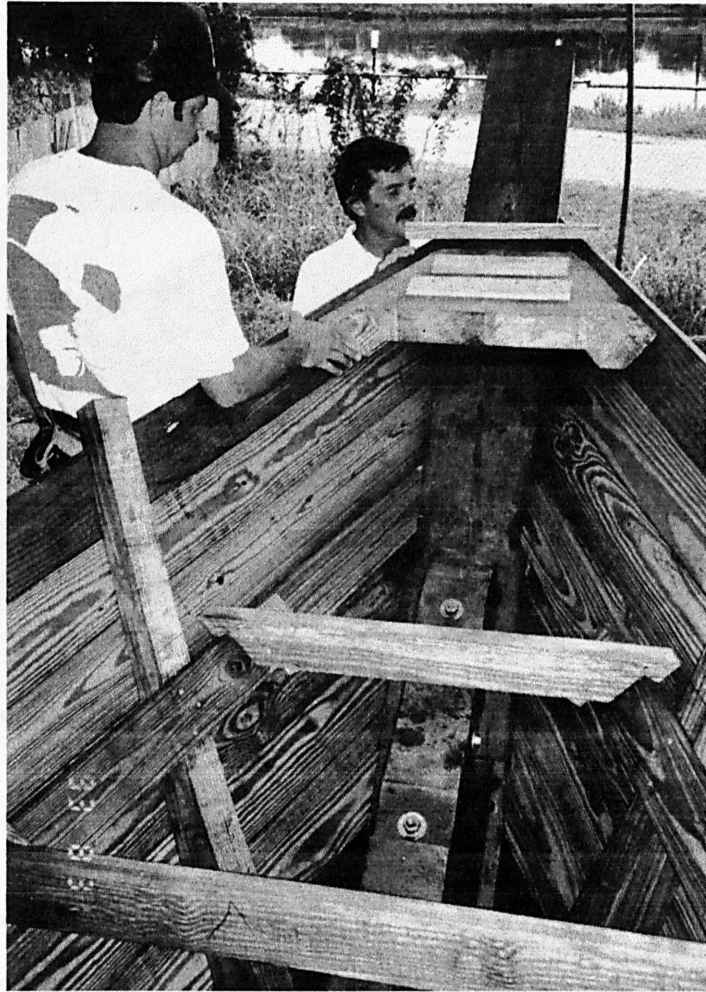


Figure 88: Breast hook being installed in bow (photo: Mark Newell).

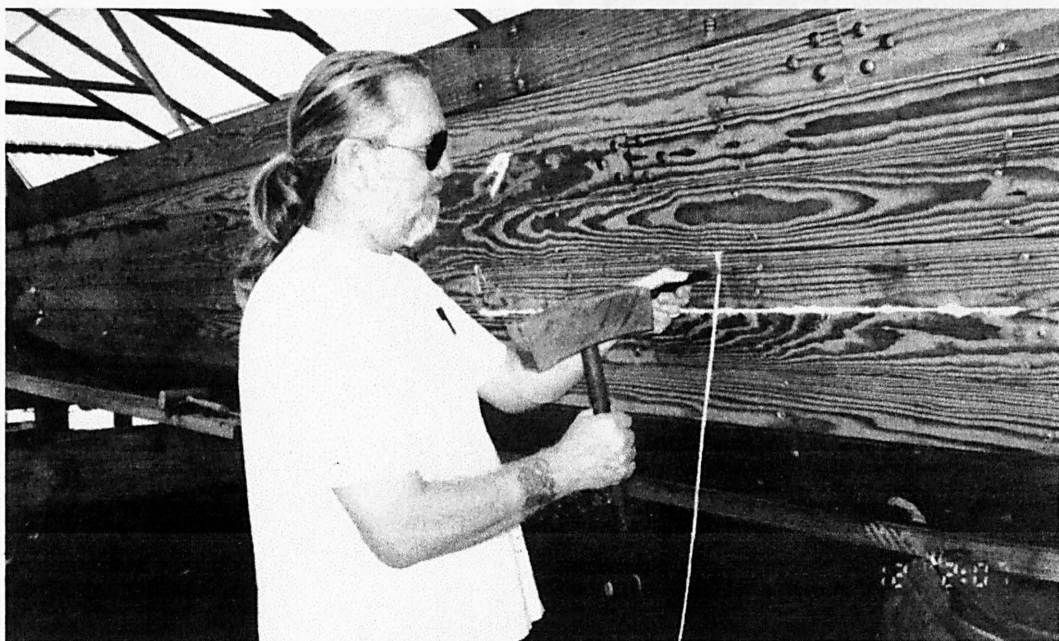


Figure 89: Author caulks seam with raw cotton fibre (photo: Christine Newell).



Figure 90: Petersburg Boat is launched into the Augusta Canal (photo: Danielle Seward).

Figure 91: Crew rowing the Petersburg Boat (author on left) at the start of its 189 mile journey to Savannah Georgia (photo: Britt Nickels).

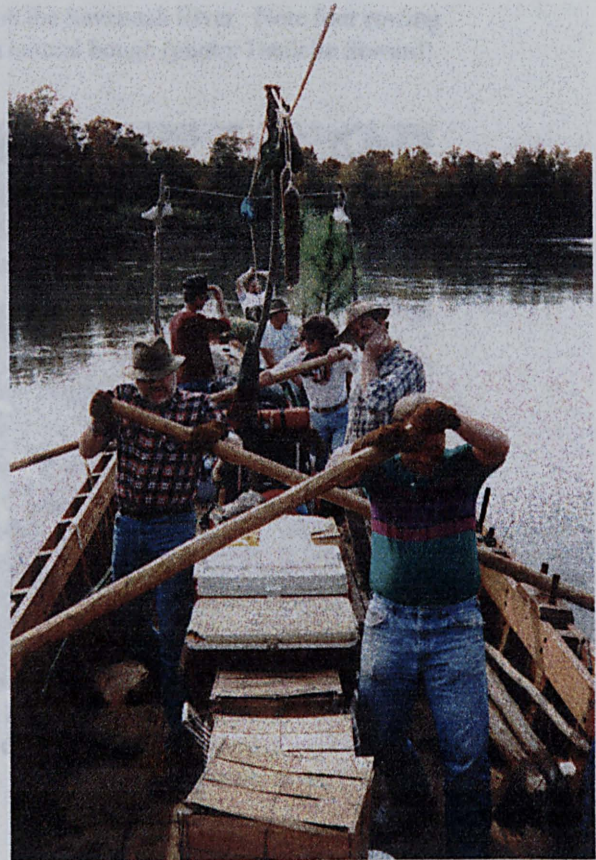




Figure 92: The Petersburg boat on the Savannah River. Note four rowing stations and sweep made from a natural bough (photo: Danielle Seward).



Figure 93: Shavings at Petersburg boat construction site. Entire site was photo mapped to document debris typical of various tasks (photo: Mark Newell).

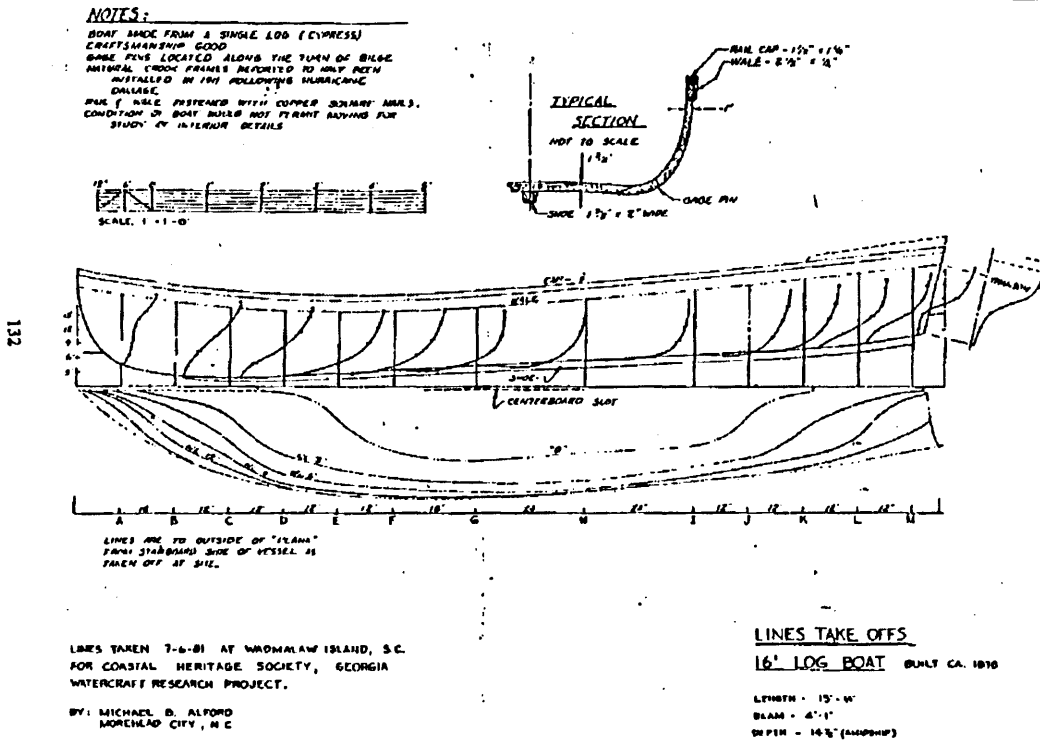


Figure 94: Dugout plantation boat documented by historian Michael Alford and now in the possession of the Georgia Coastal Heritage Society (drawing permission North Carolina Maritime Museum).

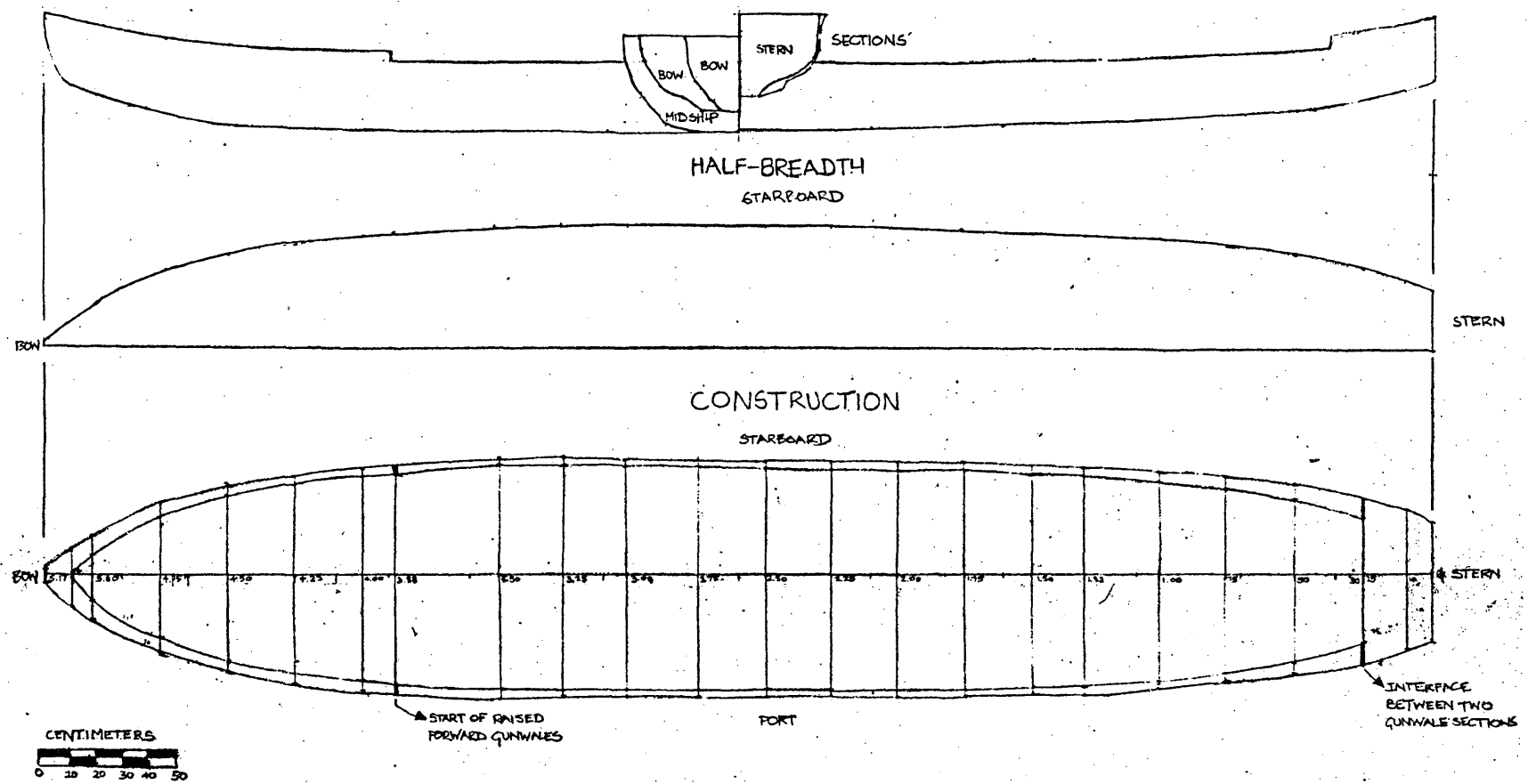
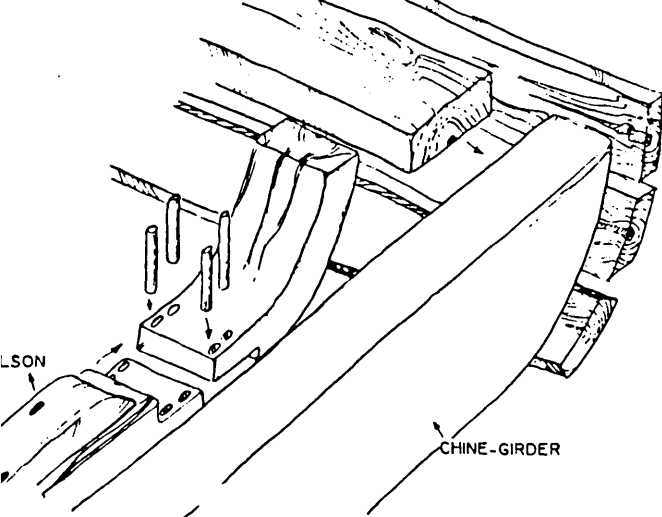


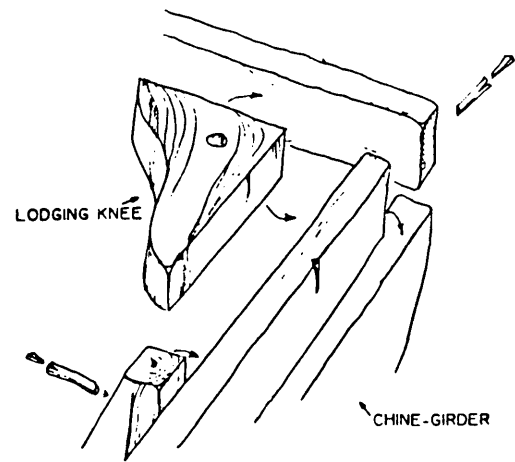
Figure 95: Europeanized dugout from the late nineteenth century by author and Lynn Harris.

Barge Diagnostics

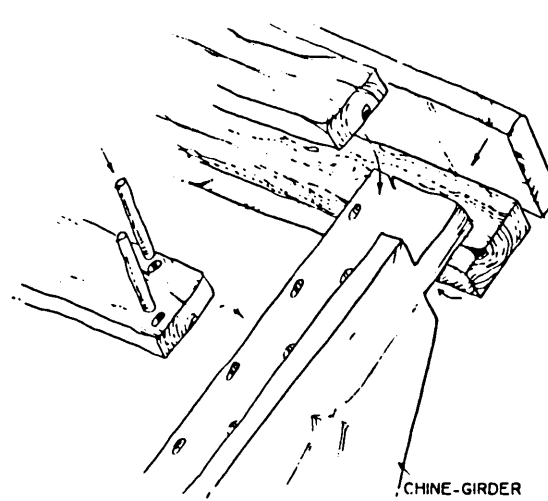
Figure 96: Diagnostic drawing of construction features of most barge forms. The corner construction details best show the decline in craftsmanship from early to late construction periods (Mark Newell).



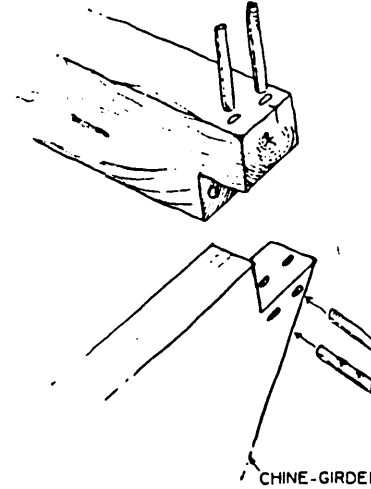
POTATOE FERRY CRAFT
(RECONSTRUCTION)
LATE 18th EARLY 19th
CENTURIES



LAUREL HILL CRAFT
LATE 18th EARLY 19th
CENTURIES

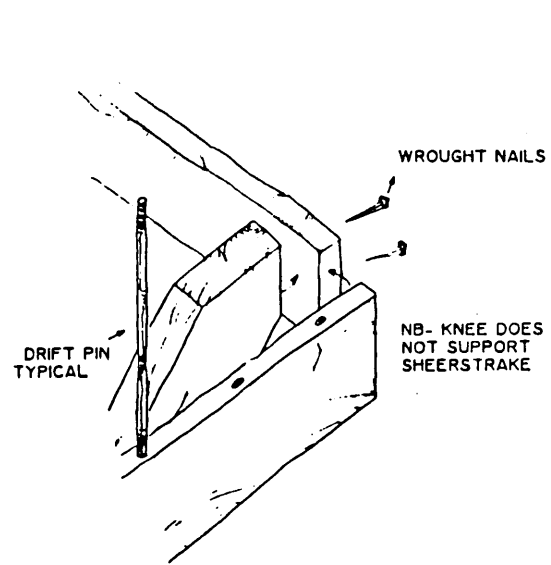


PEE DEE RIVER CRAFT
EARLY 19th
CENTURY

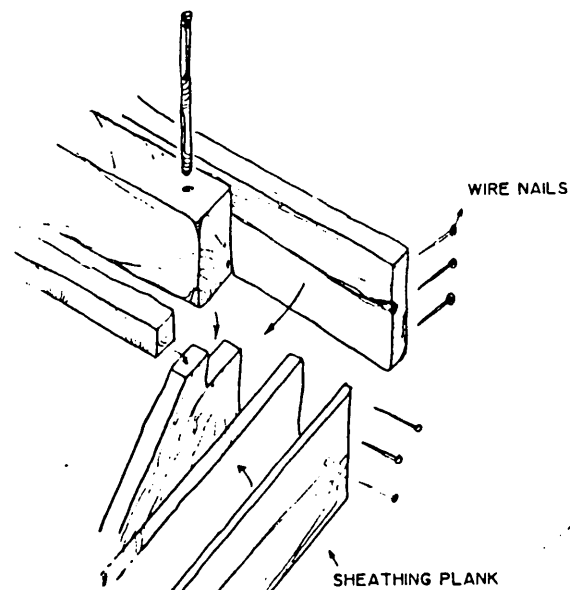


AVANT'S FERRY CRAFT
EARLY 19th
CENTURY

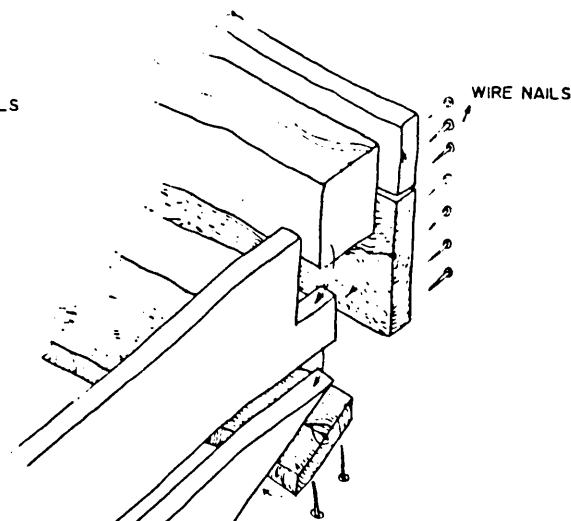
SIDE TO BOW/STERN
CONSTRUCTION COMPONENTS
ON S.CAROLINA FLATS & FERRIES
18th - 19th CENTURIES



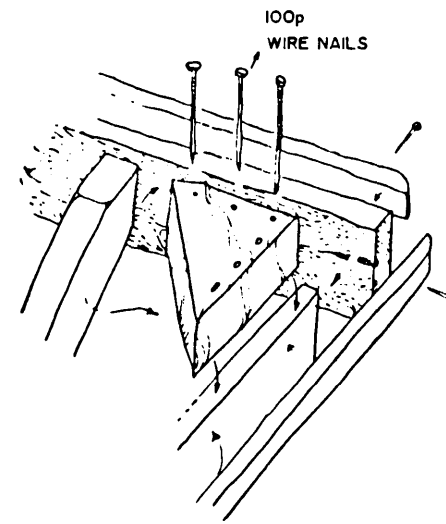
FRIENDFIELD PLANTATION BARGE
1850 - 1860



S. EDISTO RIVER
PHOSPHATE BARGE
1870 - 1883



BROWN'S FERRY CRAFT No. 1
1890 - 1920



MEPKIN PLANTATION BARGE
1940

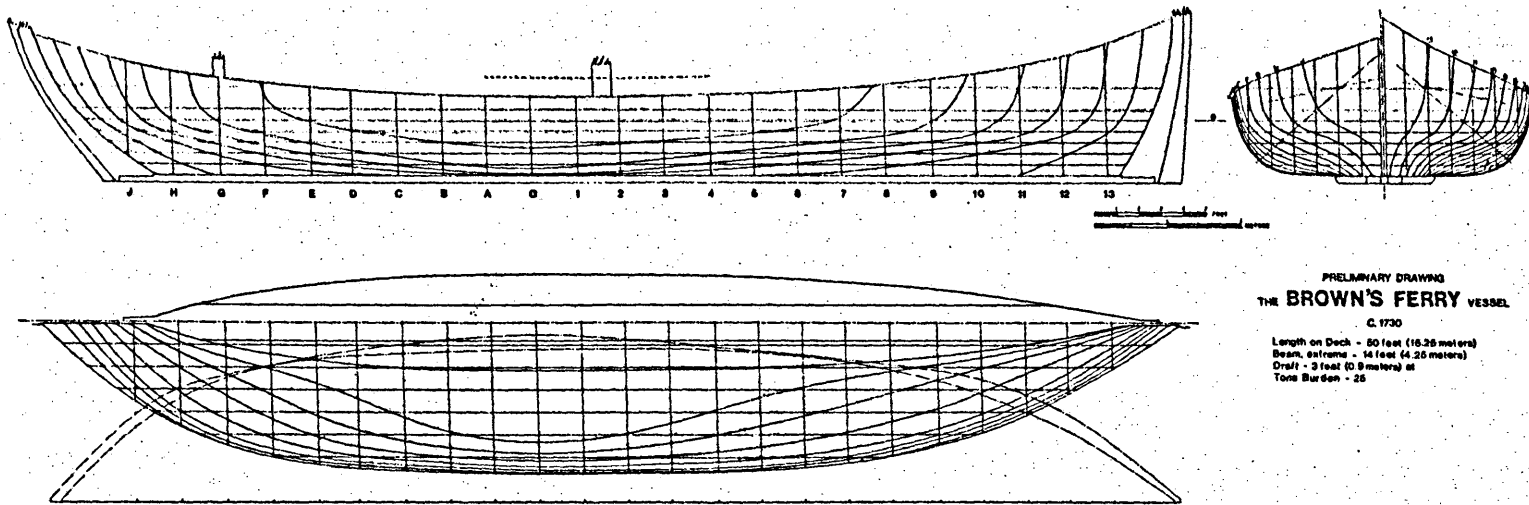


Figure 97: Dick Steffy's early interpretation of the lines of the ca 1733 vessel at Brown's Ferry (permission of Dick Steffy).

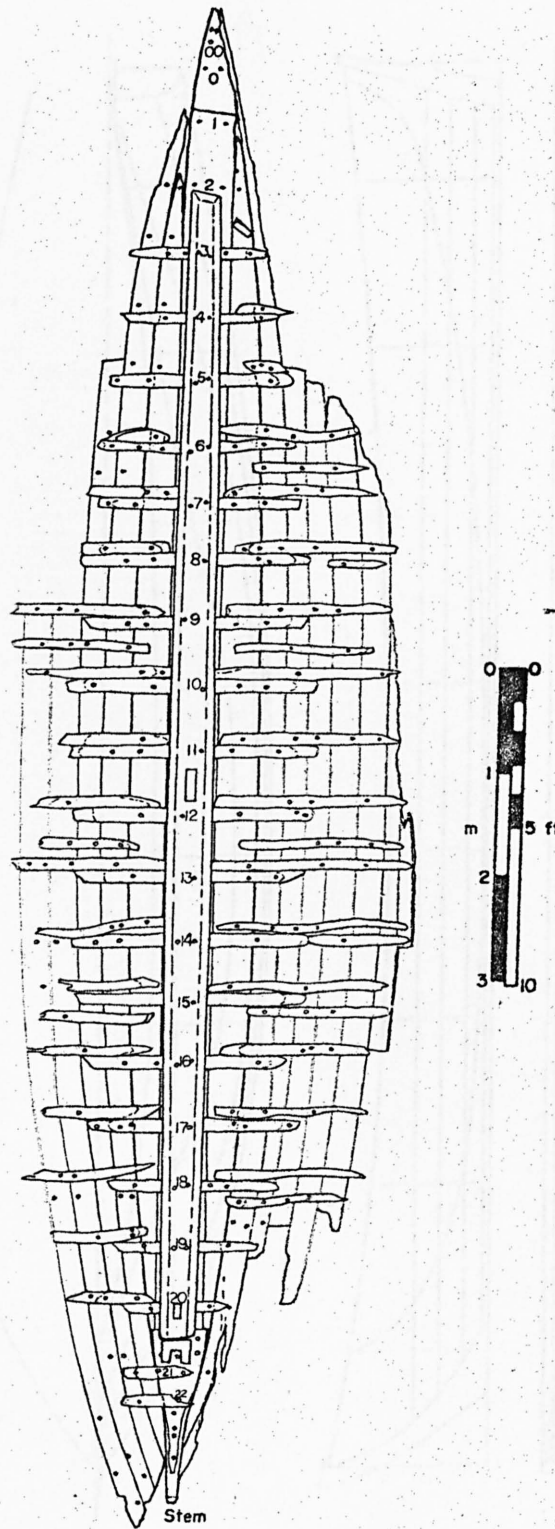


Figure 98. Framing Plan of the vessel at Brown's Ferry by Darby Erd.

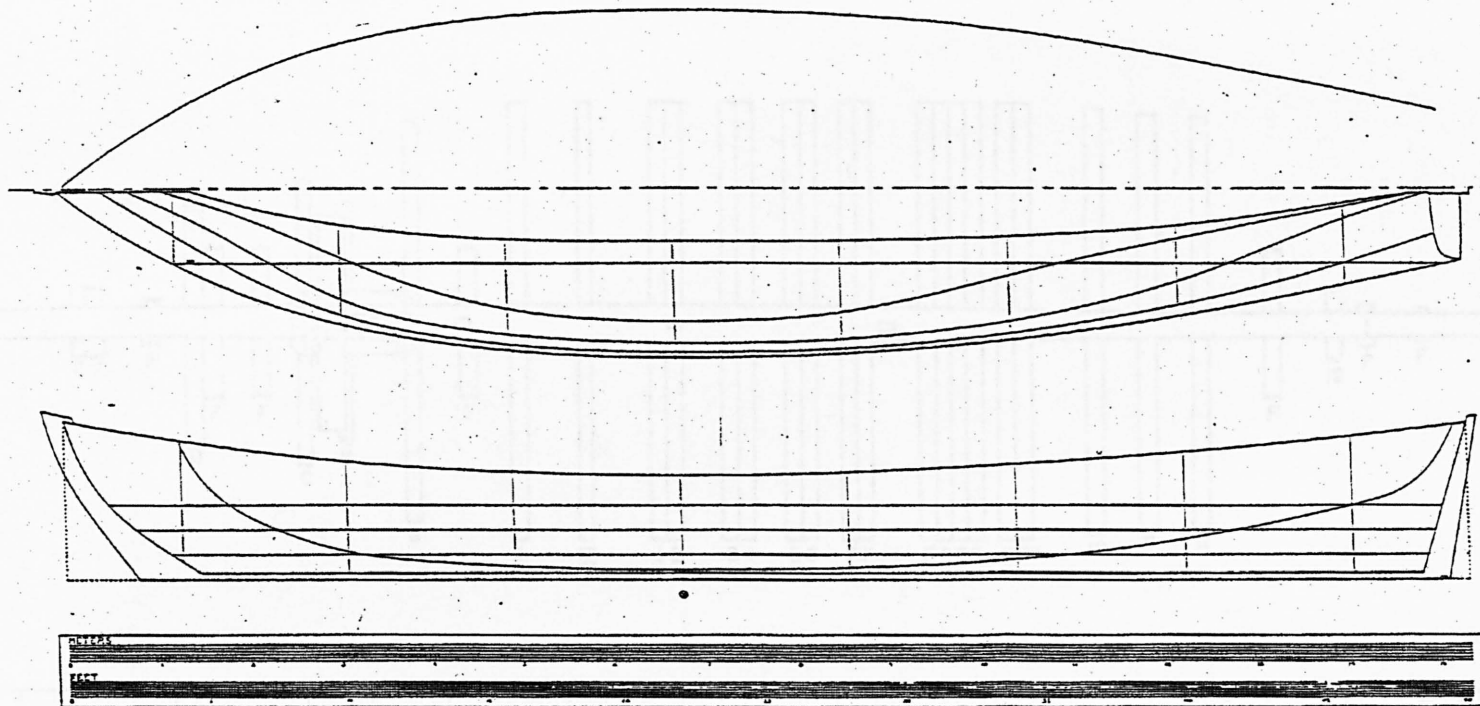


Figure 99: 1991 interpretation of the lines of the vessel at Brown's Ferry by Fred Hocker
Note transom stern more consistent with archival findings (permission of the Institute of Nautical Archaeology, Texas).

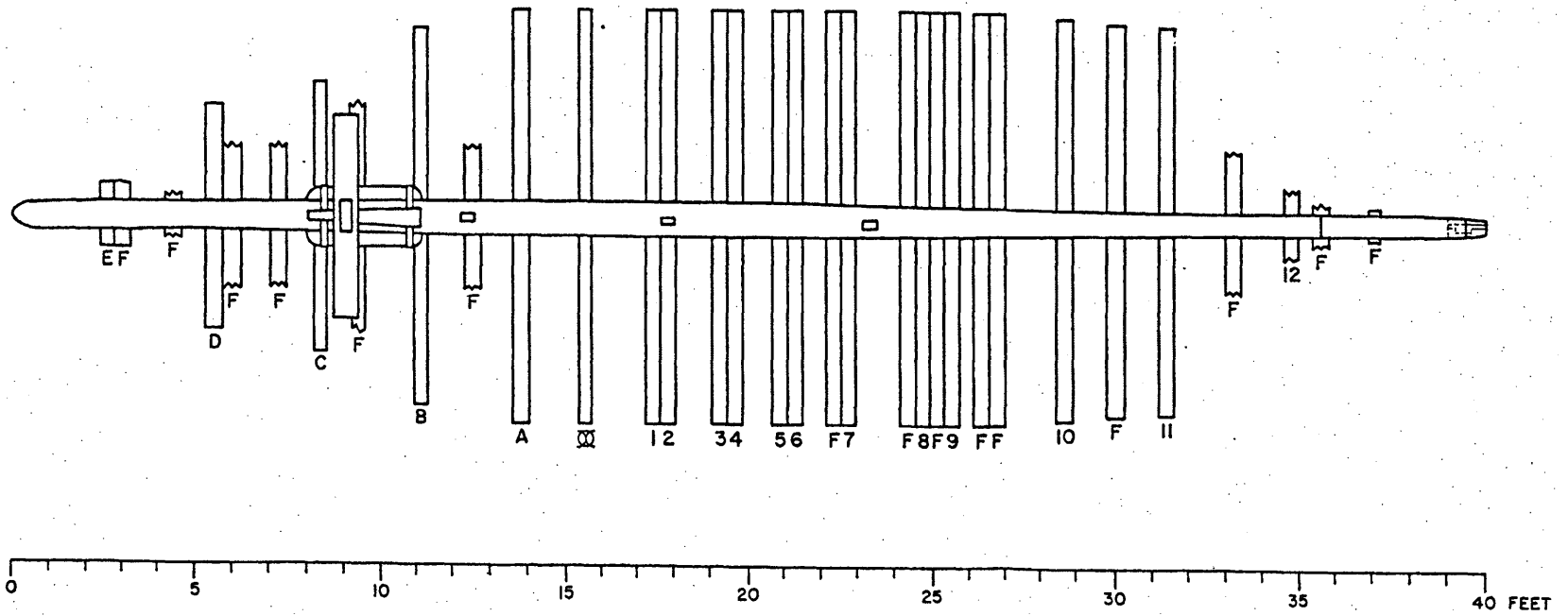


Figure 100: Floor plan of the Mepkin Abbey vessel showing the extreme fore and aft extension of maximum Beam (Darby Erd).

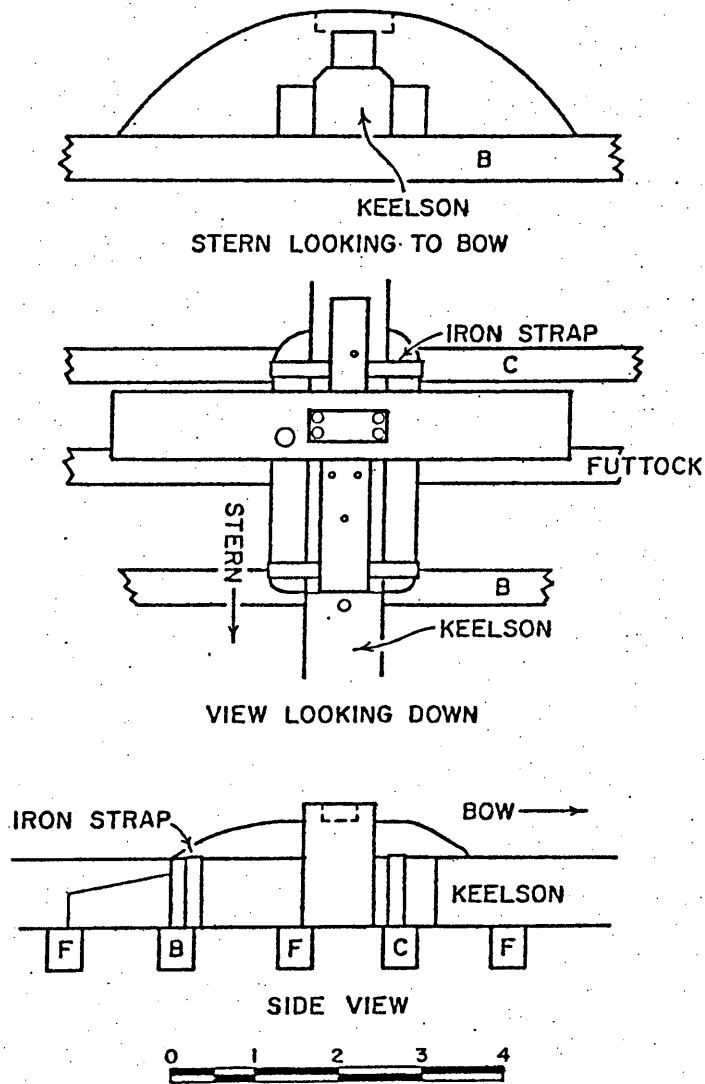


Figure 101: Erd's drawing of the Mepkin Abbey wreck mast step.
Note saddle assembly and sistered keelson.

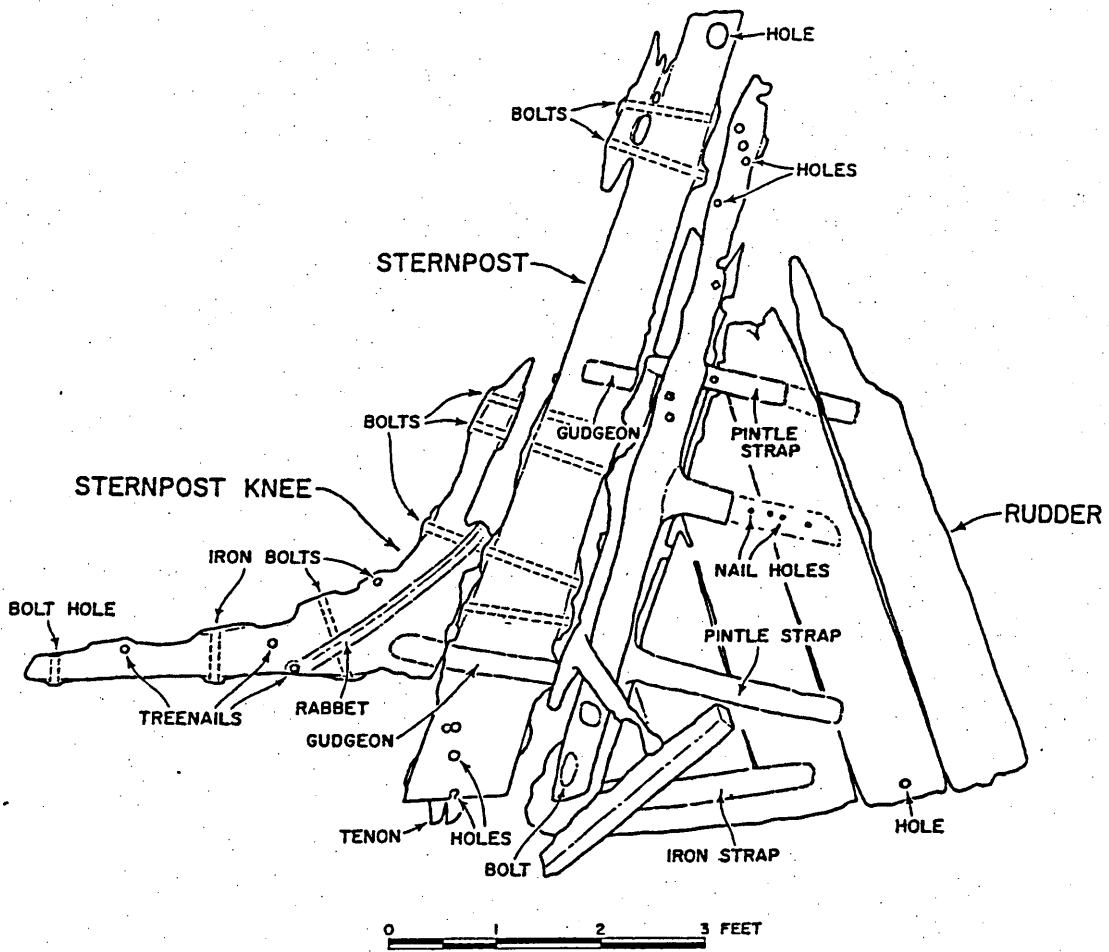


Figure 102: Rudder, sternpost, and knee assembly of the Mepkin Wreck (Darby Erd).

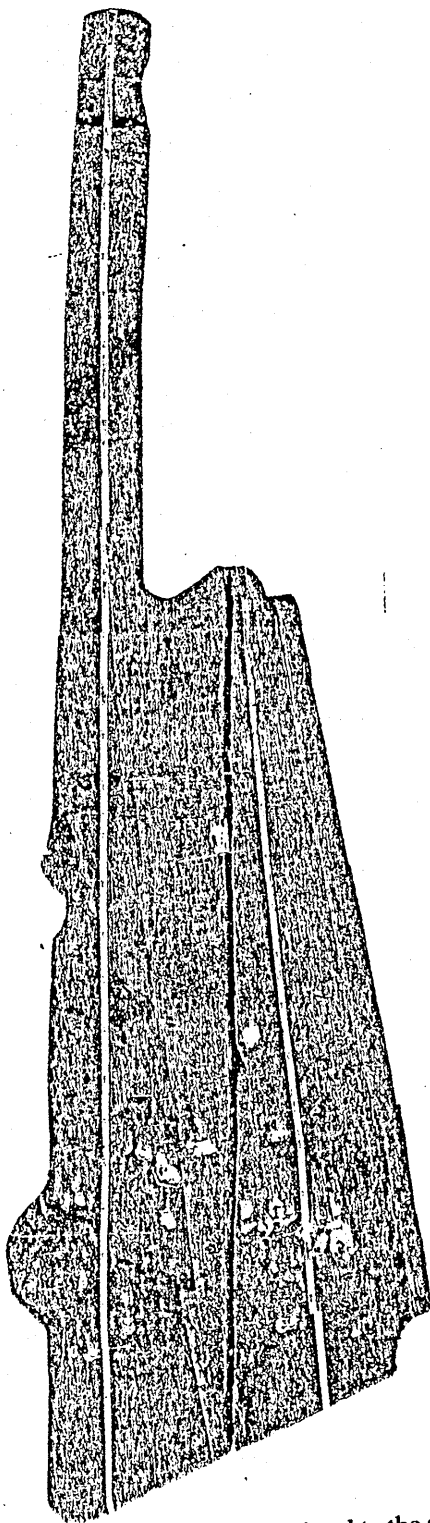


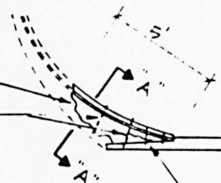
Figure 103: Rudder from the Hobcaw wreck, dated to the same period as the Mepkin wreck (photomontage: David Beard).

King's Grant foldout

Figure 104: Floor plan of the King's Grant Vessel showing extreme beam aft of midsection (William Judd, 1985).

PARTIAL BOW STEM
SHOWN IN POSITION
FOR PLEASANT
ORIGINAL APPEARANCE

5/8" IRON ROD



PARTIAL WOODEN COREL

1'-0" (TYPICAL)

APPROXIMATELY
FOUR (4) FEET OF
MUD ABOVE PORTION
OF VESSEL

(SEE ATTACH LETTER
SKETCH)

HIGH WATER LEVEL

LOW WATER LEVEL

PLANKING

57'-0"

- SIDE VIEW -

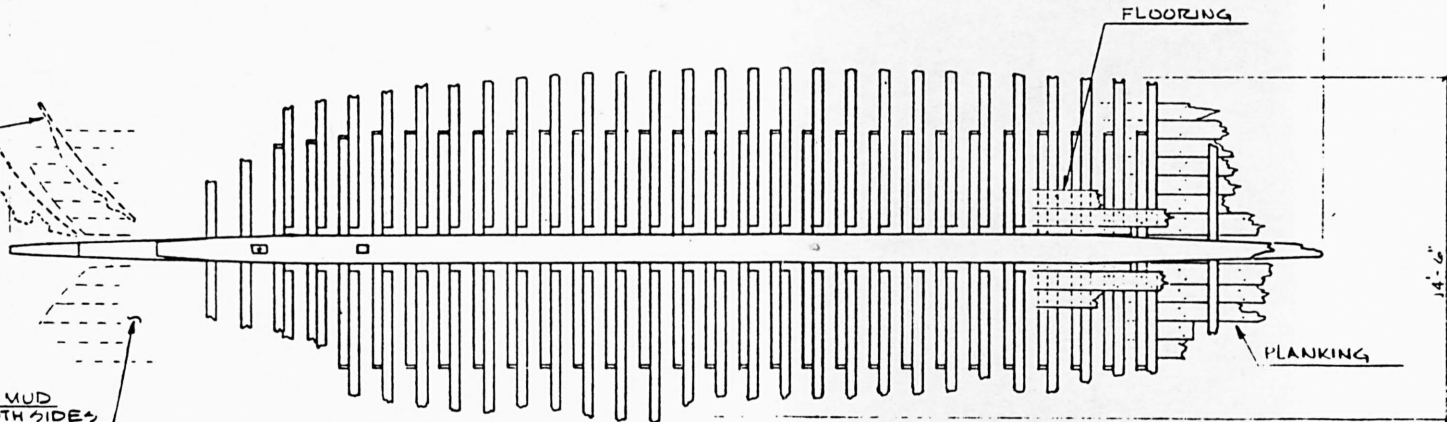
BOW STEM

SECTION "A-A" -

SCALE - 1" = 1'-0"

(FEBRUARY, 1985)

A PORTION OF THE
BOW STEM AND
STEM POST FOUND
IN THIS LOCATION
UNDER 2' OF MUD
(SOUPY)



PLANKING UNDER MUD
IN THIS AREA - BOTH SIDES

FLOORING

PLANKING

- PLAN VIEW -

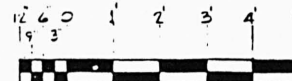
- VESSEL No 1 -

SCALE - 1/4" = 1'-0"

NOTE: THIS VESSEL HAD A BEAM OF AT LEAST 16 FEET
AND A KEEL LENGTH OF 57 FEET AS SHOWN.

MEASURED NOVEMBER, 1983 AND
DRAWN FEBRUARY 1985 BY
WILLIAM R. JUDD

SCALE - 1/2" = 1'-0"



SCALE - 1/4" = 1'-0"

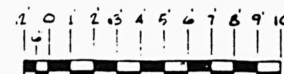




Figure 105: Old slave cabin, and 1970 resident, on the Carswell plantation, Burke County, Georgia (Photo: Newell).



Suriname: Bush Negroes heating treating a dugout canoe (photo by Daryl Miller for the author).

Appendix B: Tables of Scantlings and Measurement Conversions

Table 4: Avant's Ferry Craft

Measurement Conversion Table (Flats)			
Vessel Name:		Avant's Ferry Craft No. 1	
Feature	Dimension		Comment
	Metric (m)	English (ft)	
			Large chine log construction
Length	14.63	48.00	remaining:
Length			original
Beam	4.19	13'8"	remaining
Beam			original
Depth	0.66	2'3"	remaining:
Depth			original:
Side Planks			
Bot. Planks	.762x.254	3"x10"	thwartship
Keelson S	0.10	4"	
Keelson M	0.25	10"	
Thwarts S			
Thwarts M			
Header S			
Header M			
Fasteners	3.81cm	1.5"	Treenails, cypress
Scarphs			
Ramp Angle			
General Comments:			
	Craft capsized with holed bottom. Second largest Chine log recorded in SC.		
Chine log:			
sided	0.2	8"	Gunwhale carved down to 0.101m or 4"
moulded	16.8	48'	

Table 5: Pee Dee River Ferry Flat

Measurement Conversion Table (Flats)			
Vessel Name:		Pee Dee River Ferry Craft	
Feature	Dimension		Comment
	Metric (m)	English (ft)	Chine log construction
Length			remaining:
Length	12.19	40.00	original: estimated
Beam	3.05	10.00	remaining
Beam			original
Depth	40cm	15.75"	remaining:
Depth			original:
Side Planks			
Bot. Planks	.48x1.9cm	12"x.75"	
Keelson S	10.16cm	4"	
Keelson M	15.24cm	6"	
Thwarts S			
Thwarts M			
Header S			
Header M			
Fasteners	3.81cm	1.5"	diameter treenails, cypress
Scarphs			
Ramp Angle:			
General Comments:	One corner of craft exposed, rest beneath coarse sand and gravel		
	"traditional" form of chine-girder construction reversed		

Table 6: Potatoe Ferry Craft

Measurement Conversion Table (Flats)			
Vessel Name:	Potatoe Ferry Craft		
Feature	Dimension		Comment
	Metric (m)	English (ft)	chine log construction
Length	4m visible		remaining:
Length			original
Beam	2.24	7.84'	visible, rest buried
Beam	.30 to 4.60	11' to 15'	original
Depth			remaining:
Depth			original:
Side Planks:			
Bot. Planks:	0.28x0.05	11"x2"	thwartship
Keelson S	0.28	7.1"	Rider keelson
Keelson M	0.10	4"	
Thwarts S			
Thwarts M			
Header S			
Header M			
Fasteners	0.04	2"	Treenails, cypress
Scarphs			shiplap type, four treenails in table
Ramp Angle:			Curved profile
General Comments:	Craft is extremely degraded and partially buried		
Chine log			
sided	0.24	9.5"	
moulded	0.18	7.1"	

Table 7: Laurel Hill Flat

Measurement Conversion Table (Flats)			
Vessel Name:		Laurel Hill Chine-girder Flat	
Feature	Dimension		Comment
	Metric (m)	English (ft)	
Length	17.10	56.08	remaining:
Length			original
Beam	4.74	15.54	remaining
Beam		16.00	original
Depth	0.88	34.65"	remaining:
Depth			original:
Side Planks	0.27	10.63"	
Bot. Planks			
Keelson S			
Keelson M			
Thwarts S			
Thwarts M			
Header S	11.50	4.53"	15.5' long
Header M	36cm	14.17"	
Fasteners			Treenails - at least one wedged with metal
Scarphs			Shiplap type
Ramp Angle:			curved
General Comments:			Interior framing pieces plus standard
Chine Girder:			knees on a thwart (See Conway Flat)
Sided			Walking board attached to bow gunwhale
Moulded	57cm	22.44"	
Largest Chine-girder recorded to date in SC			

Table 8: Friendfield Flat

Measurement Conversion Table (Flats)			
Vessel Name:		Friendfield Flat	
Feature	Dimension		Comment
	Metric (m)	English (ft)	
Length	13.48	44.25	remaining:
Length		48'	original estimated
Beam	4.03	13.25	remaining
Beam			original
Depth	1.06	42"	remaining:
Depth			original:
Side Planks	.356x.076	14"x3"	
Bot. Planks	.356x.076	14"x3"	
Keelson S			Header knees 7"mx5"s
Keelson M			
Thwarts S			
Thwarts M			
Header S	0.18	7"	4.8m/15' length
Header M	0.20	8"	
Fasteners	wrought nails, 1.75" iron drift pins, wrought nails		
Scarphs			
Ramp Angle			
General Comments:			
Stern identified by rowlock nail pattern, bow severely degraded			

Table 9: Trent River Flat

Measurement Conversion Table (Flats)			
Vessel Name:	Trent River Flatboat		
Feature	Dimension		Comment
	Metric (m)	English (ft)	
Length	9.46	31' 1,5"	remaining:
Length			original
Beam	3.45	11' 4"	remaining
Beam			original
Depth	45.7cm	18"	remaining:
Depth			original:
Ceiling		7/8" x 8"	
Bot. Planks	30.4cm	12"	Also 8" Planking is longitudinal
Keelson S			
Keelson M			
Thwarts S		4"	
Thwarts M	10.16cm	4"	typical
Header S	10.16cm		
Header M			
Fasteners		3/8" x 4.5"	wrought nails. Also .75" - 1" dia treenails
Scarphs			
Ramp Angle:			
General Comments:	Unusual chine cross section which incorporates chine strake		
	Planking was longitudinal - rare in GA and SC		
Chine-log	.435s		
	.07 - .10m		

Table 10: Mepkin Mud Barge

Measurement Conversion Table (Flats)			
Vessel Name:		Mepkin "Mud Barge"	
Feature	Dimension		Comment
	Metric (m)	English (ft)	
Length	9.14	30.00	remaining:
Length			original
Beam			remaining
Beam	3.04	10.00	original
Depth	60.96cm	2.00	remaining:
Depth	60.96cm	2.00	original:
Side Planks:		10x2.5	
Bot. Planks:		10x2.5	
Keelson S	10.16cm	4"	Used in lengths of 12.00
Keelson M	10.16cm	4"	Butt joints sistered
Thwarts S			
Thwarts M			
Header S			
Header M			
Fasteners			wire nails: 40p planking 100p supports
Scaphs			None - strakes butted over framing pieces
Ramp Angle:			
General Comments:			
	Burlap and pitch used for caulking		
	All support wood cut from heartpine		

Table 11: Pon Pon Phosphate Barge

Measurement Conversion Table (Flats)			
Vessel Name:		Pon Pon Phosphate Barge	
Feature	Dimension		Comment
	Metric (m)	English (ft)	
Length	18.24	59.82	remaining:
Length		60.00	original
Beam	6.65	21.81	remaining
Beam			original
Depth	0.61	2'	remaining:
Depth			original:
Side Planks	0.29x0.06	11.5"x2.4"	
Bot. Planks	0.29x0.06	11.5"x2.4"	
Keelson S	0.29	11.4"	Chine keelsons with riders
Keelson M	0.29	11.4"	
Thwarts S	0.23	9"	
Thwarts M	0.10	4"	
Header S			
Header M			
Fasteners			1.5" iron drift pins edge fastened
Scarphs			
Ramp Angle:			
General Comments:			
Craft is severely degraded and partially incorporated into bank			

Table 12: South Edisto Phosphate Barge

Measurement Conversion Table (Flats)			
Vessel Name:		S. Edisto Phosphate Barge	
Feature	Dimension		Comment
	Metric (m)	English (ft)	
Length	22.55	74.00	remaining:
Length			original
Beam	6.70	22.00	remaining
Beam			original
Depth	1.83	6.00	remaining:
Depth			original:
Side Planks	7.6x27.9cm	3"x11"	
Bot. Planks	7.6x45.7cm	3"x18"	Also 3" x12"
Keelson S	30.49cm	12"	Sills or Chine-Keelsons
Keelson M	30.49cm	12"	Five interior keelsons were 5"s x 12" m
Thwarts S			
Thwarts M			
Header S			Composite assembly*
Header M			
Fasteners			Nails and .75" dia drift pins
Scarphs	1.016m	. 4'	shiplap with 2" nips
Ramp Angle:		30 degrees	
General Comments:			
			Side supports included composite standard knees made of a natural knee braced beneath a section of 5"x11" lumber
Date	1870 - 1910		

Table 13: The Biggin Creek Barge

Measurement Conversion Table (Flats)			
Vessel Name:		Biggin Creek Flat (Judd & Newell)	
Feature	Dimension		Comment
	Metric (m)	English (ft)	
Length	12.00	40.00	remaining:
Length			original
Beam	4.89	16.00	remaining
Beam	1.41	3'5"	original
Depth			remaining:
Depth			original:
Side Planks	4.4X24.1cm	1.75x9.5"	Under .75x9.5" sheathing
Bot. Planks	4.4x24.1cm	1.75x9.5"	
Keelson S			Not available - silted
Keelson M			
Thwarts S			
Thwarts M			
Header S	15.24cm	6"	
Header M	15.24cm	6"	
Fasteners			nails & drift pins
Scarpshs			shiplap
Ramp Angle		37 degrees	
General Comments:			
			3"x6" framing pieces typical
			Decked: 2.5"x4" deck beams & supports typical
			Liner board 2 strakes, 1.5"x7.5"

Table 14: Brown's Ferry Craft No. 1

Measurement Conversion Table (Flats)			
Vessel Name:		Brown's Ferry craft no.1	
Feature	Dimension		Comment
	Metric (m)	English (ft)	
Length	12.50	41.00	Planked construction remaining:
Length	4.27	14.00	original
Beam			remaining
Beam			original
Depth	0.69	2'3"	remaining:
Depth			original:
Side Planks:	.06x.30	2"x12"	
Bot. Planks:	.076x.30	3"x12"	Thwartship. Smallest planking width: 9"
Keelson S	0.07	2.75"	Total of four (planks set on edge)
Keelson M	0.27	10.5"	
Thwarts S			
Thwarts M			
Header S	0.15	6"	
Header M	0.18	7"	Single 4m/14' length used
Fasteners			wrought nails and drift pins
Scarpns			shiplap type fastened with 3 drift pins
Ramp Angle:			
General Comments:			
	Longest single plank 25'6"		
	Or 7.3m		

Table 15: Brown's Ferry Craft No. 2

Measurement Conversion Table (Flats)			
Vessel Name:	Brown's Ferry Craft no.2		
Feature	Dimension		Comment
	Metric (m)	English (ft)	
Length	13.41	44.00	plank construction remaining:
Length			original
Beam	3.66	12.00	remaining
Beam			original
Depth	0.58	1'11"	remaining:
Depth			original:
Side Planks	0.26x.05	10.5"x2"	
Bot. Planks	0.42x.06	16.5"x2"	Smallest width .23m or 9" thwartship
Keelson S	0.09	3.5"	
Keelson M	0.27	10.5"	
Thwarts S			
Thwarts M			
Header S			
Header M			
Fasteners			Wrought nails
Scarphs			diagonal type, fastened with 3 iron drifts
Ramp Angle:			
General Comments:	Vessel severely degraded		
	Longest strake 6.7m or 22'		

Appendix C: Glossary of Terms

Adze	Common tool for shaping logs and ship's timbers. Takes variety of forms depending upon specific use. Most common form is the "foot adze" or shipwright's adze.
Athwart ship	Crosswise, as in the use of bottom planking on flats being laid transversely from side to side of the craft as opposed to the more common longitudinal or bow to stern construction in most European flats and barges.
Bag	Long, round bag of cotton weighing approx. 200lbs. and used prior to cotton compresses. Also "long bale."
Bale	Square compressed form of cotton weighing from 300-500lbs. In use after 1824.
Bow	Forward end of flat (most flats appear to have a permanently mounted rowlock for a stern sweep).
Butt Block	Any square piece of timber used inside a flat to provide a brace for scarphs in the side or bottom planking.
Butt Join	Flat section of wood mounted behind or above right angle ends of joined planks on side or bottom of a flat or barge. A butt block supports this type of weak joint from inside the craft.
Chine-girder	Term coined by European archaeologists for the timber produced when a single log is split to create both sides timbers of a flat. Also chine-log or "ile" (French).
Crabbing	Unintentional sideways movement of vessels without a keel when under way.
Factor	A planter's agent who normally received the planter's product and arranged its sale for a commission. Factors were the business link between the planter and the end user. Not to be confused with the modern broker who purchases cotton outright and sells to the end user at a profit.
Flat	Rectangular, slab-sided craft of shallow draft and minimal freeboard, propelled by hand or tide. Also, lighter, barge and scow.
Framing Piece	Any square vertical timber used in place of a standard knee to brace the sides of a flat.
Gunwhale	Upper edge or top of uppermost plank on side of flat or vessel. Also Gunwale, Gunnell.
Head diameter	Diameter of the head, or end of a barrel.
Header	Large timber or square-cut log forming the upper timber of the stern and bow of a flat. Sheerstrakes and Chine-girders attach to these timbers by various means.
Hogshead	In South Carolina, the common name given to a tobacco barrel. Commonly a barrel containing approx. 54 gallons in traditional English "wet coopering."
Keelson	Inboard longitudinal run of timber from bow to stern providing additional support for bottom planking of flat. As many as five are used. Also, reelson, stringer, sill, floor timber, and kelson.
Knees	"L" shaped supporting timbers connecting the sides of flats with thwarts or bottom planking, less often with deck supports. Two types have been observed: Standard (usually

	placed vertically against the side and resting on a thwart) and Lodging (placed horizontally as in a stern to side support) A third type, a Hanging knee supports side to deck beams.
Moulded	Shipwright's term for the "face" of a given construction timber facing stern or bow or port or starboard.
Osnaburg	Coarse imported blankets or two weights (Summer and Winter) provided by planters to slaves. Made in Georgia after 1828.
Patroon	Eighteenth century term for ship captain, usually of coasting schooners, but also other vessels. Most often an African or African-American.
Pipe	In South Carolina, often used for any large barrel. Commonly a barrel for 116 gals of Port in traditional English "coopering."
Pirogue	In South Carolina and the Caribbean, a flat bottomed sailing vessel up to 60-70 feet in length in which construction strength is derived from three built-up logs as opposed to a keel and keelson assembly. Other local spellings: Pettiauger, Perryauger.
Pitch diameter	Diameter of a barrel at its widest point (usually the centre).
Port	Left side of vessel when facing the bow.
Puncheon	In South Carolina, both a barrel containing approximately 72 gallons of fluids, and a spiked length of wood, usually pine, driven into earth and mud to form a retaining structure for rice field dikes.
Rake timber	Squared timber used as internal framing for ramps of flats.
Rabbet	Groove or notch carved into a length of planking or a chine-girder on a flat to receive end or bottom planking.
Roller gin	Simple double roller type of gin used for separating cotton seed from Sea Island or long staple cotton lint.
Scantlings	General dimensions of a vessel and its component timbers.
Scarph	A shipwright's joint in which two timbers are joined by carving L-shaped ends which oppose and exactly match each other.
Sheerstrake	Uppermost run of planking on the side of a vessel or flat. The top of the sheerstrake is the gunwhale.
Sided	Shipwright's term for the "face" of a given construction timber facing the bottom planking of a vessel.
Starboard	Right side of vessel when facing the bow.
Strakes	Runs of planking on bottom and sides of a vessel.
Sweep	Long, oar-like steering device mounted on the stern of a flat or mountain boat.
Thole Pins	Vertical pins set into the gunwhale of a craft to hold oars in place.
Thwart	Or Transverse Plate or Transverse Timber. A timber running from side to side of a vessel or flat often used as a seat when running from sheerstrake to sheerstrake and often used to support planks on which the crew stand to pole the craft (sometimes called a spall), or for structural strength when set into the bottom of a flat.
Tierce	Historic period rice barrel ranging in weight from 450 - 600lbs. Commonly referred to as a provision cask in traditional English "dry coopering."

Treenail	Wooden peg or pin (usually cypress in South Carolina) used to fasten one timber to another or to hold tenons into mortises. Often round, sometimes crudely carved with six to eight faces and often "wedged" with wrought nails or shims and four sided spikes of harder wood (large thorns were used for this purpose in ancient European vessels).
Tup	Heavy squared log with handles on top and sides, used for ramming puncheons into soft soil.
Walking plank	Loose planks which rested on the stern and bow header logs of flats on one end and a gunwhale thwart or spall on the other. Used by crew of walk on while poling the craft.
Whitney gin	Invented by Eli Whitney in 1793 to separate cotton seed from upland or short staple cotton lint.

Appendix D: Barge-form Data Gathering Methodology

Barges, or rice flats, ferry craft and industrial barges all share many common features. The basic field measurement form below was therefore devised for this group of craft. This form has been developed by the author to enable sport divers and other interested members of the public to undertake the simple recording of these historic craft.

Measurement:

Your measurement technique may differ according to the nature of the recording environment and the condition of the vessel under study. In many cases, these craft are submerged, partially destroyed, or timbers severely reduced from original dimensions by erosion. In such cases, metric measurements should be taken since this system provides the easiest way of obtaining and recording a mean measurement. In some cases, the vessel remains in a complete condition, with timbers in an excellent state of preservation. In these cases, measurements can be made in English inches and feet, which may be closer to the system used by the original builders. The early English measurement system used by shipwright's was inches and eighths. Even so, you may want to use a tape with decimal feet and tenths (of feet) in order to provide easy conversion to metric measurement.

Site Map:

Prior to data gathering, each site should be mapped by making a general site plan including local road routes and major permanent landmarks in relation to the vessel remains. Bouys should be fixed either to each corner of the craft and each bouy located on the site map either by compass vectors (Brunton Compass) or, if available, a transit. If possible, try and add an "elevation" sketch, a sideways on view showing how the craft sits on the bottom, the nature of the bottom itself and the depth of the water above it. Bottom conditions will usually range from sands and gravels to mud, marl or rock. The wrecks are rarely level.

This data can then be transferred to a United States Geodetic Survey (USGS) map for the area and a more precise location for then the craft established. This is done using Universal Transverse Mercator (UTM) coordinates scaled off the grid on every USGS topographical map. It is a good idea to make an enlarged copy of

the area you are working in from one of these maps to simplify the mapping process.

Data to be gathered from each vessel should be collected in a programmed procedure commencing with "gross" or overall measurements and terminating in collection of as much minute constructional detail as circumstances permit. The form provided guides the recorder through this process. In many cases one or a combination of circumstances may prevent field recording to the ideal extent. These may range from lack of time to changing site conditions (tide) or factors such as the partial burial of sections of the hull. In such cases, if data gathering were terminated for one of these reasons, sufficient information will have been gathered to support a basic determination as to vessel type and function. In all cases, your data gathering should be non-invasive and designed to disturb the vessel's equilibrium with its context as little as possible. The basic purpose of initial recording is only to identify the craft and record of as much of the structure as possible, without causing the damage that results from extensive excavation.

Overall measurements of each vessel should be recorded first. These are length, breadth and depth. Next, the profile of the ramp, or rake of the bow, should be recorded by taking depths from the gunwhale down to the bottom of the craft at 0.10m (3.3in) intervals. Lightly tack your measuring tape along the gunwhale with the zero point starting at the nose rail or edged of the bow header log.

Plank-built barges:

In the case of flats constructed with planking, a table on the recording form assigns numbers to each plank with the sheerstrake as plank number one. Only one side and one end (bow or stern) needs to be recorded if the planking schemes match for the other sides. The thickness and the depth of each plank should be recorded. Scarphs or butt joints along each strake should be noted as to type, plank number and distance point from bow as measured along the tape tacked to the gunwhale. If scarphed, measurements should be taken to note the depth of the edges (nips) and the scarf table (flat or angled section between the nips). These measurements also then described the type of scarf, shiplap or otherwise. Depending upon construction technique, the end grain of the bow or side planking may be visible. In this case, the grain should be noted as it indicates how the plank was converted from the original log. Most early flats used heartwood, later ones used sap wood - the grain on the edge of the plank will show which type was used on your craft.

Chine-girder barges:

Chine-girder flats or barges may also be recorded by using a table for the most commonly encountered features. These are the width of the gunwhale, outside depth to turn of chine, inside depth to top of shelf, depth of shelf, depth of planking rabbet, width of planking rabbet and width of bottom. A standard moulding gauge should be used to recover the curvature of the chine at a pre-selected point along the tape on the gunwhale. If you record a cross section, try and do it at this same point. It is best to select the location of a cross spall or thwart for the cross section.

Interior:

Once the basic shape of the craft has been recorded, it is usually possible to determine if it is a rice plantation barge, a ferry flat, a phosphate barge or later industrial barge.

Interior features of each craft can then be recorded, commencing with bow construction features. First locate and measure internal members which either strengthen the construction or connect its frame together. These structural elements are called knees, battens, thwarts or spalls, stringers and ramp timbers. Knees are the "L" shaped timbers that support the sides and bottom of the craft when upright, the sides with the bow and stern when laid horizontally in each corner, and the sides and a deck on decked barges. Battens are straight, square cross section pieces of timber which are mounted upright on the chine stringer to support the side planking. Thwarts or Spalls are the timbers which cross the flat from gunwhale to gunwhale (usually above the "knuckle" or point where the ramps meet the flat bottom of the craft). The bottom stringers are the longitudinal timbers which run from bow to stern and support the bottom planking. The two stringers set in the corner where the side and bottom planks meet is called the chine-stringer. Ramp timbers are little more than a continuation of the bottom stringers and are the inner supports for the ramp planking. Many flats had "ceiling" planks which made a floor on top of the stringers. These are rarely found. If present, record length, width and thickness.

Details of bottom planking features should then be taken, noting athwartship or longitudinal planking. The number of planks forming the bottom and the width of each plank (often, not all planks are the same width). The pattern of fastenings used to attach the planks to the stringers should be measured when possible. Finally record the position and nature of rowlocks or thole pins, particularly at the ends of the craft, as these usually designate the stern. Locate them by using the tape along

the gunwhale. The stern thole pins or rowlock will be in the centre of the header log. Quite often these features are missing, but can be located by looking carefully for the remains of fasteners which held rowlocks in place, or drill holes in which the thole pins were placed. This feature is important as it indicates which end of the vessel is the stern.

Particular attention should be paid to types of fastenings used in the craft as these may provide good indicators of both age and craftsmanship. Earlier craft use far more treenails than later craft. Treenails can be made of round dowel, or of a length of wood shaved down to six or eight sides with a hatchet. Often the treenails are wedged with a shim to spread the end for better fastening strength. This is also done by driving a spike of hardwood or a metal nail into the end of the treenail. Nails can also be good indicators of age. Earlier vessels used wrought iron spikes and nails. These were often square headed or rose headed. Later craft were fastened with "cutnails" stamped from sheet iron or even more modern wire nails. Larger sections of wood, such as ramp timbers or knees, are often fastened with thick wooden dowels, or iron rod called "drift pins." The length and thickness of these fastenings should be recorded.

Most craft are made of pine planking, live oak framing and cypress treenails. Other woods from white oak to cedar were also used, if the types of wood are known, they should be recorded on the form.

Barge Recording Form 1						Date:
Site Information:		Site Name:				
Location:	State	County	River		Bottom Conditions:	
Nearest Road Routes:					Gravel	Y <input type="checkbox"/> N <input type="checkbox"/>
Site Map Y/N	Y <input type="checkbox"/> N <input type="checkbox"/>	Site Sketch Y/N		Y <input type="checkbox"/> N <input type="checkbox"/>	Sand	Y <input type="checkbox"/> N <input type="checkbox"/>
Landmarks: Match to site map		1	2	3	Mud	Y <input type="checkbox"/> N <input type="checkbox"/>
Vectors:	Bouy 1	Bouy 2	Bouy 3	Bouy 4	Marl	Y <input type="checkbox"/> N <input type="checkbox"/>
Landmark 1					Current	knots
Landmark 2					Tidal	Y <input type="checkbox"/> N <input type="checkbox"/>
Landmark 3					Vis	Y <input type="checkbox"/> N <input type="checkbox"/>
Vessel information:		Metric Y/N	Y <input type="checkbox"/> N <input type="checkbox"/>	Dec. Ft Y/N	Y <input type="checkbox"/> N <input type="checkbox"/>	
Length		Width		Depth		
Ramp Profile:	0 (Bow)	10	20	30	40	
	50	60	70	80	90	100
	110	120	130	140	150	160
	170	180	190	200	210	220
Planking	Port <input type="checkbox"/>	Starboard <input type="checkbox"/>	No of Strakes:			
Strake 1	Sided:		Moulded:			
Strake 2	Sided:		Moulded:			
Strake 3	Sided:		Moulded:			
Strake 4	Sided:		Moulded:			
Location of Scarphs: measure to leading edge from bow N=nip T= table						Scarph Type:
Strake 1	1	2	3	4	5	Shiplap:
Strake 2	1	2	3	4	5	Y <input type="checkbox"/> N <input type="checkbox"/>
Strake 3	1	2	3	4	5	Angled:
Strake 4	1	2	3	4	5	Y <input type="checkbox"/> N <input type="checkbox"/>
Measurement of Scarphs						Straight:
Strake 1	1 N: T:	2 N: T:	3 N: T:	4 N: T:	5 N: T:	Y <input type="checkbox"/> N <input type="checkbox"/>
Strake 2	1 N: T:	2 N: T:	3 N: T:	4 N: T:	5 N: T:	Diagonal Cut:
Strake 3	1 N: T:	2 N: T:	3 N: T:	4 N: T:	5 N: T:	Y <input type="checkbox"/> N <input type="checkbox"/>
Strake 4	1 N: T:	2 N: T:	3 N: T:	4 N: T:	5 N: T:	Butt Type:
Scarph Fasteners		Dowels	Y <input type="checkbox"/> N <input type="checkbox"/>	Drift Pins	Y <input type="checkbox"/> N <input type="checkbox"/>	Y <input type="checkbox"/> N <input type="checkbox"/>
		Diameter		Diameter		
Plank Fast:	Treenails:	Y <input type="checkbox"/> N <input type="checkbox"/>	Wrought Nails	Y <input type="checkbox"/> N <input type="checkbox"/>	Wire Nails:	Y <input type="checkbox"/> N <input type="checkbox"/>
Treenails:	Spiked	Y <input type="checkbox"/> N <input type="checkbox"/>	Wedge	Y <input type="checkbox"/> N <input type="checkbox"/>	Cut Nails	Y <input type="checkbox"/> N <input type="checkbox"/>
Plank end grain	Heartwood	Y <input type="checkbox"/> N <input type="checkbox"/>	Sapwood	Y <input type="checkbox"/> N <input type="checkbox"/>		
Wood Species	Pine	Y <input type="checkbox"/> N <input type="checkbox"/>	Other:			
Rub rail	Y <input type="checkbox"/> N <input type="checkbox"/>	Sided		Moulded		
Nose rail	Y <input type="checkbox"/> N <input type="checkbox"/>	Sided		Moulded		
Chine-Girder Craft						
Depth of girder		Width	At gunwhale		At shelf	
Planking rabbet:		Width	Depth			
Splash Boards: Y <input type="checkbox"/> N <input type="checkbox"/>		Sided	Moulded			

Barge Recording Form 2						
Interior Recording						
Cross Spalls	Sided		Moulded			
Location from Bow	Spall 1		Spall 2			
Add. spalls:						
Notched to Gunwhale	Y <input type="checkbox"/> N <input type="checkbox"/>		Fastened to blocks or battens			Y <input type="checkbox"/> N <input type="checkbox"/>
Knees:	Standard	No.:	Width:	Height:	Thick:	
Number:	Lodging	No.:	Width:	Height:	Thick:	
	Hanging	No.:	Width:	Height:	Thick:	
Location (measure to centre from bow)						
Standard	1:	2:	3:	4:	5:	6:
Lodging	1:	2:	3:	4:	5:	6:
Hanging	1:	2:	3:	4:	5:	6:
Knee Fasteners	Dowels		Y <input type="checkbox"/> N <input type="checkbox"/>	Drift Pins	Y <input type="checkbox"/> N <input type="checkbox"/>	
	Diameter			Diameter		
Floor Thwarts						
1 Sided	2 Sided	3 Sided	4 Sided	5 Sided		
1Molded	2 Molded	3 Molded	4 Molded	5 Molded		
Location (measure to centre from bow)						
1:	2:	3:	4:	5:		
Stringers:						
Location: Measure location from side to centre of each stringer. From:					Port	Star'b
Stringer No:	1:	2:	3:	4:	5:	6:
1 Sided	2 Sided	3 Sided	4 Sided	5 Sided	6 Sided	
1Molded	2 Molded	3 Molded	4 Molded	5 Molded	6 Molded	
Ramp Supports						
					No. of Supports:	
Support No:	1:	2:	3:	4:	5:	6:
1 Sided	2 Sided	3 Sided	4 Sided	5 Sided	6 Sided	
1Molded	2 Molded	3 Molded	4 Molded	5 Molded	6 Molded	
Stern Rowlock	Y <input type="checkbox"/> N <input type="checkbox"/>	Thole Pins	Y <input type="checkbox"/> N <input type="checkbox"/>	Diameters		
Side Rowlocks	Y <input type="checkbox"/> N <input type="checkbox"/>	Diameters				
Ceiling Planking						
Sided			Moulded			
Bottom Planking						
Random widths			Y <input type="checkbox"/> N <input type="checkbox"/>	Width 1	Width 2	Width 3
Bits	Y <input type="checkbox"/> N <input type="checkbox"/>	Mooring rings	Y <input type="checkbox"/> N <input type="checkbox"/>			
Bilge Pump	Y <input type="checkbox"/> N <input type="checkbox"/>					
FORM:	Newell 1989					
Mail: 826 Georgia Ave. North Augusta SC 29841						
Phone (803) 278-4855						
-30-						