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UNDERWATER REMOTE SENSING SURVEY DOG RIVER, MOBILE COUNTY, ALABAMA

FINAL REPORT

February 2001

Panamerican Consultants, Inc.
15 South Idlewild Street
Memphis, Tennessee 38104
Contract No. DACW01-00-P-0702

PREPARED FOR:

U.S. Army Corps of Engineers
Mobile District
109 St. Joseph Street
Mobile, Alabama 36628

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14. ABSTRACT
During the fall of 200, archaeologists from Panamerican Consultants, Inc (PCI) conducted remote-sensing investigations in the Dog River, Mobile County, Alabama, as part of the U.S. Army Corps of Engineers, Mobile District's project entitled Underwater Remote Sensing Survey, Dog River, Mobile County, Alabama. Project plans call for the dredging of an area 100 feet wide in the center of the navigation channel. The project area consists of several corridors 100 feet in width and ranging in length from 500 feet to 8000 feet. The remote-sensing survey located seven anomalies in the project area. Of these seven anomalies, four did not meet the accepted criteria of 50 gamma strength over 80 feet duration. Two more met the criteria, but were close enough in proximity that they were treated as a single anomaly cluster rather than distinct individual anomalies. Finally, one anomaly had characteristics representative of a pipeline, but a historical records search revealed no known pipeline in the area of the anomaly. This anomaly and the aforementioned anomaly cluster are both recommended for further investigation via probing or diver inspection.

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Remote-sensing magnetometer survey of Dog River, Mobile Harbor, Alabama; seven anomalies identified, one anomaly and one anomaly cluster recommended for further investigation.

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Contract No. DACW01-00-P-0702

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February 2001

ABSTRACT

During the fall of 2000, archaeologists from Panamerican Consultants, Inc. (PCI) conducted remote-sensing investigations in the Dog River, Mobile County, Alabama, as part of the U.S. Army Corps of Engineers, Mobile District's project entitled *Underwater Remote Sensing Survey, Dog River, Mobile County, Alabama*. Project plans call for the dredging of an area 100 feet wide in the center of the navigation channel. Implemented by the Corps in partial fulfillment of their obligation under the National Historic Preservation Act of 1966, the current remote-sensing survey was designed to determine the location, if present, of any targets that might represent potentially significant cultural resources or sites in the form of historic shipwrecks that might be adversely affected by the proposed project. The investigation included an intensive remote-sensing survey using a magnetometer. The project area consists of several corridors 100 feet in width and ranging in length from 500 feet to 8000 feet.

The remote-sensing survey located seven anomalies in the project area. Of these seven anomalies, four did not meet the accepted criteria of 50 gamma strength over 80 feet duration. Two more met the criteria, but were close enough in proximity that they were treated as a single anomaly cluster rather than distinct individual anomalies. Finally, one anomaly had characteristics representative of a pipeline, but a historical records search revealed no known pipeline in the area of the anomaly. This anomaly and the aforementioned anomaly cluster are both recommended for further investigation via probing or diver inspection.

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1. INTRODUCTION

On October 12, 2000, archaeologists from Panamerican Consultants, Inc. (PCI) conducted a magnetometer survey on the Dog River, Mobile County, Alabama. This remote-sensing survey was conducted by PCI for the U.S. Army Corps of Engineers, Mobile District. The project, entitled *Underwater Remote Sensing Survey, Dog River, Mobile County, Alabama*, was performed specifically under Contract No. DACW01-00-P-0702 for the Mobile District. This work is in partial fulfillment of the District's obligations under the provisions of Section 106 of the National Historic Preservation Act of 1966, as amended through 1992 (36 CFR 80, Protection of Historic Properties), and the Abandoned Shipwreck Act of 1987.

The area examined during the study is located in the lower reaches of the Dog River, and consists of several corridors 100 feet in width and ranging in length from 500 feet to 8000 feet (Figure 1). The coordinates of the project area are listed in Table 1.

Table 1. Coordinates for the Project Area.

Easting	Northing	Comment
1774974	215723	Rabbit/Hall's Mill Creek start
1772543	214984	Rabbit Creek end
1773814	216402	Hall's Mill Creek end
1774935	219354	Dog River start
1780885	223008	Dog River end
1775445	222573	Moore Creek end

The remote-sensing survey included the employment of those tools useful in determining the presence or absence of submerged cultural remains (i.e., shipwrecks) within the project area. As detailed in the Technical Proposal, which was developed and accepted for the project prior to the implementation of fieldwork, remote-sensing equipment employed during the survey included a magnetometer, fathometer, and a differential global positioning system (DGPS). Recorded magnetic anomalies were prioritized as to their probability of representing historic shipwreck remains based on characteristics such as anomaly strength and duration.

The remote-sensing survey located seven anomalies within the entire project area. This number includes four anomalies which did not meet established magnetic strength and duration criteria for the anomaly to represent a shipwreck, and two anomalies that were close enough in proximity to each other to be treated as a single cluster. Another anomaly had magnetic characteristics that resembled a pipeline, but no historical records as yet located indicate the existence of a pipeline. After evaluation of the collected data, it was determined that one of the located anomalies and the located anomaly cluster have the potential to represent submerged cultural resources and, accordingly, are recommended for further investigation via probing or diver inspection.

The following report, which describes in detail the methods and results of the investigation, is divided into chapters on Prehistoric and Historic Background, Investigative Methods, Results, and Conclusions and Recommendations.

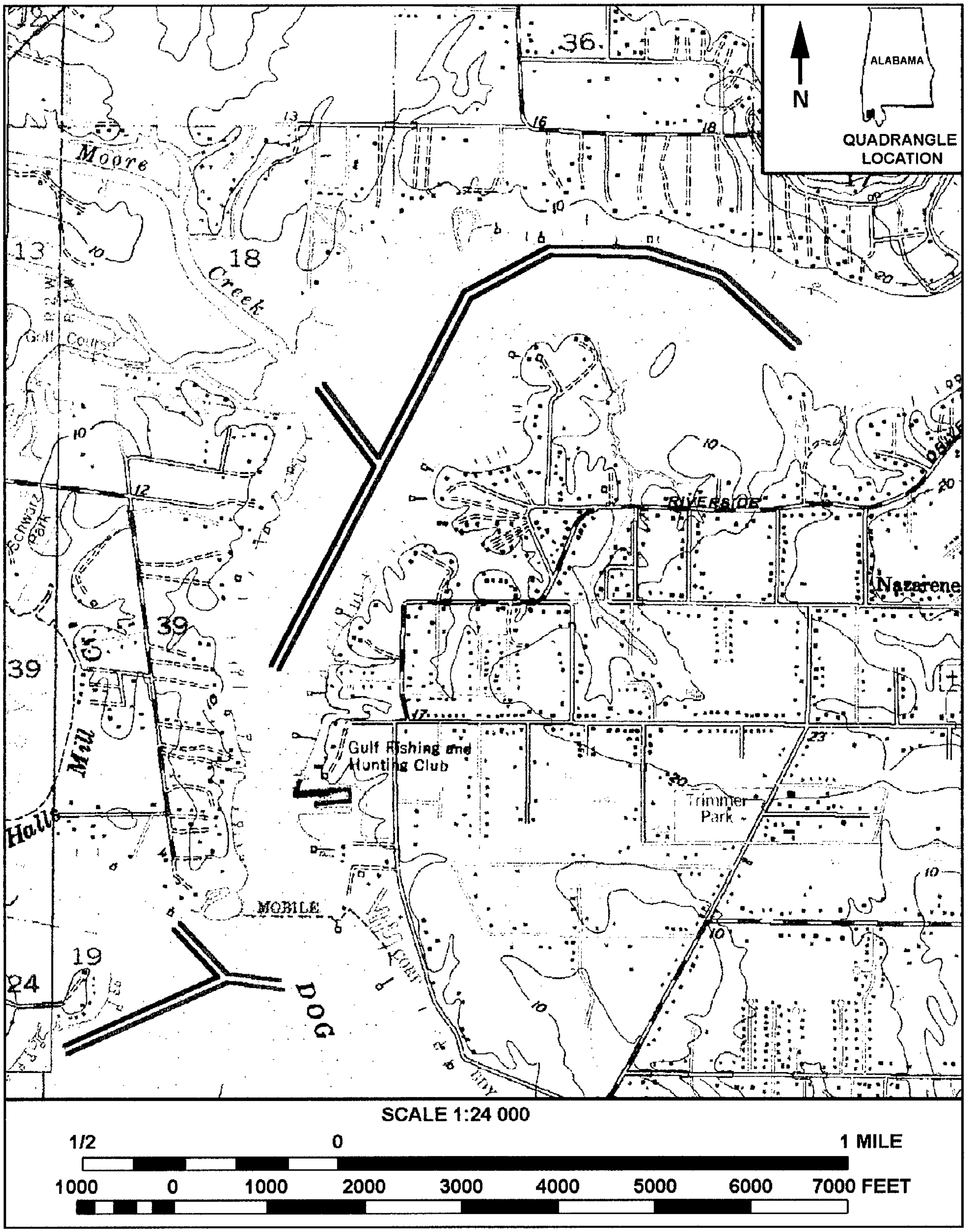

Figure 1. Project area map (base map: 1953 U.S.G.S. Hollingers Island, AL 15' quadrangle [photorevised 1982]).

2. PREHISTORIC AND HISTORIC BACKGROUND

Prehistoric Background

It is generally accepted that the first people to enter North America traveled overland across what is now the Bering Strait on a land bridge that formed when vast quantities of the Earth's water were concentrated in glacial masses. The warming trend that began at the end of the Pleistocene epoch and continued through the early Holocene melted glacial water, causing sea levels to rise. That rise in sea level coincided with the arrival of the earliest peoples in the Americas and presumably the earliest arrivals to the inundated prehistoric river valley that extended out onto the continental shelf in the Gulf of Mexico and lies below the present Mobile River Delta and Mobile Bay.

Earliest Arrivals

The arrival of prehistoric peoples to the northern Gulf Coast is considered to have occurred between 25,000 and 10,000 years before present (B.P.). Within a geologic time frame, this falls within the late Pleistocene or early Holocene epochs. Sea levels fluctuated significantly during these periods and reached sufficiently low levels to expose the continental shelf to a point as much as 100 kilometers south of the present Gulf shoreline. All of what is now Mobile Bay and the Mobile River Delta is considered to have been above sea level at the time when aboriginal peoples representing the Paleoindian and Archaic periods first arrived in the region.

Specific evidence of early human presence in the Mobile Bay area dates to the Early Archaic stage. This evidence is in the form of distinctive Dalton, Hardaway, and Big Sandy projectile point types recovered from upland areas (Trickey and Holmes 1971:124). The accurate dating of those projectile types at other locations has provided a comparative date of 9,000 to 10,000 years B.P. for the minimum earliest arrival of man in the Mobile area. These upland sites have been interpreted as former hunting-foraging stations used on a seasonal basis by Archaic nomadic bands. By 3,000 years B.P. the general geomorphology of modern Mobile Bay had formed and the lower bay area had become the focus of a somewhat sedentary aboriginal occupation with notable utilization of oysters as a food resource. While aboriginal material culture and society changed through time, the exploitation of rich estuarine food resources was characteristic of the prehistoric period.

Archaeological materials pre-dating 10,000 years B.P. remain to be located in the Mobile area and are presumed to lie within areas now inundated by changes in sea level. Evidence such as fluted projectile points indicative of a Paleoindian presence have been located in nearby Escambia and Covington counties (Futato 1982). If Paleoindians were present in the Mobile area before 10,000 years ago, the evidence of their presence may be expected near water and estuarine food resources that, at that time, were perhaps most abundant along waterways at the bottom of the now inundated valley that lies under Mobile Bay and the Mobile River Delta (Trickey and Holmes 1971:124).

At present, however, no submerged prehistoric cultural resources have been documented in the Mobile Bay area. That submerged prehistoric sites should be present is not argued. The archaeological community has established that prehistoric materials can be found within sites that are below sea level (Emery and Edwards 1966, Salwen 1967, Bullen 1969, Powell 1971). Indeed, the area of the continental shelf between the relict terraces bordering Desoto Canyon offshore and the current shoreline has been identified by Coastal Environments (1977) as a high probability zone for the presence of such sites. Of interest here, it has been further argued by Mistovich and Knight (1983) that prehistoric occupation may have occurred virtually anywhere within the present confines of Mobile Bay.

Archaic Period

While the presence of Paleoindian materials is theorized as highly probable in the Mobile area and Early Archaic materials have been documented nearby, there is a relative scarcity of Early and Middle Archaic materials that have been found in abundance in other areas of the Gulf Coastal Plain. It is uncertain whether this lack of representation is merely due to a gap in the recovered and published data, or whether there was an actual low population presence in the area possibly related to local climate. As with the Paleoindian evidence, these sites may exist submerged and buried under Holocene sediments (Mistovich and Knight 1983:9). There have been found, however, small quantities of fiber tempered ceramics that may have affiliation with either the Wheeler or Norwood ceramic series that compare with suggested dates of 1200 to 700 B.C. The significance of those ceramic finds may lie in the location of some at estuaries rather than at inland or river environments. This significance lies in the importance of estuarine food resources successfully exploited by subsequent groups.

Woodland Period

The Early Woodland period followed the Late-Archaic and continued until about the year A.D. 1. The Early Woodland is well represented in the archaeological record and is identified in the Mobile area by the Bayou La Batre ceramic series, which encompasses the Mobile River Delta and Mobile Bay areas (Wimberly 1960:64-74). The Bayou La Batre ceramics are characterized by coarse grit tempers with tripodal and tetrapodal bases decorated with shell impressions and scallop shell rocker stamping (Trickey and Holmes 1971:126). The culture represented by the Bayou La Batre ceramics series is shown by extensive archaeological evidence to have exploited the fish and shellfish of the Bay area; the estuarine environment was a major, if not the primary, source of subsistence. Mistovich and Knight point out that the archaeological evidence, both the subsistence materials recovered and the presence of Bayou La Batre materials on Dauphin Island, "strongly suggests the development at this time of a watercraft technology accompanying the estuarine economic orientation of these peoples" (1983:10). While there is no direct evidence for the development of prehistoric watercraft technology in the Mobile area at this time, it is indeed strongly suggested and implies a potential for aboriginal sites at any location within the estuarine environment following its introduction.

The Middle Woodland period is characterized by Porter phase ceramic types. Present from roughly A.D. 1 to 500, it has been suggested that the Middle Woodland peoples of the Mobile area had a cultural continuity with the peoples that produced the preceding Bayou La Batre ceramic series as well as influence from the Santa Rosa culture to the east (Wimberly 1960, Walthall 1980:156). While estuarine exploitation continues in this period, it is also characterized by the appearance of inland settlements that might be described as villages and by the presence of some burial mounds. Excavations in these mounds have shown artifacts which suggest the widespread exchange of trade goods at this time with both the Santa Rosa culture and the Marksville culture in the west, perhaps in part due to the extensive river connection with the interior (Wimberly 1960:12-30, Wimberly and Tourtelot 1941, Walthall 1980:161).

Widespread interaction between groups on the Gulf Coast during the Late Woodland period of A.D. 400 to 800 was evidenced by material from a mound excavated on the eastern shore of Mobile Bay at Starkes Wharf at the turn of the century (Moore 1905:287). Similar evidence was recovered at excavations by the Alabama Museum of Natural History at other mounds on the Fort Morgan Peninsula in 1937 (DeJarnette and Buckner 1937). The interaction between Gulf Coast peoples was shown by the similarities between the Tates-Hammock phase pottery of this time, which resemble the earlier Santa Rosa, and the Weeden Island sand tempered ceramics of Florida (Walthall 1980:171-2). Overall, the period was similar to the preceding, with mortuary and village patterns and considerable exploitation of estuarine food resources as evidenced by substantial shell middens. That agricultural development is not yet clearly evidenced and Late Woodland society shows no clear signs of developing a social hierarchy may be due to the reliable and abundant food resources available in the Mobile Bay area.

Mississippian Period
Significant changes occurred when the Woodland was replaced by the Mississippian culture about A.D. 900, lasting until European influence reached the Americas. Distinctive new pottery forms were introduced, as well as major social changes evidenced by the construction of cultural centers of earthen platforms surrounding a central plaza. The Mississippian also introduced the bow, floodplain horticulture, ceremonialism, long distance trade, organized chiefdoms, and increased warfare (Walthall 1980:185). Walthall (1980) has suggested that the changes were gradual, supplanting existing local groups through acculturation and internal development rather than by invasion and displacement. In the Mobile area, Mississippian culture is most profoundly expressed in the Bottle Creek site, a large ceremonial mound complex located in the very center of the Mobile River Delta, an area curiously subject to annual flooding (Curren 1976:79). The Bottle Creek site has been dated to A.D. 1250-1600, with the last 150 years associated with a later manifestation of the Pensacola culture identified as the Bear Point complex.

Transitional Period
The proto-historic period for the native inhabitants of the Mobile area is poorly documented, although some collections exist from Fort Conde as well as the site of an early French warehouse on Dauphin Island and from the D'Olive site (Harris and Nielsen 1972, Knight 1976, and DeJarnette 1976). The contact period ceramics from those sites reflect the arrival of new people who introduced non-indigenous forms with western influences (Knight 1976:145).

The thousands of years of cultural change and adaptation to the Mobile environment abruptly ended during a relatively short period following the arrival of European colonists in the eighteenth century. The local cultures had already been affected by the shock of Spanish expeditions through the southeast and had undoubtedly suffered from European diseases brought directly by the Spaniards or contracted through other indigenous peoples. When a European colony was finally established in the Mobile area, the native cultures were rapidly displaced. Eventually the remaining communities of native tribal peoples were forcibly removed to what was once known as the Indian Territory of Oklahoma (Walthall 1980:275).

The prehistoric period of the Mobile Bay and Mobile Delta area is acknowledged to be poorly understood by the archaeologists and anthropologists most closely associated with its study (Knight 1976). The limited knowledge about the peoples who inhabited this region for thousands of years is due in part to both the lack of systematic surveys for the area and a scarce number of detailed excavations with published reports.

Historic Background

The historic era for Mobile Bay began with the exploratory voyage of the Spaniard Alonso Alvarez de Pineda in 1519. Sailing from Jamaica with four ships, Pineda became the first recorded European to enter Bahia del Espiritu Santo (or Spirito Sancto), the name given to Mobile Bay by Pineda. The Pineda expedition, ordered by the Spanish Governor Garay of Jamaica, mapped the bay and described its inhabitants. This expedition is accepted as the first thoroughly documented exploration of that body of water (Scaife 1892:149). Other Spanish voyagers are known to have sailed the Gulf Coast west of Florida in the second and third decades of the sixteenth century, including Juan Ponce de Leon and Diego Miruelo.

The Era of Exploration
It is possible that the northern coast of the Gulf of Mexico, including Mobile Bay, was explored by unknown parties before any of the recorded expeditions. The earliest period of exploration during the very late fifteenth century and the first decade of the sixteenth century is, however, characterized by a scarcity of documentation for perhaps a majority of those involved in the enterprise. That the area may have been explored prior to any documented expeditions is seen as possible in some of the earliest maps of the Americas. The maps of La Cosa (1500), Cantino

(1502), Caniero (1502), and Waldseemuller (1507) each contain elements which indicate a knowledge of the Florida peninsula and the gulf coast to the west. It has been suggested by Summersell (1949:frontispiece) that a bay depicted by Waldseemuller represents Mobile Bay. While it is possible that unrecorded early voyages of exploration of the area did occur, it has been pointed out that in that earliest era of exploration claims were still being made that the new lands were the fringes of the Orient, which Columbus claimed to have discovered, and that those early maps may have depicted the southwest coast of Asia as it was known from overland journeys preceding the Columbian voyages (Fite and Freeman 1926:16, 26, 34).

Regardless of whether the early maps depicted geographic knowledge brought back from the New World or were merely misplaced representations of old knowledge, there is evidence for the unrecorded presence of early voyages on the Gulf Coast. As early as 1513 an expedition by Ponce de Leon recorded encountering a Spanish-speaking Indian on a voyage to Florida. Additionally, Narvaez recorded the presence of European objects in the possession of Indians in northern Florida who related that the objects had originated in the Apalachee area in the Florida panhandle (Smith 1971:56-58).

Following the Pineda expedition of 1519, the next two Spanish groups to visit Mobile Bay were the Narvaez and Maoldanado expeditions. Panfilo de Narvaez apparently stopped at Mobile Bay in October of 1528 while navigating toward Mexico on makeshift boats following an ill-fated expedition to the east. Narvaez was met by a force of natives who may have retained two of the expedition members as captives following an aborted effort by the Spaniards to obtain water (Cabeza de Vaca 1871:55-60, Smith 1968:242, Nuzum 1971:26). The Narvaez visit to Mobile Bay was brief and it appears that the two lost members of the expedition may have been the only ones to go ashore. In 1540 Francisco Maldanado may also have stopped at Mobile Bay with several brigantines during an effort to meet and resupply the expedition of Hernando De Soto. The failure of these early expeditions to the northern Gulf Coast to locate any easily obtainable wealth contributed to a general lack of interest in the region by Spaniards who were more profitably occupied elsewhere.

There was a delay of 18 years before further interest in the area brought another Spanish expedition. In 1558 Guido de Las Bazares was sent from Vera Cruz, Mexico with three small vessels on an expedition to examine the northern Gulf coastline for the purpose of locating an appropriate site for the establishment of a colony. Bazares explored the Bay and wrote a favorable account of the area. From his description, it is clear that the expedition had explored Mobile Bay (Hudson et al. 1989:124). The Bazares account gave considerable attention to navigational advantages, noting details concerning the entrance to the bay, water depths within the bay, and a favorable anchorage. Additionally, the Bazares account of the land emphasized the abundance of specific tree species suitable for the building of ships. Among observations recorded concerning the native inhabitants, Bazares noted that the Indians were on the bay in large canoes and that they used fish traps (Nuzum 1971:29).

Despite the glowing account given the Mobile Bay area by Bazares, the colonization fleet that set out the following year selected another location. The Tristan de Luna y Arellano expedition of 1559 set sail with 13 vessels, 1,000 colonists and servants, 500 soldiers, and 240 horses (Hudson et al. 1989:124). Missing their intended destination, the de Luna fleet did, temporarily, put into Mobile Bay where they remained from July 17 to August 14 while a vessel was sent in search of the bay intended for the location of the colony. This was to be the largest group of Europeans to enter the bay for some decades. Archival evidence indicates that the de Luna colony was established on Pensacola Bay although the actual site has not yet been discovered (Hudson et al. 1989:126). When the expedition departed Mobile Bay, some men were left on the eastern shore to travel overland with all of the surviving horses. Following an early loss of vessels and supplies to a hurricane, unprofitable excursions into the interior, and periods of starvation, the colony at Pensacola failed and was all but abandoned by 1561.

For more than a century following the de Luna colonization attempt, the central Gulf Coast and the Mobile area were virtually ignored by the Spanish. Content with possessions in Florida and the western Gulf, the Spanish maintained nominal possession of the central Gulf Coast but failed to explore further or attempt colonization until foreign competition sparked renewed interest more than a century after the failure of the de Luna colony. That the Spanish had little contact with the Mobile Bay area during this period is reflected in the paucity of archaeological evidence for sixteenth century contact which, at present, is limited to a single mid-sixteenth century coin of Mexican origin found at the Shellbanks Bayou Site (Lazarus 1965).

The Colonial Era

The European return to the Mobile area began with a renewed interest in the central Gulf Coast stimulated by the failed effort of Rene-Robert Cavelier, Sieur de La Salle, to expand the area claimed by the French Crown for the territory of Louisiana. In 1685 LaSalle attempted to establish a colony on Matagorda Bay in what is now eastern Texas after failing to find the mouth of the Mississippi River, down which he had previously traveled. Although the colony in coastal Texas soon failed and LaSalle lost his life in the attempt, the French interest in a territory that the Spanish regarded as their own stimulated a renewed effort by Spain to explore and consolidate their hold on the central Gulf Coast that they had long ignored.

The French Period

The French attempt to secure control of the southern terminus of the Mississippi River system was soon renewed. In 1698 an expedition sailed under the command of Pierre Le Moyne, Sieur de Iberville, to locate the mouth of the Mississippi River. The Iberville expedition was to begin another colony to secure access through the Gulf of Mexico to the vast French territory of Louisiana. Finding that the Spanish had recently established a new foothold at Pensacola, Iberville sailed west, explored Mobile Bay, and then continued on to establish a base at Biloxi.

Permanent European settlement of the Mobile area began as a result of the efforts of Iberville's younger brother Jean Baptiste Le Moyne, Sieur de Bienville, to move the colony to Mobile Bay, a location considered by Bienville to have conditions better suited to maritime trade. French colonization efforts on Mobile Bay began in 1702 with the establishment of Port Dauphin, on Dauphin Island near the entrance to Mobile Bay, and with the founding of the colony's capitol on relatively high ground, known as 27-Mile Bluff, on the Mobile River. The French built a wooden stockade near the river and named it Fort Louis de la Louisiane in honor of King Louis XIV. From an early point, the settlement was popularly given the more geographically specific name of Fort Louis de la Mobile after the name of a local Indian tribe (Foscue 1989:94).

At the time the colony was established, the entrance to Mobile Bay had a depth of over ten feet at low tide and could accommodate all but the largest vessels. These found an anchorage in the protected waters of a main harbor established at Pelican Bay, an anchorage protected by barrier islands on the Gulf side of Dauphin Island near the mouth of the Bay (McWilliams 1981:40, Surrey 1916:40). From there, passengers and supplies were off-loaded to Port Dauphin and then carried aboard smaller vessels to Fort Louis 60 miles through the bay and up the Mobile River. The products of the colony were similarly lightered down to Port Dauphin for export. Coastal trade in small vessels, often locally built, expanded the commerce (Surrey 1916:55-81). The early maritime trade of the French colony included the immigration of colonists and slaves, the importation of supplies and trade goods, and the exportation of natural resources and agricultural products (Surrey 1916:164).

The main settlement at Fort Louis was abandoned in 1711 in favor of the present location of the City of Mobile at Choctaw Point. This new location was free of the flooding that the site at 27-Mile Bluff had been subject to, and additionally, reduced by half the distance to the growing settlement at Port Dauphin. The settlement on Dauphin Island, however, was abandoned by the French in 1719 after being devastated by a hurricane, and by shoaling at the entrances both to

Pelican Bay and Mobile Bay that forced the larger vessels to anchor in the open water of the Gulf in order to discharge or receive cargoes (Summersell 1949:2). The French capital was moved to Biloxi in 1720, and then again to New Orleans in 1722. Mobile continued to export the natural resources of the region throughout the remainder of the French period in Alabama, but without remarkable commercial success. Despite the loss of its former prominence as a seat of government and commercial center, Mobile remained important as a military outpost and population center and as a focal point for Indian trade (Hamilton 1910:102).

During the French period, navigation on the rivers, the bay, and along the coast was developed and expanded. Inland commerce of this period, largely carried on with the local Indian population, relied on small vessels that could be rowed, punted, or towed and included open flat boats (pirogues or bateaux) and small decked vessels (galere). Bay navigation and coastal trade was carried on in sailing vessels (barques and brigantines) that generally carried less than 50 tons of cargo. These coasting vessels made voyages to ports as distant as Cuba and Mexico. The ships that brought supplies from France and carried away the exports were not much larger than the coasting vessels during the first few years of the colony. By 1720 vessels over 100 tons burden were standard and by the end of the French period, ships of as much as 700 tons were involved in the Mobile trade (Surrey 1916:70,78). Exports were largely restricted to furs traded from the Indians during the first few years of the French period, but gradually grew to include salted beef, cattle, hides, tallow, ship masts and lumber, tar and pitch, corn, rice, tobacco, indigo, sassafras, cotton, and quinine (Surrey 1916:164-166, Hamilton 1976:290).

The British Period

Following the French and Indian War, the Treaty of Paris gave the French territories east of the Mississippi River to Great Britain. When Mobile was taken over by the British, it was incorporated into the administrative district of West Florida. Maritime commerce expanded under British rule. Better charting and increased knowledge of the entrance to Mobile Bay allowed a return of deep draft vessels to a protected anchorage, now in the lower bay rather than south of Pelican Island. The return of major shipping allowed the commerce of the city to flourish. Access to the lower bay still, however, required lightering of the cargoes of larger vessels to and from the city due to the shallowness of the upper bay (Delaney 1962:43).

Commerce focused on the export of products obtained in trade with the local Indian tribes, primarily hides and pelts as during the French period. Most of the Indian trade materials came from the interior which, north of the district border, was closed to colonists and reserved by the British for the indigenous population. While animal skins remained the dominant export product, a greater emphasis was placed on the production of timber, naval stores, and indigo. Another product which began to be recognized for its export potential was cotton, later to become the dominant agricultural product of the entire region (Hamilton 1976:290). During the French period, trade had been a government monopoly, while under British rule, trade was conducted by private enterprise with a resultant increase in capital for local expenditure and investment (Delaney 1962:41).

The Spanish Period

During the American Revolution, both Spain and France were allied with the Americans against the British. At the instigation of American revolutionaries the Spanish governor of Louisiana, Don Bernardo de Galvez, sailed in the winter of 1780 with a force of 2,000 soldiers to attack the British garrison at Mobile. Following a siege of 14 days, the British surrendered the city to the Spanish forces. Galvez then spent a year at Mobile in preparation for an assault on Pensacola, the British capitol of West Florida. During this period of preparation, a fort was constructed next to the Blakeley River east of the Mobile River Delta. The British launched an unsuccessful attack against the fort in January of 1781 and retreated back to Pensacola. In May of 1781 Galvez captured Pensacola, returning to the Spanish crown control of the Gulf Coast from Mexico to Florida (Harris 1977:50-51).

Although the commerce of Spanish Florida and the Gulf Coast port of Mobile suffered under a return to a system similar to that which had existed under the French, the colony was now nearly self-sufficient (Mistovich and Knight 1983:17). Trade with the native Indian tribes continued and the exportation of furs and hides remained a dominant part of overseas trade. Much of that trade was in the hands of a British trading firm that maintained a virtual monopoly with several tribes and imported vast quantities of British goods to exchange for the Indian furs and deer hides (Hamilton 1910:352-353). It was during this period of Spanish rule that the cotton gin was invented and introduced to the area.

During the Spanish period, Americans began settling in Spanish west Florida and in the new United States territory to the north. By necessity, these settlers exported produce and received supplies through Mobile as the port city at the terminus of the Tombigbee, Alabama, and Mobile Rivers. Resentment by the American settlers of heavy Spanish import duties may have been a contributing factor to the United States' annexation of west Florida during the War of 1812.

The American Era

The city of Mobile became part of the United States during the War of 1812 following annexation of the district by Congress on the pretense that Spain was then a military ally of England, with which the United States was at war. It was, however, almost a year after the annexation before American forces actually occupied Mobile. The American presence in Mobile was soon threatened by British military actions. In 1814 American forces at Fort Bowyer, established on Mobile Point in 1813, were involved in combat with a British naval expedition. The American forces repulsed the attack and received credit for the destruction of the HMS *Hermes* at the entrance to the bay. The British returned in 1815, following the Battle of New Orleans, with 38 warships and 5,000 troops. This second British assault captured the fort, but the forces were withdrawn after it was learned that the Treaty of Ghent, which ended the war, had been signed before Fort Bowyer had been taken. Construction of present-day Fort Morgan was begun in 1818 on Mobile Point at a location immediately northeast of Fort Bowyer.

Following the War of 1812, the American era for Mobile was the start of a half-century of economic prosperity. The dissolution of the international border north of Mobile opened the second largest watershed in the southeast to free trade under one nation. Substantial numbers of new settlers arrived from the Atlantic states. The government obtained land through Indian treaties, and this opened most of the state of Alabama for settlement (Royce 1899). The arrival of steamboats in 1819 opened the vast inland waterways to practical two-way navigation. When Alabama was granted statehood in 1819, Mobile was rapidly growing as an international port, soon to rival New Orleans for supremacy as a center of commerce on the Gulf Coast.

The influx of settlers opened new land to the cultivation of export crops and led to the establishment of many new towns. Less than five years after the American annexation of Spanish West Florida, the town that was to become Tuscaloosa was founded on the Black Warrior River. Demopolis was established near the confluence of the Tombigbee and Black Warrior Rivers, and Montgomery, Selma, and Claiborne were settled on the Alabama River. Each of these towns took advantage of the transportation opportunities that placement on a navigable river provided (Summersell 1949:16).

The first steamboat built in Alabama was the *Alabama*, built at the city of St. Stephens in 1818. While the *Alabama* was the first steamer on the rivers of the state, making a trip down the Alabama and Mobile Rivers to Mobile, it was, however, insufficiently powered to make the return trip upriver. The first successful river steamer built in Alabama, by Brown and Bell at Blakeley, was the *Tensas,* a 60-ton single deck sternwheeler with a shed-like cover that could carry about 200 bales of cotton. The *Tensas* had a long and active career and was the first steamer to ascend the Alabama River, arriving at Selma after a pioneering voyage that took 23 days in the spring of 1822 (Hardy 1879:168, Brannon 1935:5).

Steamboats steadily increased in capacity, speed and reliability, although the formative years of the trade were filled with disasters such as boiler explosions, fires, and sinkings that resulted in considerable loss of life and property. Many of the early disasters were due to negligence or incompetence. Federal, state, and local legislation concerning the inspection, certification, and operation of steamboats was slow in effective development in most areas. An adequate system of federal regulation was not passed until 1852, preceded by a largely ineffective act in 1838. Alabama, however, had an advantage over most areas in that the navigable rivers of the area were within the state borders and virtually all of those rivers ultimately came together at the port of Mobile. With an inland navigation system largely separate from other areas of inland navigation, it was possible for the steamboat laws of Alabama to be effective. Similar laws elsewhere did exist, but were largely ineffective due to the extended lengths of rivers, such as the Mississippi and Missouri that passed through a number of different states and territories. The Alabama General Assembly was able to pass a law as early as 1826 requiring the annual inspection and certification of steamers by the harbormaster and port wardens of Mobile. In 1840, legislation passed by the Alabama State legislature provided penalties relating to boiler explosions and losses caused by overloading. In the following year, the legislature passed laws providing for the examination and licensing of engineers that included penalties for both steamboat engineers and owners who failed to comply (Hunter 1949:521-524).

Prior to the introduction of effective steamboats, river traffic was primarily conducted on keelboats and flatboats. While keelboats could make the round trip from farm or plantation to port and back, it was a slow and labor intensive process. Flatboats were simply constructed and often made only a downriver run, being sold for lumber after discharging their cargoes. Before steam navigation became effective, planters would send their produce downriver to Mobile, but because of the difficulty of upriver navigation, would generally receive their supplies overland, another slow and expensive process (Abernathy 1922:74-75). The rapid development of the agricultural economy of the interior was due, in large part, to the introduction and development of steam navigation on the rivers. It was primarily cotton as a high value export crop that brought in the revenues that supported the development of the river steamers.

The ascendancy of cotton as a profitable export product provided revenues that helped finance the development of steam navigation. Steam navigation, in turn, provided the means for a genuine reciprocal trade between Mobile and the interior (Mistovich and Knight 1983:18). Cotton, while the most significant export in the antebellum era, was not the sole product of the interior or the only export from Mobile; lumber and naval stores were also exported in some quantity (Summersell 1949:23). Overseas trade from Mobile, however, continued to suffer from the shallowness of the waterways between the city and the Gulf. Larger oceangoing vessels were still required to anchor in the lower bay and transfer imports and exports via smaller vessels.

To alleviate the navigational problems that faced the port of Mobile, the first of many congressional appropriations was made in May of 1826 for harbor and channel improvements. This appropriation and subsequent federal moneys were used for an expanding series of improvements to navigation that included an opening at Pinto Pass and the dredging of a channel through the Dog River bar. Following a final antebellum appropriation in 1857, a continuous channel 10 feet deep was maintained from the lower bay to the city (Bisbort 1957, Delaney 1981:89, COE 1915:1840-1841). The antebellum improvements made by the federal government did much to improve navigation, but did not fully open the city docks to oceangoing vessels. These improvements did stimulate the commerce of the city of Mobile and contributed to the decline of Blakeley as a rival port (Mistovich and Knight 1983:19). A navigational improvement by private enterprise that stimulated trade through Mobile Bay was the opening of Grant's Pass in 1839 by a retired army engineer of that name. The pass was created as a toll channel with a six-foot deep cut at the southwest corner of Mobile Bay that provided a direct inland waterway connection between Mobile Bay and the city of New Orleans through the Mississippi Sound.

Before the outbreak of the Civil War, perhaps as many as 100 steamboats were in operation at one time on the river system. The city itself had grown from a population of about 2,000 at the start of the American era to as many as 30,000 by 1860. Exports of pine lumber were in excess of one million board feet in 1830 and grew to exceed ten million board feet annually in the 1850's (Reynolds 1868:7). Annual cotton exports increased dramatically in the antebellum period. The total number of cotton bales exported in 1818 amounted to less than 10,000 bales, but by 1822 exceeded 45,000 bales. Cotton exports exceeded 100,000 bales by 1830 and 300,000 bales by 1840. During the last years before the war, cotton exports exceeded half a million bales annually (Reynolds 1868:7). By the start of the Civil War, Mobile had become second in importance only to New Orleans as a cotton shipping port on the Gulf of Mexico.

The Civil War

Following the secession of Alabama on January 11, 1861, the outbreak of the Civil War severely affected the maritime commerce of the port of Mobile. Commerce remained largely unchanged for the first few months of the war, but in April of 1861 Lincoln declared a naval blockade of the Confederacy to slow or stop both export of Confederate goods and import of materials that might aid the Confederate war effort. Union warships patrolled off the mouth of Mobile Bay in an increasingly effective effort to intercept, destroy, or deter vessels attempting to run the blockade. The outbound blockade runners carried valuable cargoes of cotton that provided the revenue that paid for the medicines, munitions, and the multitude of other goods, including a considerable proportion of luxury goods, of which the South was in short supply. These goods were brought in on the inbound runs from Europe, the Bahamas, or Cuba. Following the Union capture of New Orleans and Pensacola in 1862, the city of Mobile remained the only major port open to the Confederacy on the eastern Gulf Coast.

To secure, the Confederate defenders established an extensive series of obstructions and fortifications and built up naval and land forces in an attempt to protect the city from Union assault. The protection of Mobile was given a high priority by the Confederate government and considerable expense and effort were devoted to that cause. The defensive preparations began with the strengthening of Fort Morgan and Fort Gaines on opposite sides of the entrance to Mobile Bay. However, the fall of similar forts early in the war demonstrated that such masonry fortifications had been rendered obsolete by improvements in naval ordnance. In response, a series of earthen forts and gun batteries guarded an elaborate system of obstructions and explosive torpedoes to stop or delay the advance of Union naval forces. These defensive installations extended from the bay entrance up into the rivers of the Mobile Delta and were complemented by a similarly extensive series of fortifications built on both sides of the bay to defend the city from land assault. On the eastern side were included earthworks at Spanish Fort on the Blakeley River and at the nearly deserted site of the former city of Blakeley north of Spanish Fort on the Tensaw River.

These defenses proved to be an effective deterrent until the summer of 1864 when, on August 5, a Union fleet fought its way past Fort Morgan and through the torpedoes at the entrance to Mobile Bay. During the forced entry past Fort Morgan, the USS *Tecumseh*, a turreted ironclad, struck a torpedo and quickly sank with most of its officers and crew. After entering the bay, the Union fleet defeated the four Confederate warships that challenged it. Complete control of the lower bay was not achieved until combined naval and shore bombardment forced the surrender of Fort Morgan on August 23.

Following Union capture of the lower bay, the Confederate defenses in the upper Mobile Bay area remained stubbornly effective, slowing the Union advance against the city until the very end of the war. With the defenses on the western side of the city considered to be nearly impregnable to anything but an extended siege, Union strategy focused on an advance up the eastern shore for an eventual assault against Mobile through the rivers on which the Union had a significant advantage in vessels. A siege at Spanish Fort proceeded through naval and shore bombardments and preliminary assaults when defense of that position no longer seemed likely; the Confederate forces withdrew to the fort at Blakeley under cover of darkness. The last major battle of the Civil War was fought at Blakeley on April 9, 1865, when a vastly superior Union army overran the Confederate defenders only hours after Robert E. Lee had surrendered at Appomattox.

During the Union advances against Spanish Fort and Blakeley, Confederate torpedo warfare had considerable success at sinking Union vessels in the Blakeley River. Known today as mines, Confederate torpedoes were of two basic types, floating or fixed, and detonated either by contact or electrical charge. On March 12, 1862, the USS *Althea*, a small screw gunboat mounting one gun, was involved in torpedo removal operations near Battery Huger, on the point of land between the Appalachee and the Blakeley Rivers, when a torpedo detonated under the port side behind the pilot house and quickly sank the 72-ton vessel (Perry 1965:184). On March 29, the USS *Milwaukee*, a double-turreted 972-ton river ironclad, went up the Blakeley River to shell a Confederate transport and was sunk by a torpedo that exploded under the port side 40 feet from the stern (Perry 1965:185, Way 1983:401). On April 1 the USS *Rodolph,* "a small, stern-wheeled, tinclad gunboat with six cannon, picked up a large load of salvage gear for the *Milwaukee* and towed it toward the hulls. She never completed her mission, however, for at 2:40 that afternoon, midway between the *Chickasaw* and the *Winnebago*, a torpedo blew a ten-foot hole in her bottom. The *Rudolph* sank rapidly..." (Perry 1965:186, see also Sheliha 1971:276-277).

Following the fall of the fort at Blakeley and the surrender of Lee in Virginia, Confederate forces withdrew from Mobile and scuttled their last two armored gunboats, the *Huntsville* and *Tuscaloosa,* in the Spanish River. On April 12, 1865 the war was essentially over and Union troops entered Mobile, accepting its surrender without firing a shot.

Reconstruction to the Twentieth Century

During the period of Reconstruction that followed the war, Mobile continued to be an important port city. Both the city itself and the interior of the state suffered considerably less damage than other areas of the South. Shipping soon returned, as with, for example, the important Mobile to New Orleans trade through Mississippi Sound which was re-opened by the Morgan line in mid-1865 and had at least three vessels in operation on that route by 1866 (Pearson et al. 1994:5.54-55). There was, however, a general decline in the commercial traffic of the port in comparison to the pre-war era, due in part to war efforts that left the entire bay area less accessible to commercial navigation. The extensive series of obstructions established to prevent the passage of warships was still in place, and shoaling had built up during the war years. To deal with these and other problems facing the port, the Mobile Board of Trade was organized in 1868 (Hamilton 1913:376-377). Following an unsuccessful plan to improve the channel below Mobile through the use of jetties, the U.S. Army Corps of Engineers began a program of dredging that has continued harbor improvement to the present.

In 1870 the renewed federal program of harbor improvements was initiated, and by 1876 the channel from the Gulf to Mobile was increased from 10 to 13 feet in depth, with a width of 200 feet through the Dog River Bar. Between 1878 and 1886 appropriations were made for the creation of a channel 17 feet deep, and in the year 1888, the first oceangoing steamship docked at Mobile (Summersell 1949:48-49). The depth of the channel was increased again to 23 feet by the River and Harbor Acts of 1888 through 1897, which also provided for the upriver extension of the shipping channel to Chickasaw Creek above Mobile (COE 1915:1840-1841). By the late 1930s channel depths had been increased to 30 feet or more. Between 1936 and 1943 the Gulf Intracoastal Waterway was opened by the Corps of Engineers, allowing barge traffic between Gulf Coast ports (Mistovich and Knight 1983:21-22).

Following the Civil War, there was a considerable increase in vessel traffic on the waters of the Mobile area by local steamers and small boats involved in transportation and in the collection of seafood. The development of resorts and summer homes on the eastern shore led to a number of cross-bay ferries and excursion steamers that became a major part of the life of the people of Mobile and the Mobile Bay area. The bay ferries and excursion boats, known locally as bay boats, developed a substantial and regular service until a rapid decline following the opening of Cochrane Bridge across the lower Mobile River Delta in 1927 (Anthony 1991:part 4). At the same time that cross-bay traffic was developing, private yachts and sailing clubs were introduced to the bay area and have continued to the present. The bay waters also saw the development of a seafood industry involved in fishing, oystering, and shrimping. By the early twentieth century, substantial fleets of locally built small schooners and sloops were active on the bay. In the off seasons these vessels were commonly involved in charter service, and transporting farm produce and timber (Mistovich and Knight 1983:22). Oystering developed into an export industry and thrived until the early twentieth century when siltation brought about a decline in the oyster population. It was, however, also early in this century that the development of the otter trawl brought about the shrimping industry that continues to work out of Mobile Bay today.

Cotton and timber steadily declined as maritime exports from Mobile, largely due to the regional development of railroads which soon made connections with the rest of the country. By the 1880s the coal, iron, and steel industries of Birmingham were contributing to national and international trade through the port. Barge traffic in these commodities had been made possible by a series of locks and dams that extended the navigable waters beyond the shallows and rapids that had previously set the upriver limit of vessel traffic directly connecting with Mobile Bay. Additional commercial growth influencing maritime traffic in the region during the twentieth century included wood products, shipbuilding, and the seafood industry. Shipbuilding in particular reached significant proportions during both the First and Second World Wars. Steady improvements in the economy of the area during the twentieth century have been matched by upgrades in harbor facilities and increases in vessel traffic.

Vessel Types

A multitude of European-built or European-style vessels were in use during the period of exploration and discovery. However, there is little specific information on vessels in use prior to 1870. Most records only give brief descriptions of the vessel type and little else. Therefore, it is often hard to distinguish among various types of vessels of the period by description alone. Many vessels were described by hull type, whereas others were described by their rig or sail configuration. Still others are described by both hull and rigging type. In any case, differences in vessel type are not always clear, and it is not always certain that any given vessel was described correctly at the time.

The first vessels to explore the Gulf Coast were small, ranging from 35 to 60 tons' burden. Most vessels remained small until after 1736, when they frequently ranged upwards of 500 tons. While many vessels before 1736 were 50 to 60 tons in range, many were between 100 and 200 tons' burden. Even in 1759 small vessels of 50 tons were known to have made the passage from France to the Gulf region (Surrey 1916:78).

The bark (or barque) has been described as a three-masted vessel with the fore and mainmast square rigged, while the mizzenmast was fore-and-aft rigged (Kemp 1993:61–62) (Figure 2). Those barks recorded by Chapman during the eighteenth century ranged in length from 64 feet (17 feet in beam) to 112 feet (27 feet in beam) (Chapman 1768:37–40).

Another type of vessel in use in the area during the age of exploration was a brigantine. A brigantine was two-masted, square-rigged on the foremast, and fore-and-aft rigged on the mainmast (Kemp 1993:109) (Figure 3). In 1718 an inventory of vessels in the Gulf was taken. Several of the vessels were listed as "brigantins." One in Mobile was rated between 25–40 tons' burden; another at Biloxi rated from 30–35 tons' burden (as did a vessel named *Le Pinere* located between New and Old Biloxi). Two of the vessels were stranded and badly worm-eaten but could be repaired and put into service, "except the one at Biloxi" (Surrey 1916:71). Three other brigantines were at New Orleans, each ranging from 15–50 tons respectively (the 50-ton vessel being in a bad state of decay). Previous to 1731, the Company of the Indies began construction of a "brigantin" approximately 45 feet in length with a 19-foot beam. The vessel had a draught of nine feet and a 76-ton capacity (Surrey 1916:71).

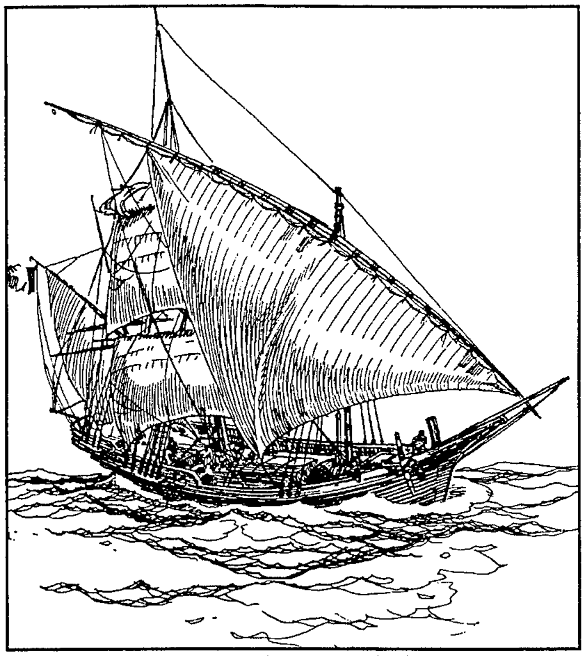

Figure 2. The barque *Provencale* (as presented in Culver 1992:136).

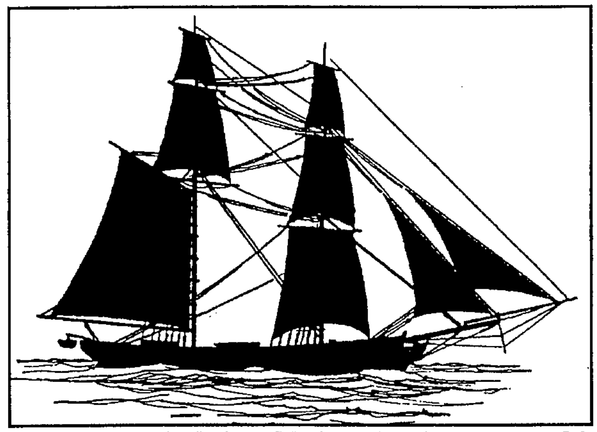

Figure 3. Typical rigged brigantine (as presented in Bloomster 1940:9).

During the eighteenth century the English used vessels called corvettes to explore the Gulf Coast as well as the Mississippi. Although originally a French design, no reference has been found noting that the French were using this type of vessel in the Gulf region during this time. A corvette is defined as a flush-decked warship with a single tier of guns, smaller than a frigate but ship-rigged on three masts (Kemp 1993:207) (Figure 4). In the eighteenth century a corvette was defined as a two-masted vessel with a bowsprit carrying a spritsail. After time the corvette design was modified, its size approaching that of a ship (Culver 1992:188).

Feluccas have also been mentioned as a vessel type in numerous French accounts from the eighteenth century. Feluccas have been described as small, fast sailing ships that could be powered by sail or oars; their use in the Gulf region has been well documented. These vessels were used as coasting and transport vessels. Descriptions state that the vessel was a double-ender and could be sailed or rowed from either end (Surrey 1916:63). Records of a Spanish felucca built in Havana in 1786 state the vessel was 100 feet long and 27 feet wide (Mistovich and Knight 1983:31). However, draught lines of a French felucca recorded in the eighteenth century show a vessel with a length between perpendiculars of $43^{5/6}$ feet and a moulded breadth of $8^{5/6}$ feet. The vessel had a draught of $2^{7/12}$ feet (Chapman 1768:70). The example from Chapman shows a vessel with a distinct bow and stern and would have therefore not been a double-ender.

The French used the term "flute" to describe a vessel that had had some of its guns removed or moved below in order to make additional room for stores or troops (Figure 5). The word is the anglicized version of the Dutch term fluyt, a small supply vessel with a rounded stern (Kemp 1993:318). The French expression *en flute* referred to a vessel with guns on the upper deck only, with the lower decks used for storage of goods or troops (Culver 1992:104). On his second voyage, Iberville returned to Biloxi Bay on January 8, 1700 onboard the *Renommee* and accompanied by the 700-ton flute *Gironde*, commanded by the Chevalier de Surgeres. Flutes were ship rigged and were therefore lengthy and wide in beam. This type of vessel would have had difficulty in passing into shallow harbors and would likely have been anchored offshore.

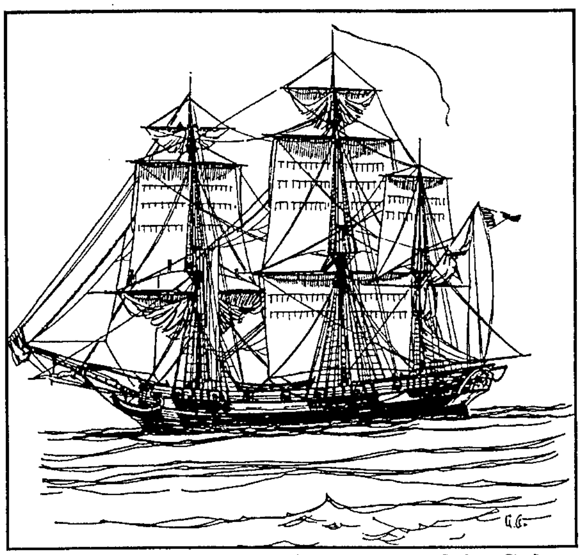

Figure 4. The corvette (as presented in Culver 1992:186).

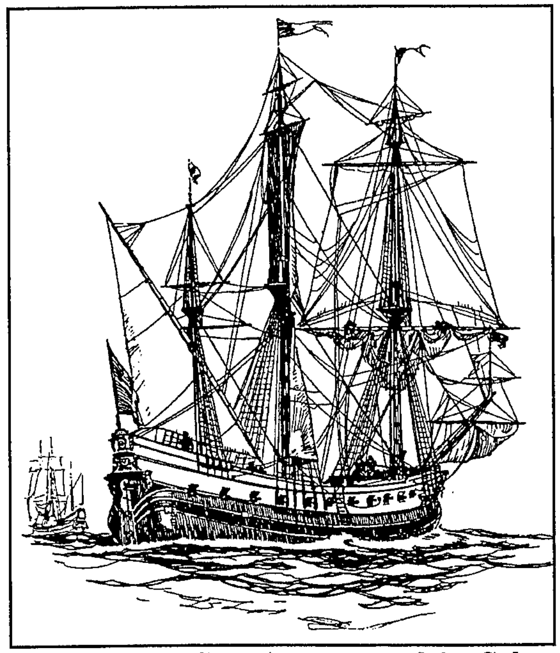

Figure 5. The flute (as presented in Culver 1992:103).

Frigates were another type of vessel used around the Gulf during the expansion of the southern territories. Iberville employed the use of two frigates (*La Badine* and *Le Marinas*) during his initial explorations of the Gulf Coast in 1699 (Giraud 1953:23). A frigate has been typically described as a three-masted, fully-rigged ship with a main deck as well as a raised quarter deck and forecastle (Figure 6). They were armed with 24 to 38 guns that were carried on a single gun deck (Kemp 1993:329). Frigates were quick sailing vessels and were often used as lookouts and messengers. Plans of frigates from the eighteenth century show that frigates ranged in length from 56 to over 160 feet (Chapman 1768:11–17). The 56-foot frigate had a beam measurement of 18.5 feet and only one mast (Chapman 1768:17).

Another vessel in use during the era of exploration, a ketch, has been described as a small sailing vessel with two masts; the mizzen mast is stepped before the rudder head. This description is not always appropriate, as some yawl-rigged vessels also had the same mast placement (Kemp 1993:447). With the main mast stepped back along with the mizzen mast, a ketch has been generically described as a vessel without a foremast (Culver 1992:113) (Figure 7). When Iberville left France to explore the Gulf, he supposedly sailed with his two frigates (*La Badine* and *Le Marinas*) and two ketches (Caruso 1966:228). Another source states that the two vessels that accompanied Iberville were two traversiers (*Le Precieux* and *Le Biscayenne*) (Higginbotham 1968:15). Whether or not the vessels were rigged as ketches and both statements are correct is unknown. Ketches were used extensively in the coastal trade and were adopted by many of the European maritime powers during the Napoleonic wars to aid in tending fleets (King et al. 1995:221). Two ketches recorded by Chapman during the eighteenth century were 76 to 85 feet in length with beams of 21 to 23 feet respectively (Chapman 1768:49). Although ketches were known as an effective vessel type during war time, they were also used to carry freight and passengers. The main differentiating features of these vessels were the sail arrangements and the employment of cannons onboard (Surrey 1916:72).

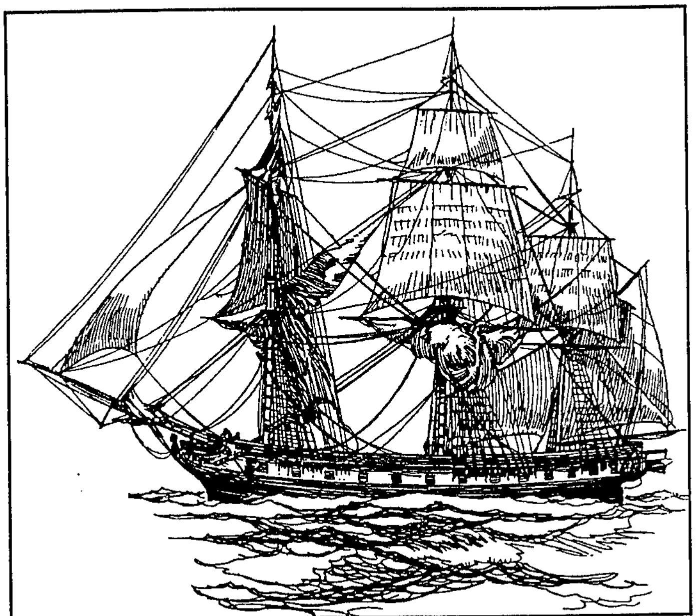

Figure 6. An 1820 frigate (as presented in Culver 1992:169).

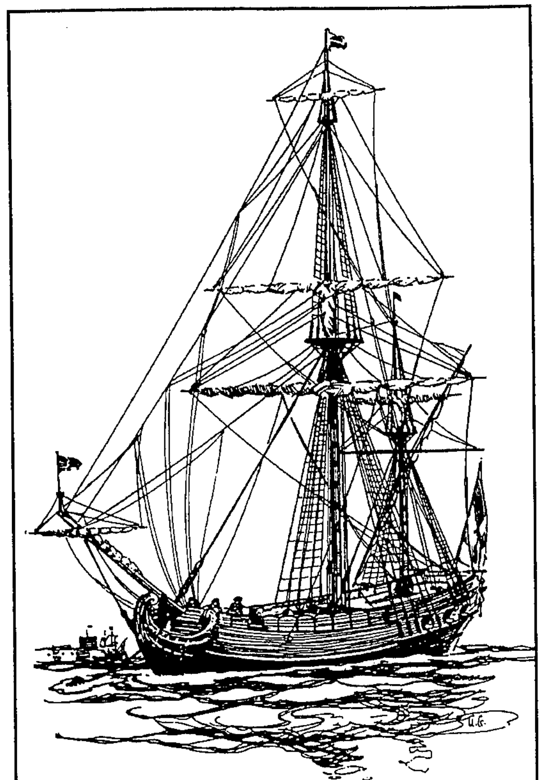

Figure 7. The ketch (as presented in Culver 1992:112).

A "longboat" is a general term for a ship's boat, commonly a shallop. The vessel could be propelled by sail or oars and was typically round bottomed, 20 to 30 feet in length (Wilson 1983:32). Many had bluff bows with relatively narrow sterns, increasing their ability to perform as sea-going vessels (Lavery 1987:218). These were the largest vessels carried onboard a ship. Their principal purpose was transporting heavy stores to and from shore as well as taking water casks to shore to be filled. They were often stocked with provisions, as their secondary purpose was to serve as a lifeboat in case of emergency (Kemp 1993:496). Chapman surveyed a number of longboats in the eighteenth century; they ranged in length (between perpendiculars) from 18.5 feet to 34 feet (Figure 8). The breadth moulded of these boats ranged from $7\frac{1}{3}$ feet to 10 feet (Chapman 1768:58).

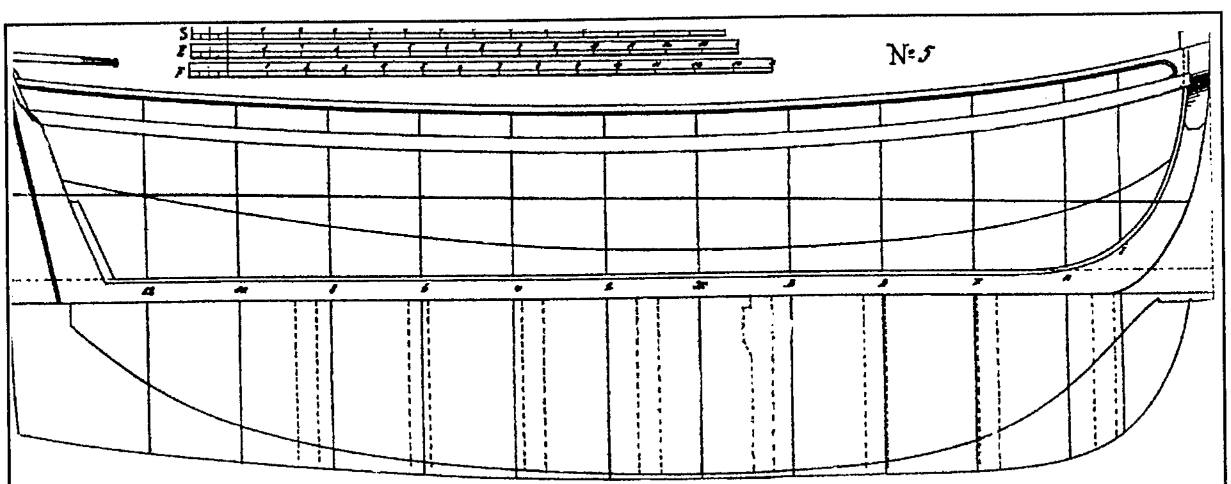

Figure 8. Hull lines of a 34-foot longboat (as presented in Chapman 1768:58).

Another vessel in use during the Age of Exploration was called a pinnace. This was a small vessel that could be rowed or sailed and was initially designed to accompany larger ships. Although used primarily as ship tenders, pinnaces were known to accompany ships during voyages of exploration, being built to withstand substantial seas and adverse conditions. Pinnaces have been described as small ships, and the only difference between the pinnace and the longboat was in bulk and burden (Baker 1962:54). Many descriptions of pinnaces state that they had square sterns, and that the name came to denote a use or service rather than a specific vessel type (Baker 1962:56). Pinnaces were larger than longboats and differed from shallops in their square stern. They were rigged in a variety of ways depending on the service they were to perform: an ocean crossing would require a different rig than that of a coastal mission (Baker 1962:59). Pinnaces ranged in size from 30 feet in length (Chapman 1768:51) to upwards of 90 feet (Baker 1962:76) (Figure 9).

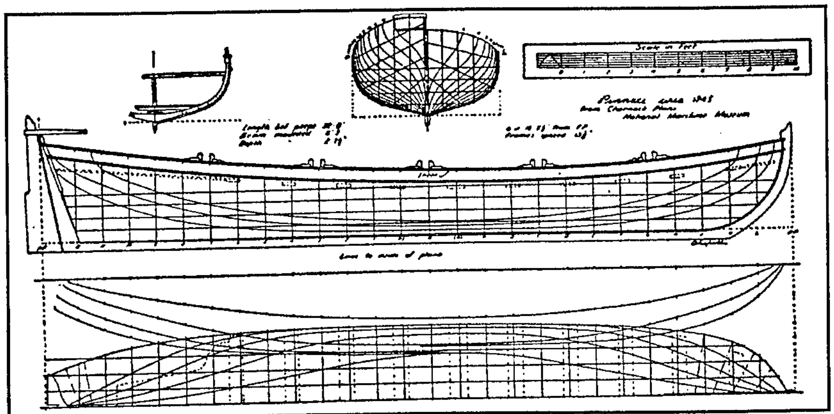

Figure 9. Hull lines of a 1700–1750 pinnace (as presented in Chapelle 1951:23).

The French used vessels called shallops (chaloupes) for a variety of reasons during the colonial period (Figure 10). Shallops were often employed by larger vessels for placing/lifting anchors and helping in times of distress (Surrey 1916:62). Shallops often varied in size from four tons to upwards of 60 tons. They were usually open, heavily constructed, and useful for coastwise voyages. Rigging for shallops usually included a single mast fore and aft that was rigged with a sprit mainsail and a staysail. Some shallops had two masts with square rigging, a large mast amidships, and a small foresail stepped forward (Baker 1962:151). The term "shallop" was replaced later in the eighteenth century by the terms "longboat" and "launch" (Chappelle 1951:20). All these vessels were considered ship's boats and were used extensively throughout the eighteenth century. Surrey states that as "early as 1704 two of these boats were at Biloxi, and in 1707 were brought into the transport service" (Surrey 1916:61). A shallop of 60 tons was also in use in the Gulf of Mexico near Deer Island (adjacent to Biloxi Bay), manned by a crew of five or six sailors (Surrey 1916:61).

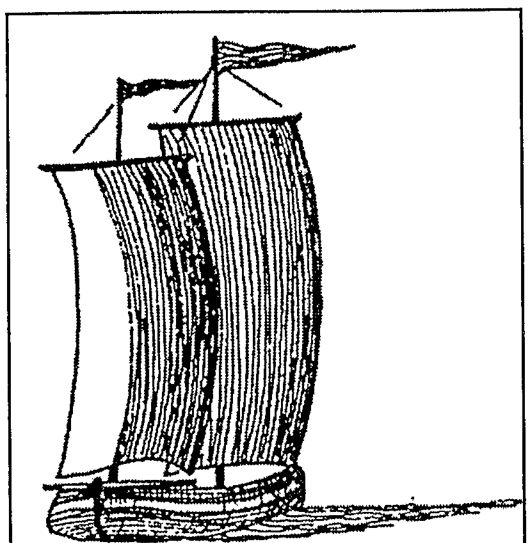

Figure 10. 1725 shallop (as presented in Baker 1962:66).

Iberville made frequent mention of vessels called "smacks" during his early explorations off the Gulf Coast. However, a description of the vessel is difficult to discern. A smack has been described as a small sailing vessel rigged as a cutter or ketch, normally 15 to 30 tons in size and commonly used for inshore fishing (Kemp 1993:810). Smacks were often compared to "hoys," small coasting vessels constructed to upwards of 60 tons used extensively to transport passengers from port to port. These vessels usually had a single mast with a fore-and-aft sail (Kemp 1993:404). Chapman, in his work *Architectura Navalis Mercatoria*, provides the dimensions of a number of English and Dutch smacks and hoys. These vessels ranged in length from 39¼ feet (13¼ feet in beam) to 110¼ feet (27 feet in beam) (Chapman 1768:64–70).

Another vessel, called a traversier, has been mentioned in numerous accounts of voyages around the Gulf Coast. A traversier was often not a particular type of vessel but rather one that made frequent voyages between two points that were not far apart. In 1704 two traversiers were recorded making voyages between Louisiana and Mexico. Each of the vessels was rated at 50 tons. Traversiers could make passage to the West Indies and were also used as transport vessels (batiments de transport). However, Surrey states that traversiers could not get too close to shore for fear of grounding, so shallops were used to transfer supplies to shore. Traversiers were common throughout the French period in the Gulf but were employed less during the royal rule (Surrey 1916:63).

With the advent of the Colonial Era, the maritime character of the area witnessed an increasing influx of watercraft types and numbers. Vessel types present during the Colonial Era were all powered by sail and/or current, and included small coastal merchant vessels rigged as sloops and schooners, large merchantmen and warships, small local fishing craft, and early river craft which brought commodities by river to Pascagoula. During the nineteenth and early twentieth centuries other vessel types emerged in use in the area, including river and coastal steamers, sailing craft such as lugers, sloops, schooners, ships, and barks, unpowered rivercraft of the flatboat family, Civil War vessels such as monitors and rams, small vernacular craft and fishing vessels such as bateaux, oyster boats, and bay shrimpers, and harbor craft like steam tugs, barges, and dry-docks.

Before the introduction of steam, the bulk of farm products from the interior were shipped downriver on rivercraft of the flatboat family. Often referred to as flats, family boats, New Orleans or Orleans boats, arks, Kentucky boats, and tobacco boats, flatboats were used to transport settlers, household goods, and livestock downriver to market (Figure 11). In addition, they were also used to transport various types of cargo, including cotton, flour, bacon, whiskey, cider, pottery, and the like. When the cargo was sold, the flatboats were either sold for lumber or abandoned, and their owners would return home (Baldwin 1941).

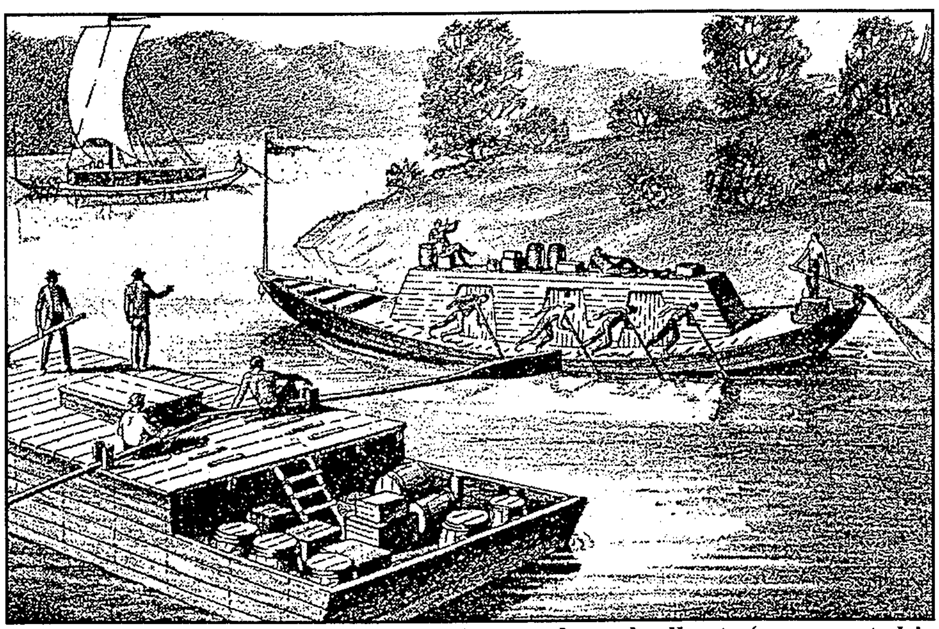

Figure 11. River scene showing a flatboat and two keelboats (as presented in Baldwin 1941:43).

Prior to the ante-bellum period, the average size of flatboats increased substantially. From 1810 to 1819, the average flatboat capacity was 30 tons and cost $45 to construct. During the period between 1850 and 1860, flatboats averaged 146 tons capacity and cost an average of $219 to build, with some able to carry 300 tons (Haites et al. 1975:15, 166). Unpowered and only able to drift downriver with the current, the size and shape of flatboats varied, but generally consisted of a flat bottom, oblong shape, and a roof supported by planked sides. The average dimensions ranged from 12 to 20 feet in width and from 20 to 150 in length. Steered by a single thirty to forty-foot stern oar and two or more side sweeps, flatboats were also equipped with fireplaces or iron stoves for cooking and heating. They seldom had windows and almost never used anchors, instead using a line or cable to dock the boat. Pumps were also on board in case leaks occurred (Baldwin 1941:48; Johnson 1963:116-120, 127-128). Because the flatboat traveled only downstream, a different vessel type, the keelboat and its larger relative, the barge, evolved to handle upstream traffic. Coming into general use on the Ohio River soon after the American Revolution, these vessels were built on a keel (actually built-in keels), ribbed, and covered with planks (Baldwin 1941:42-44; Haites et al. 1975).

The barge was constructed similarly to the keelboat but was larger, longer, and heavier. Barges often approached 170 feet in length, drew three feet, had a mast (often two, with square sails), were steered by a rudder, had a small cabin built on the rear deck, and a footway around the gunwales. The barges were manned by 15 to 50 men, depending on the size, and carrying capacity ranged from 50 to 150 tons (Baldwin 1941; Haites et al. 1975). A variety of methods were employed to propel the barges and keelboats upstream. These included poling (if the river bottom was hard), pulling the boat along the bank with towlines, warping or cordelling using a skiff to carry towlines out to a tree on the bank and pulling the boat ahead by walking the cleated footway, and, as a last resort, rowing (Baldwin 1941).

Although steamboats were introduced shortly after the advent of flatboats, keelboats, and barges, these latter types continued to be used and even increased in numbers and importance throughout the nineteenth century. However, due to the high cost of slow, upstream cargo carriage, the keelboat, although its use lingered on for decades, was the first of the early craft to feel the competition from steam. The barge, the largest of the keelboats, went out of use rapidly. The flatboat, which was economical and easy to operate, continued in use through the middle of the nineteenth century (longer than keelboats on the major trunk routes) and persisted into the twentieth century on streams of the rugged hill country of Tennessee, West Virginia, and Kentucky (Haites et al. 1975:119-23; Hall 1884:181-186; Hunter 1949:52-58).

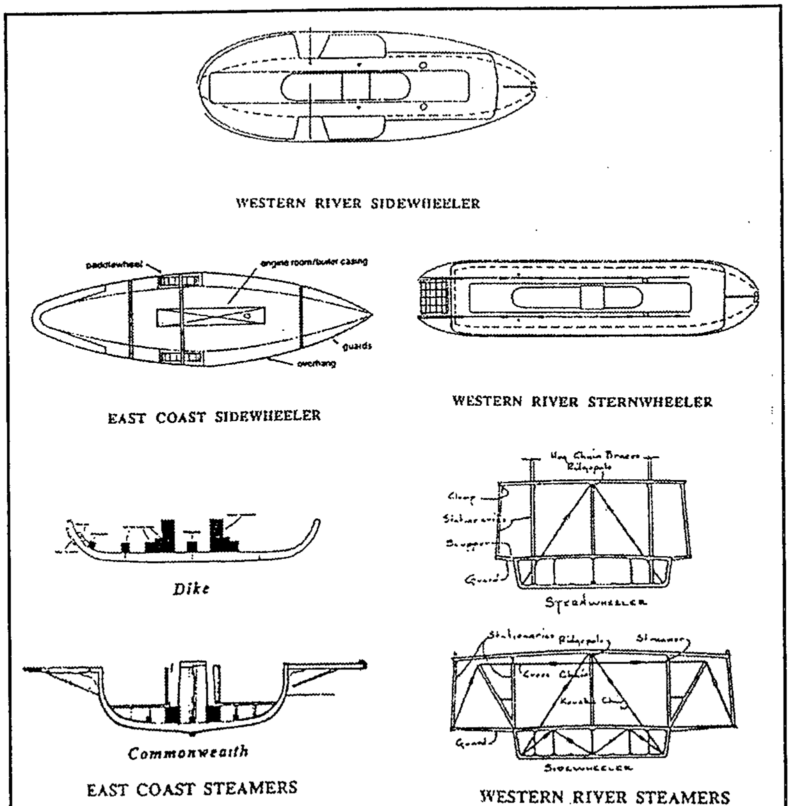

Figure 12. Comparison of hull shapes (top), and hull cross sections (bottom) of eastern seaboard and western river steamboats (as presented in Pearson et al. 1993).

The historic steamboat was one of the most prominent vessel types employed throughout the region. There were essentially two types of steamboats employed in the area: the western rivers sidewheel and sternwheelers, and the eastern seaboard sidewheeler (see Figure 12). These eastern seaboard designs had long, narrow, heavily framed, flat-bottomed hulls, and were not adapted to the western rivers' low water depth. Engines, furnaces and boilers were placed within the hull of these vessels along with the cargo. The most common engine type employed on eastern steamers was a centrally-located, low-pressure, walking beam engine (Figure 13).

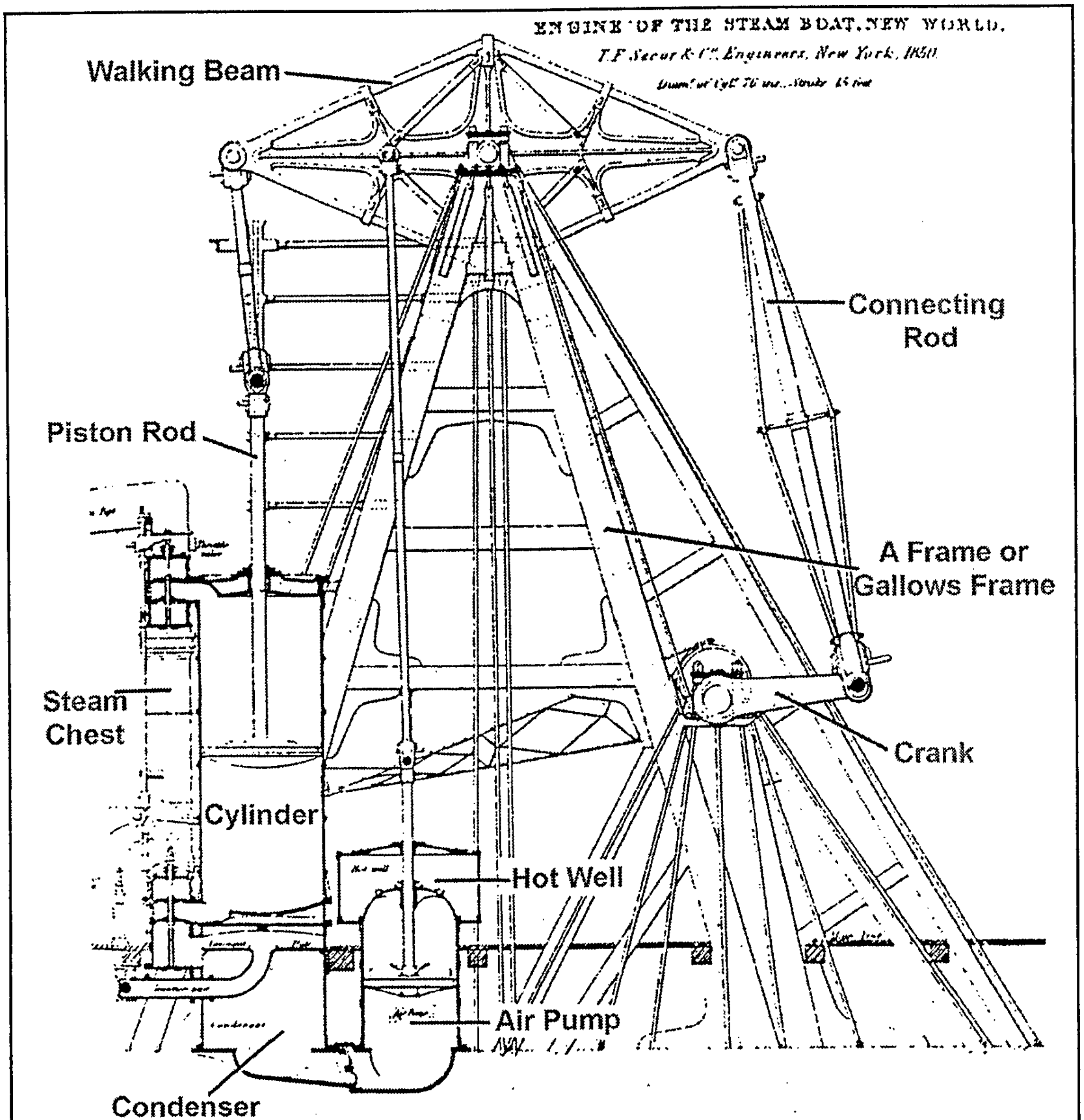

Figure 13. Major components of a mid-nineteenth century eastern seaboard low-pressure walking beam engine (as presented in Pearson et al. 1994).

The eastern-built, coastal sidewheelers were well represented in the Gulf Coast area, serving as passenger and freight carriers, bay ferries and pleasure cruise boats. Steamers like the *Louis D'Olive*, built in Wilmington, Delaware, plied the waters of Mobile Bay (Figure 14). Steamers like the *Mary*, a 234-foot iron hulled sidewheeler, also built at Wilmington, along with the *Alabama*, the *Francis*, and the *Louise,* were part of the Charles Morgan fleet of coastal vessels which operated in the Mobile–New Orleans trade (Pearson et al. 1994).

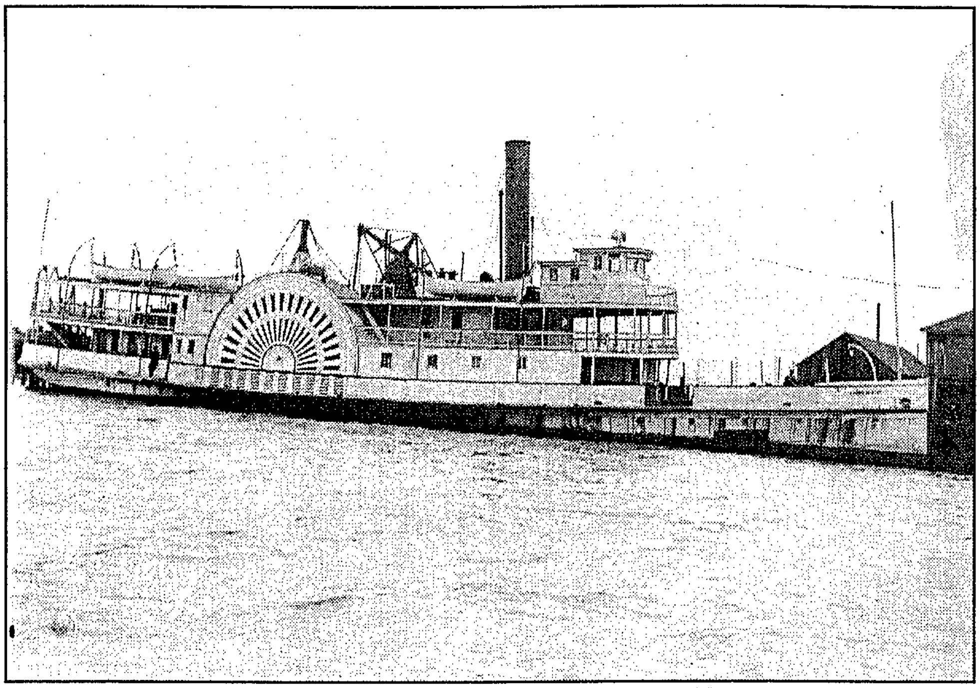

Figure 14. Steamboat *Louis D'Olive*, an eastern seaboard sidewheeler, built in 1861 (courtesy of Overbey Collection, University of South Alabama Archives).

While the first western rivers steamboats did not structurally differ much from their eastern seagoing counterparts, by 1840 a vast technical change had occurred, adapting the steamboats to the natural and economic conditions of travel along the western rivers. In adapting to the natural constraints of these shallow, swift rivers, steamboats increased in length and breadth of hull and decreased in depth. In the late 1820s experimentation began with lighter methods of hull construction, and by the 1840s hull lines had become rectangular throughout, with a flat bottom and straight sides, and with curved surfaces of the hull largely confined within the short distances of the bow and stern (Hunter 1949:77, 80). Similar to the changes in vessel hulls, the propulsion systems were changing from low pressure condensing engines to high-pressure noncondensing ones. Low pressure engines, though safer and more fuel efficient, were replaced with high pressure engines that were faster and more maneuverable under diverse navigational conditions. These engines were powered by long, horizontal, internal flue boilers (Figure 15). However, the major hazard associated with the high pressure engines was the common occurrence of a boiler explosion. These explosions were the greatest cause of death from steamboat accidents on the Mississippi (Duay 1992: 33-34; Donovan 1966; Hunter 1949:121-180).

Illustrated in Figures 16 and 17, the typical western river steamboat of the 1850s was a flat-bottomed, shallow-draft side-wheeler. Four-fifths out of water, the fully developed side-wheeler had three decks: the main deck, which covered and extended beyond the hull over the water as "guards"; the boiler deck, located above the boilers; and the hurricane deck. The pilot house stood atop the hurricane deck just aft of the stacks (Hunter 1949:90-91).

Used infrequently except on small vessels until after the Civil War, stern-wheeler propulsion replaced side-wheelers in the post-bellum decades due to "(1) the removal of the paddle-wheel from its recess in the stern; (2) the application of two engines to cranks fixed at right angles to each other at opposite ends of the paddle-wheel shaft; (3) the incorporation of the paddle-wheel assembly in the hog-chain system; and (4) the introduction of the multiple balance rudder" (Hunter 1949:172-173). By 1880, the stern-wheeler, cheaper to build, more effective in low water than side-wheelers, and more economical, had established itself as the dominant vessel type on the rivers of the interior (Figure 18).

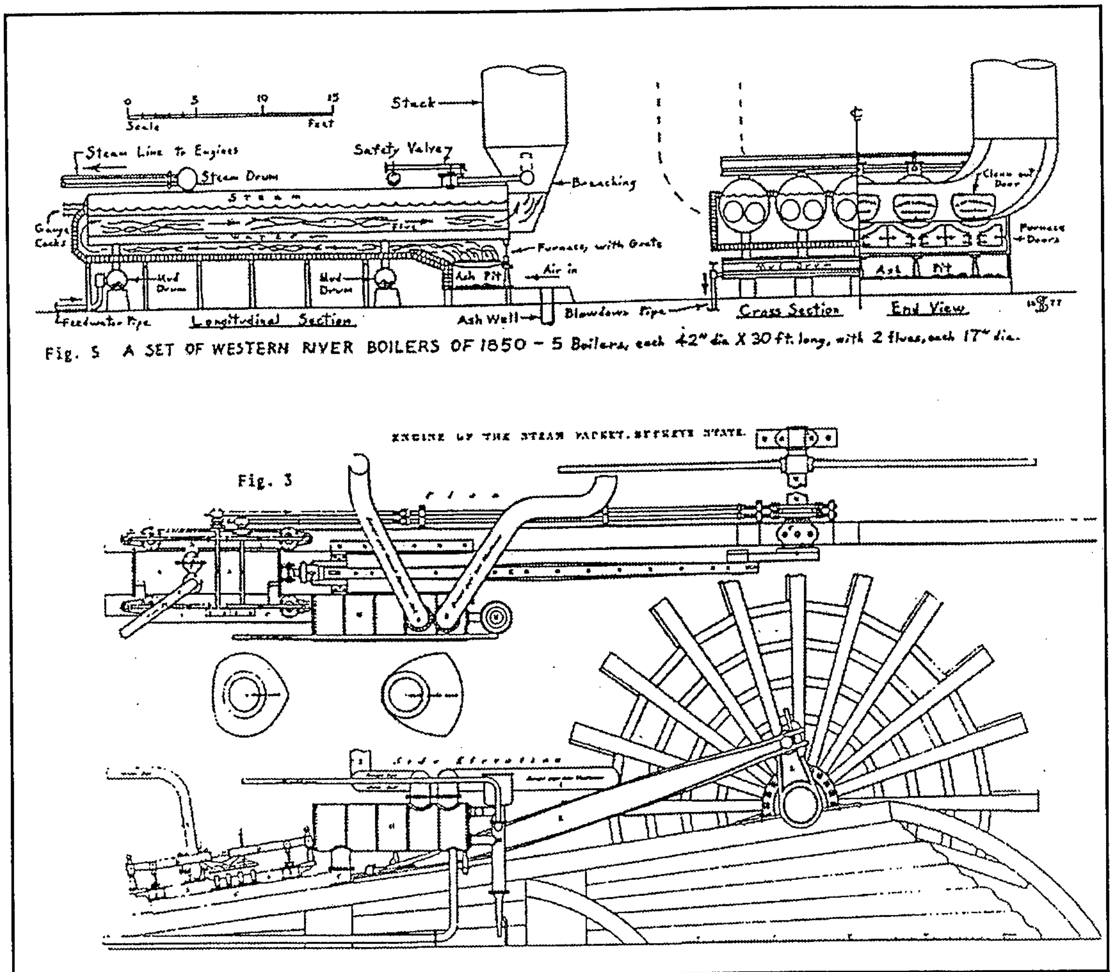

Figure 15. Illustration of an 1850s steamboat boiler and engine (as presented in Sawyer 1978:75).

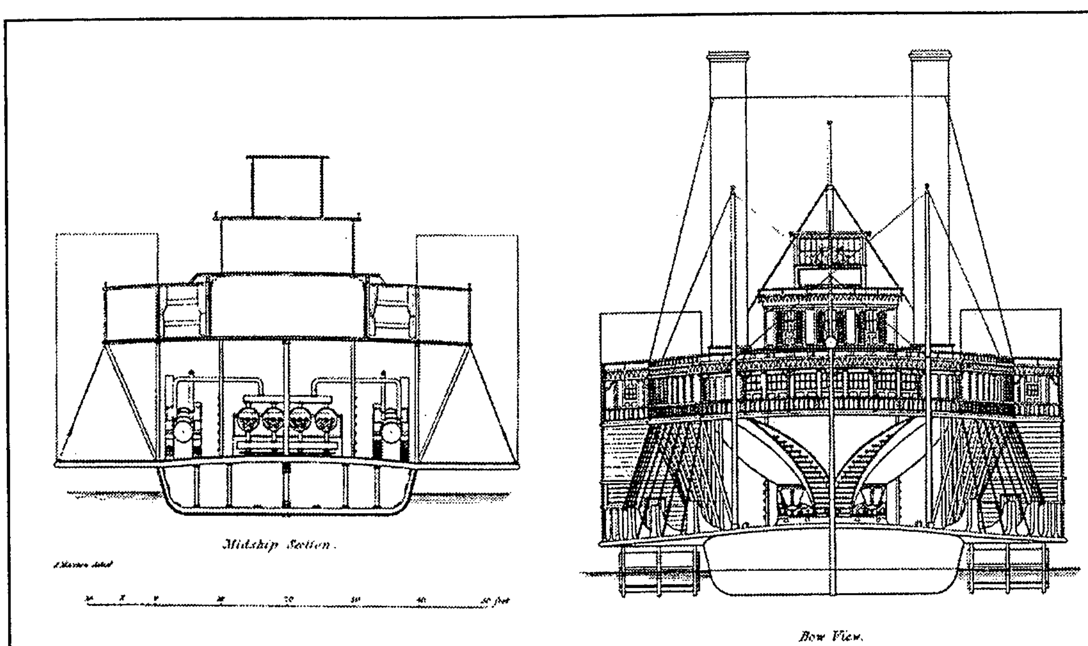

Figure 16. Midship section and bow view of a typical western rivers steamboat of the 1850s (as presented in Hunter 1949:18).

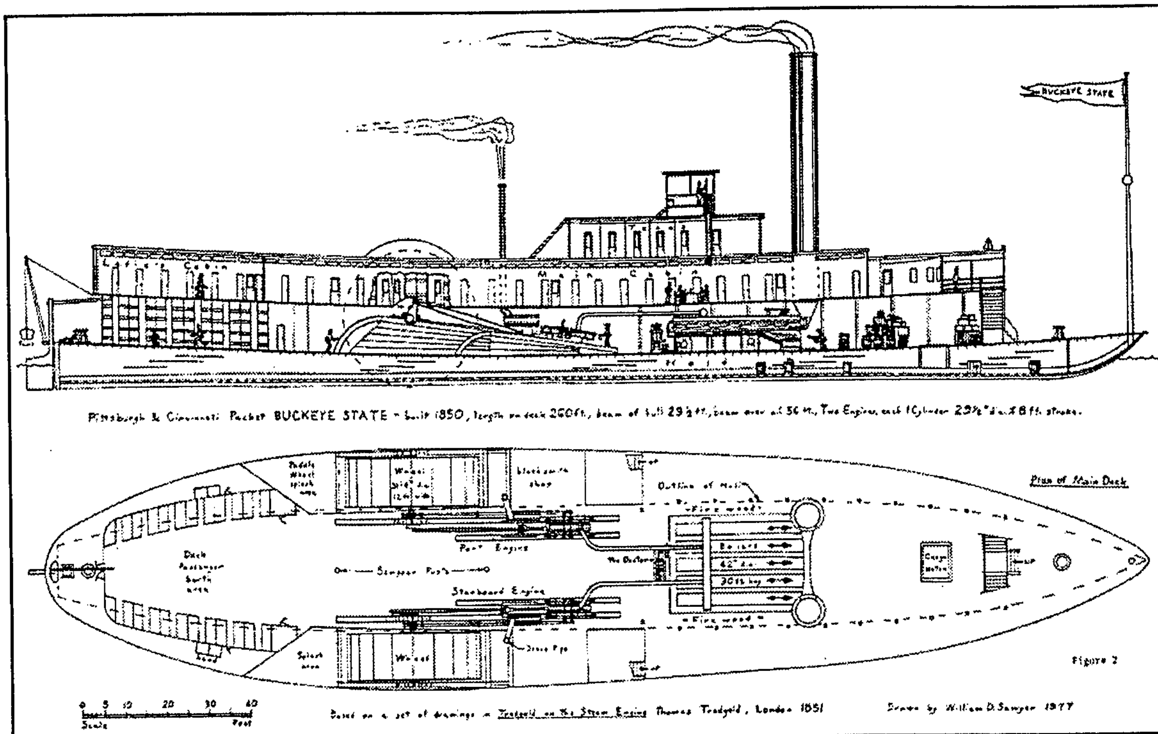

Figure 17. Plan and profile of a typical western rivers sidewheel steamboat of the 1850s (as presented in Sawyer 1978:74).

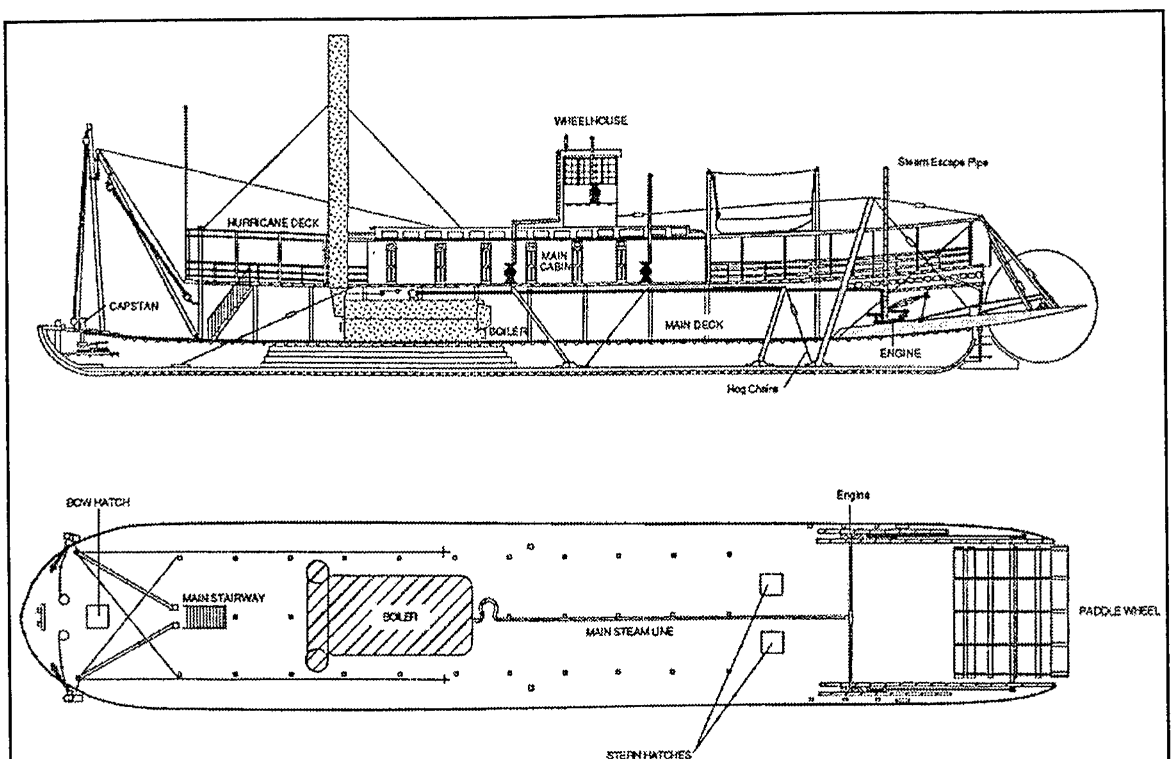

Figure 18. Plan and profile view of a typical western rivers sternwheeler (after Petsche 1974).

Though less romanticized than the steamboats which plied the bay and rivers, one of the most prolific class of vessels found on the area waters were the schooners. These included large blue-water schooners, coastal schooners, and locally built fishing schooners. Figure 19 shows a three-masted lumber schooner with a full cargo shortly after the turn of the century. These large schooners played a significant role in the local economy as lumber and lumber products such as staves and shingles were one of the main exports from the area.

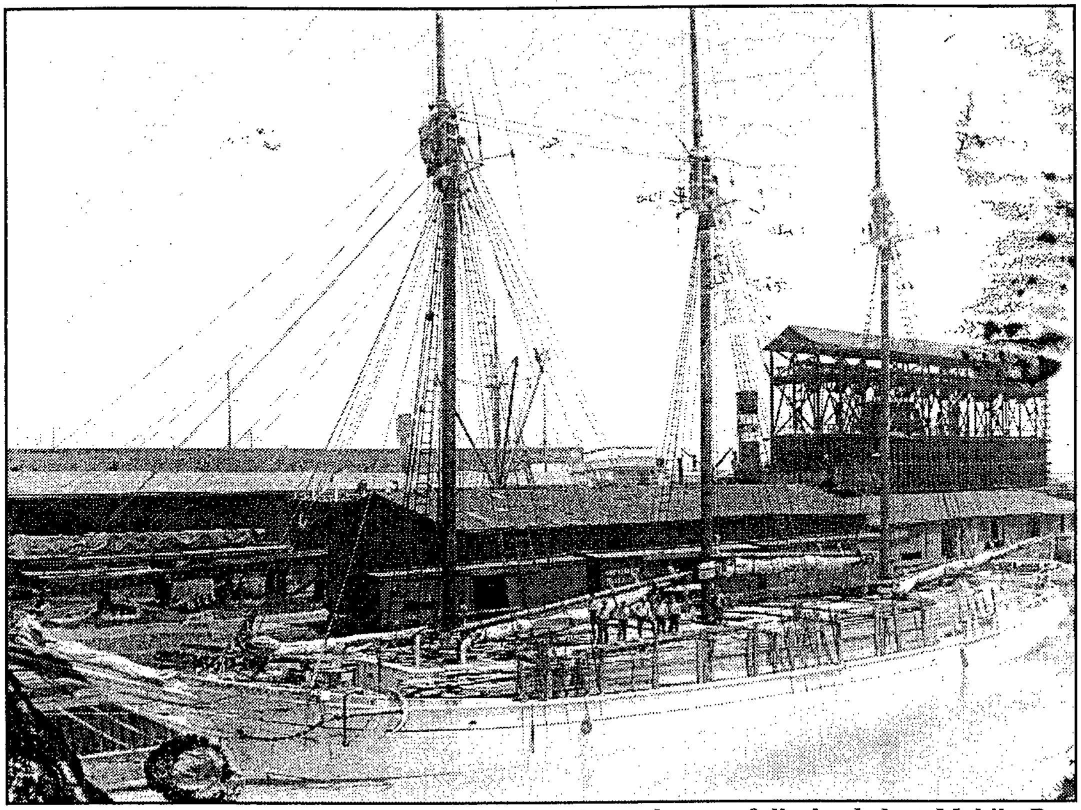

Figure 19. Photograph of a triple-masted lumber schooner fully loaded at Mobile Bay (courtesy of Overbey Collection, University of South Alabama Archives).

Another type of schooner used in the area was the light drafted coasting schooner. Flat-bottomed with a centerboard, it was designed to operate in the shoal water situations prevalent along the Gulf Coast waters and bays. Figure 20, a plan of the Bethune Blackwater Schooner, is representative of this now-extinct type. Archaeologically documented in the Blackwater River near Pensacola Bay, Florida, the Bethune Schooner was involved in the lumber and brick industry which flourished in Pensacola. The vessel may even have frequented Mobile Bay as large amounts of the lumber and bricks from the Pensacola Bay area were transported to Mobile for transshipment (Baumer 1990).

In 1937 offshore shrimp grounds were discovered, and vessels called shrimp trawlers began to be built, initially of wood, and after 1945 of steel. In the late 1930s, Florida fishermen

> introduced the "South Atlantic Trawler" when the potential for offshore shrimping in the Gulf was discovered. Begun as a variation of a powered vessel originally derived from the design of Greek sponge boats used on the west coast of Florida, the South Atlantic Shrimp trawler generally measured between 50 and 65 ft. long. The shrimp boat reached its present characteristic form and style in the very short period of time between the end of World War II and about 1950. Possibly as a result of the need for maximum rear deck working space, it was among the first powered fishing craft to have a forward-located pilot house. The hull, however, retained characteristics of the old Greek sponge boats with its full body, sweeping sheer line, and fine entrance (Pearson et al. 1993:114).

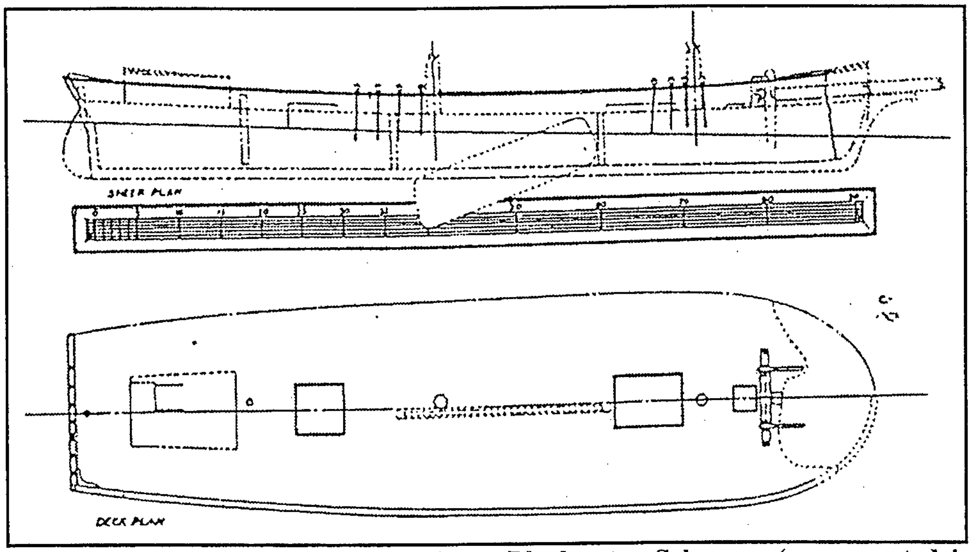

Figure 20. The double-masted Bethune Blackwater Schooner (as presented in Baumer 1990).

The small versions of this type, commonly called "shrimp trawlers," "bay shrimpers," or "shrimp boats," can still be found fishing the upper bay in and adjacent to the project area. Generally these vessels, because of their relatively recent age, would not be considered historically significant if their remains were encountered in the project area. However, the earliest examples of this vessel type might be considered significant relative to National Register of Historic Places criteria, based on their evolving, yet distinctive, construction characteristics.

Besides the vessels employed to carry the products of the major industries in the Mobile area, there were a number of utility vessels which were used in day to day activities, including tugboats, pilot boats, river and sound freighters, sloops, catboats, launches, skiffs, and dugouts.

Typical of the tugboat was the iron-hulled *Leo*, built in 1882 in Philadelphia. It was a steam powered, single screw vessel 83 feet in length, 19 feet in beam, and seven feet deep from deck to keel (United States Bureau of Customs 1889:306). It followed the typical tugboat morphology, with a forward wheelhouse, and center engine room and stack. A locally constructed tug, the *Eva*, was similar in construction, with a 56-foot length, 16-foot beam, and 4 1/2 feet from deck to keel.

Sailboats, usually sloop or cat rigged, used both for work and recreation, were built and used in many areas of the Gulf Coast. The catboat was popular around the turn of the century for use in organized sailing races. It has since has faded from popularity, and the sloop rig is now the popular choice of small recreational sailboats.

Two types of small vessels were used all over the Gulf Coast area for fishing, recreation, and short-distance transportation of people and goods. Small engine-powered launches, like the one pictured in Figure 21, were common means of over-water transportation in the late nineteenth and early twentieth centuries, used for general recreation and ferrying. Most were around 35 feet in length with a narrow hull and a canvas or wooden canopy. Small, oar-powered skiffs, which were sometimes rigged with a sail, were often used in the same manner.

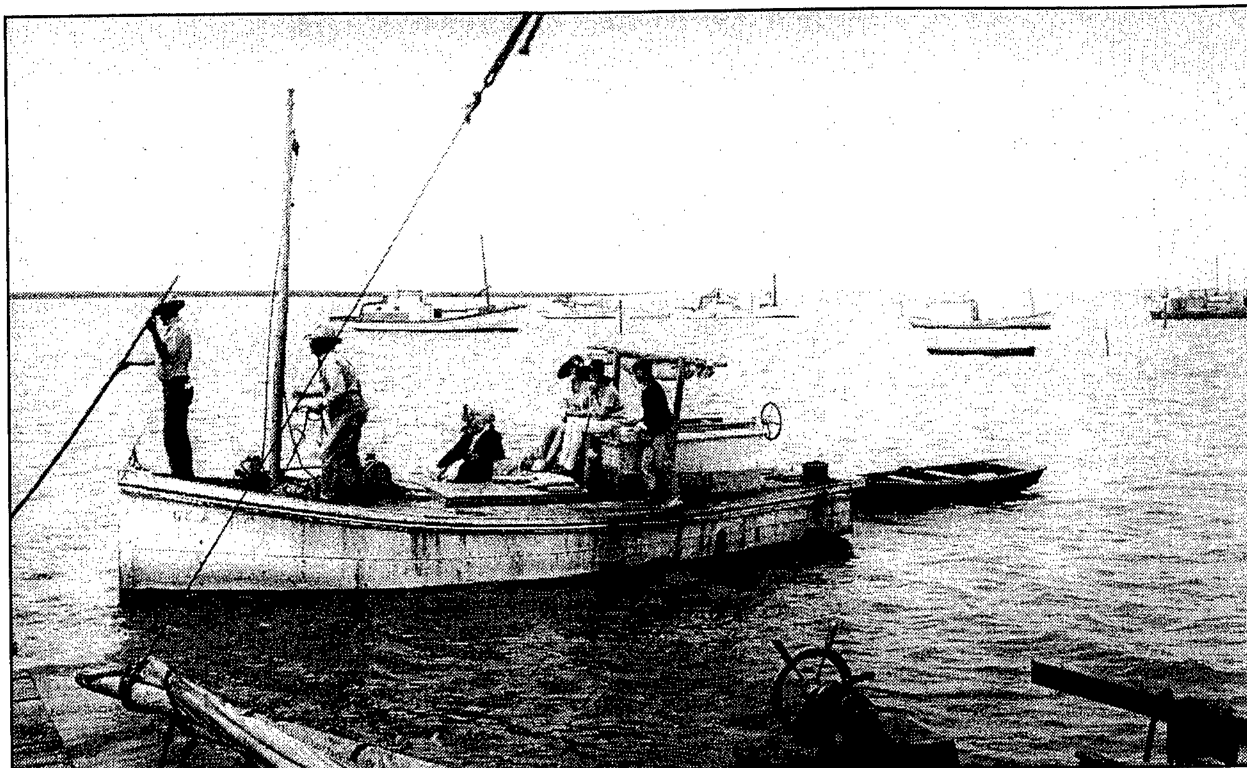

Figure 21. Early twentieth-century photograph of a small vernacular craft. Note passengers on naptha launch and towed bateau (courtesy of University of South Alabama Archives).

3. INVESTIGATIVE METHODS

The investigation was composed of archival research and a magnetometer survey. Archival research was conducted prior to fieldwork to ascertain the types of cultural material to be expected within the survey area, and to develop a predictive model of where they might be located. This research was conducted in conjunction with a remote-sensing survey using a magnetometer. The fieldwork commenced on October 12, 2000. Upon completion of the remote-sensing phase of the project, the data was reviewed. All data collected was stored on various electronic media for subsequent analysis.

Archival Research

Archival and local research consisted of consulting various local and state repositories and interviewing individuals knowledgeable in local history. Archives were checked specifically to find information on the local history and maritime aspects of Mobile Bay; local histories, maps, and previous archaeology reports were consulted. Local harbor masters and dive shop employees were interviewed regarding their knowledge of submerged cultural resources in the area.

Environmental Considerations

The project area consists of two discrete areas (see Figure 1). The first area is located at the mouths of Halls Mill Creek and Rabbit Creek, where they join Dog River; the second area is located in the Dog River, beginning just north of the Gulf Fishing and Hunting Club and extending to the end of the estuary. The second area also has an extension into Moore Creek. The project areas were 150 feet in width, and approximately 10,000 feet in total length. Water depth averaged four feet.

Dog River is the home of a healthy amount of private maritime traffic. In general this traffic did not interfere with survey activity.

Personnel

The personnel for this remote-sensing investigation were both maritime archaeologists with Panamerican. Andrew Lydecker was a maritime archaeologist and report author and James Duff was the marine survey archaeologist. The individuals involved in this archaeological investigation used an array of electronic remote-sensing equipment to safely and effectively attain the project objectives.

Remote-Sensing Survey

The remote-sensing survey phase of this project was conducted with equipment and procedures intended to facilitate an effective search for magnetic anomalies and to exactly determine their locations. The navigation/positioning system included a Motorola LGT-1000 GPS instrument integrated with a Starlink MRB-2A, MSK Radiobeacon receiver for differential (DGPS) capabilities. This unit was linked to a Winbook XP computer and VGA external video monitor for data storage and real-time data feedback. Remote-sensing instruments for this project included an Eagle I.D. 128 fathometer, and an EG&G Geometrics Model G-866 recording proton precession magnetometer with an EG&G Geometrics Model 801 marine sensor.

The DGPS was used to guide the survey vessel down pre-plotted tracklines and to provide a positioning record correlated with the remote-sensing instruments. The magnetometer was used to search for specific target features in an effort to locate and confirm the presence of acoustic and magnetic features. A fathometer was used to collect bathymetric data of the survey areas.

Every 200 feet bathymetric data was hand-annotated onto the magnetometer stripchart. The magnetometer is used to locate magnetic anomalies through the regular periodic measurement of magnetic field intensity along a line traveled by the survey vessel. Through those measurements, a recording is made of the Earth's ambient magnetic field, as well as any anomalous magnetic fields generated by objects such as the ferrous components of a shipwreck.

Survey Vessel

The vessel used for the remote-sensing survey was a 15-foot aluminum jonboat with a 30-hp Evinrude outboard. Panamerican employs this vessel for electronic survey on inland lakes, rivers, and harbors when the water is too shallow for our larger survey vessel. The jonboat has ample deck area for the placement and operation of the necessary remote-sensing equipment and sensors. The vessel carried appropriate emergency supplies including life jackets, a spare-parts kit, a tool kit, first-aid materials, and potable water. The survey vessel was launched from a trailer at a boat ramp adjacent to the Dog River Bridge. From the launching facility the boat was run to the area of survey, less than half a mile away. With the conclusion of the day's survey activity, the boat was run back to the launching facility, the equipment secured, and the boat removed from the water.

Global Positioning System

A primary consideration in the search for acoustic targets is positioning. Accurate positioning is essential during the running of survey tracklines and for returning to recorded locations for supplemental remote-sensing operations or underwater investigation of targets. These positioning functions were accomplished on this project through the use of a Motorola LGT-1000 global based positioning system used during the remote-sensing survey investigation phase (Figure 22).

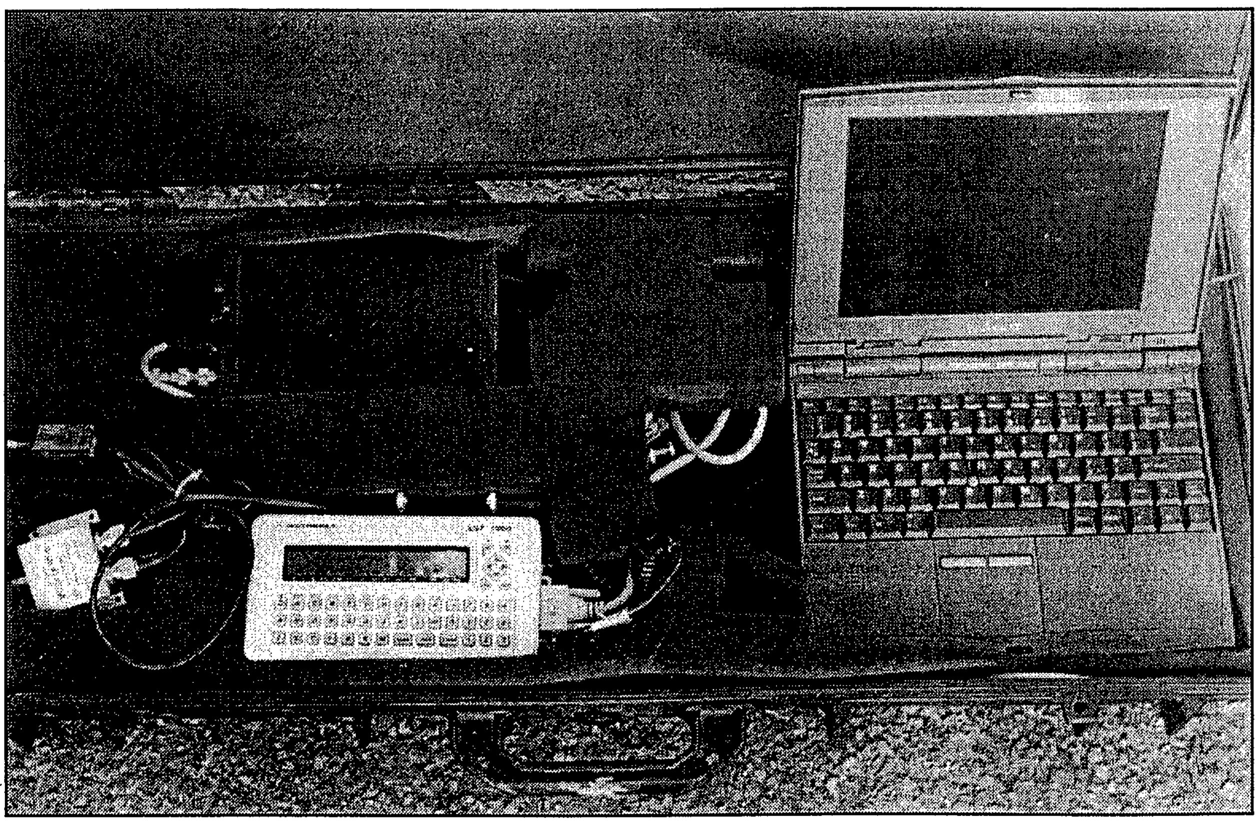

Figure 22. Motorola LG-1000 global based navigation system.

The Motorola LGT-1000 is a global positioning system that, when linked to the Starlink MRB-2A, MSK Radiobeacon receiver, attains differential capabilities. For this survey, Alabama State Plane coordinates, based on the 1983 North American Datum (NAD 83) coordinate system, were used. The GPS interprets transmissions from both satellites in Earth's orbit and a shore-based station to provide accurate coordinate positioning data for offshore surveys. The Motorola system used here has been specifically designed for survey positioning. This positioning was provided through virtually continuous real-time tracking of the moving survey vessel by using corrected position data provided by an on-board GPS processing both satellite data and differential data transmitted from a shore-based GPS station using RTCM 104 corrections. The shore-based differential station monitored the difference between the position that the shore-based receiver derived from satellite transmissions and that station's known position, and broadcast those differences. The DGPS aboard the survey vessel constantly monitored these transmissions in order to provide a real-time correction to any variation between the satellite-derived and actual positions of the survey vessel.

Both the satellite transmissions from Earth's orbit and the differential transmissions received from the shore-based navigation beacon were entered directly into a Winbook XP computer with an auxiliary display screen aboard the survey vessel. The computer and associated hardware and software calculated and displayed the corrected positioning coordinates every second and stored the data every two seconds. The level of accuracy for the system was ±1 meter throughout the survey. Computer software (Navtrak®) used to control data acquisition was written and developed by Chris Ransome & Associates (CRA) specifically for offshore survey applications. Positioning information was printed on hard copy, stored on magnetic disc aboard the survey vessel, and used to provide real-time trackline data for the vessel operator during remote-sensing survey operations. The function of the Motorola GPS was to provide both real-time on-board positioning data during the remote-sensing survey and accurate data for the relocation of any acoustic target or magnetic anomaly locations.

All positioning coordinates are based upon the position of the antenna of the DGPS. Each of the remote-sensing devices was oriented to the antenna, and their orientation relative to the antenna (known as a layback) was noted.

Magnetometer

The remote-sensing instrument used to search for ferrous objects in the project area was an EG&G Geometrics Model G-866 proton precession magnetometer linked to an EG&G Model 801 marine sensor (Figure 23). Briefly, the magnetometer is an instrument that measures the intensity of magnetic forces. It measures (at the location of the sensor) and records both the Earth's ambient magnetic field and the presence of magnetic anomalies (deviations from the ambient background) generated by ferrous masses and various other sources. These measurements are recorded in gammas, the standard unit of magnetic intensity (one gamma is equal to 0.00001 gauss). As the sensor passes through the magnetic field surrounding a ferrous mass, the strength, or intensity, of that anomaly is recorded on a stripchart printout of the magnetometer and is electronically stored in the navigation computer. It should be noted that there are other sources, such as electrical magnetic fields surrounding power transmission lines, dock facilities, navigation buoys, or metal bridges, that may significantly affect magnetometer readings. The stripchart printout of the G-866 records data both numerically and graphically, providing a record of both the ambient background field and the character and amplitude of any anomalies encountered.

The EG&G Geometrics Model 866 was run on the 10-100 gamma scale on the dual graphic printout. The magnetometer was run on all tracklines over the approximately three linear miles surveyed. For this project the magnetometer was interfaced with a Winbook XP laptop computer, utilizing Navtrak® software applications for data storage and management. During the collection of magnetic data the unit was grounded to limit electromagnetic interference that could introduce background noise into the collected data. To ensure that this did not produce false readings during development of the magnetic contour map, and to ensure that all recorded magnetic anomalies were present on the contour map, stripchart records were examined in conjunction with the contour maps produced from the collected data.

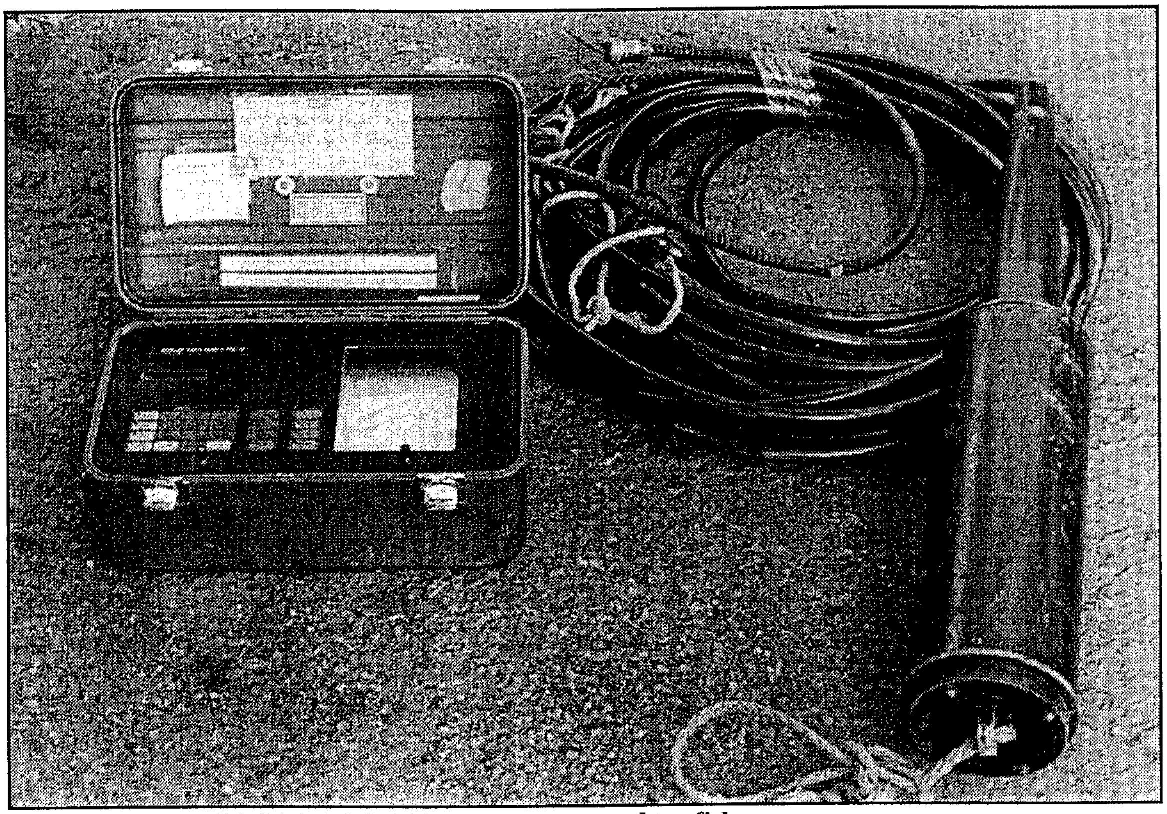

Figure 23. The EG&G Model G-866 magnetometer and towfish.

The magnetometer has the capability to be linked to a variety of sensors. The Model 801 marine tow-sensor is considered optimal for most marine applications. This device is generally towed behind a survey vessel at a sufficient distance to insulate it from onboard electromagnetic interference.

The ability of the magnetometer to detect magnetic anomalies, the sources of which may be related to submerged cultural resources such as shipwrecks, has caused the instrument to become a principal remote-sensing tool of marine archaeologists. While it is not possible to specifically identify a ferrous source by its magnetic field, it is possible to predict shape, mass, and alignment characteristics of anomaly sources based on the magnetic field recorded. Interpretation of magnetic data can provide an indication of the likelihood of the presence or absence of submerged cultural resources. Specifically, the ferrous components of submerged historic vessels tend to produce magnetic signatures that differ from those characteristic of isolated pieces of debris. It is impossible, however, to specifically identify the source of any anomaly solely from the characteristics of its magnetic signature.

Interpretation of data collected by the magnetometer is perhaps the most problematic. Magnetic anomalies are evaluated and prioritized on the basis of magnetic amplitude or deflection of gamma intensity in concert with duration or spatial extent; they are also correlated with sidescan targets. The problems of differentiating between modern debris and shipwrecks on the basis of remote-sensing data have been discussed by a number of authors. This difficulty is particularly true in the case of magnetic data, and therefore it has received the most attention in the current body of literature dealing with the subject. Pearson and Saltus state that "even though a considerable body of magnetic signature data for shipwrecks is now available, it is impossible to positively associate any specific signature with a shipwreck or any other feature" (1990:32). There is no doubt that the only positive way to verify a magnetic source object is through physical examination. With that said, however, the size and complexity of a magnetic signature does provide a usable key for distinguishing between modern debris and shipwreck remains (see Garrison et al. 1989; Irion et al. 1995; Pearson et al. 1993). Specifically, the magnetic signatures of most shipwrecks tend to be large in area and tend to display multiple magnetic peaks of differing amplitude.

The state of technology of iron-hulled or steam vessels may also be considered a factor in their potential for being detected by modern remote-sensing techniques. The magnetometer detects ferrous objects that create deviations in the Earth's natural magnetic field. The greater the weight of iron in the remains of a shipwreck, the greater the likelihood the remains will be observed, at least theoretically. The mass of metal on iron-hulled or steam vessels is made up of the hull and/or boilers, pipes, valves, steam engines, hogging trusses and straps, deck gear, auxiliary engines, pumps, hoists, winches, and other pieces of equipment. As the state of steam technology advanced, boilers and engines got larger, and/or more were used for larger vessels. Larger locomotion systems contain more iron and therefore are more likely to have a detectable magnetic signature.

In a study of magnetic anomalies in the northern Gulf of Mexico, Garrison et al. (1989) indicate that a shipwreck signature will cover an area between 10,000 and 50,000 m^2. Applicable to the Gulf Coast and based on large vessel types, the study's findings are not totally relevant to wooden sailing vessels in the pre-steam era. However, criteria from the Garrison et al. (1989) study and others developed to identify the signatures of larger vessel types are applicable. Using the Garrison et al. (1989) study, as well as years of "practical experience," in an effort to assess potential significance of remote-sensing targets, the Pearson et al. (1991) study developed general characteristics of magnetometer signatures most likely to represent shipwrecks. The report states that "the amplitude of magnetic anomalies associated with shipwrecks vary [*sic*] considerably, but, in general, the signature of large watercraft, or portions of watercraft, range from moderate to high intensity (>50 gamma) when the sensor is at distances of 20 ft. or so" (1991:70). Using a table of magnetic data from various sources as a base, the report goes on to state that "data suggest that at a distance of 20 ft. or less watercraft of moderate size are likely to produce a magnetic anomaly (this would be a complex signature, i.e., a cluster of dipoles and/or monopoles) greater than 80 or 90 ft across the smallest dimension. . . ." (Pearson et al. 1991:70).

While establishing baseline amounts of amplitude and duration reflective of the magnetic characteristics for a shipwreck site, the authors recognize "that a considerable amount of variability does occur" (1991:70). Generated in an effort to test the 50-gamma/80-foot criteria and determine amount of variability, Table 2 lists numerous shipwrecks as well as single- and multiple-source objects located by magnetic survey and verified by divers. All shipwrecks meet and surpass the 50-gamma/80-foot criteria, while all single-object readings, with the exception of the pipeline, fall below the criteria. However, the signature of the pipeline should show up as a linear feature on a magnetic contour map and not be confused with a single-source object. While the shipwrecks and single objects adhere to the 50-gamma/80-foot criteria, the multiple objects do not. If all targets listed on the table had to be prioritized as to potential significance based on the 50-gamma/80-foot criteria, the two multiple-object targets would have to be classified as potentially significant.

Although data indicate the validity of employing the 50-gamma/80-foot criteria when assessing magnetic anomalies, other factors must be taken into account. Pearson and Hudson (1990) have argued that the past and recent use of a water body must be an important consideration in the interpretation of remote-sensing data; in many cases it is the most important criterion. Unless the remote-sensing data, the historical record, or the specific environment (e.g., harbor entrance channel) provide compelling and overriding evidence to the contrary, it is believed that the history of use should be a primary consideration in interpretation. What constitutes "compelling evidence" is to some extent left to the discretion of the researcher; however, in settings where modern commercial traffic and historic use have been intensive, the presence of a large quantity of modern debris must be anticipated. In harbor, bay, or riverine situations with heavy traffic, this debris will be scattered along the channel right-of-way, although it may be concentrated at areas where traffic would slow or halt; it will appear on remote-sensing surveys as discrete, small objects.

Table 2. Magnetic Data from Shipwrecks and Nonsignificant Sources.

Vessel (object)	Type & Size	Magnetic Deviation	Duration (feet)	Reference
Shipwrecks				
Tug	Wooden tug with machinery	-30257	176	Tuttle and Mitchell 1998
Mexico	288 ton wooden bark	1260	454	Tuttle and Mitchell 1998
J.D. Hinde	129-ft. wooden sternwheeler	573	110	Gearhart and Hoyt 1990
Utina	267-ft. wooden freighter of 238 tons	690	150	James and Pearson 1991 Pearson and Simmons 1995
King Phillip	182-ft. clipper of 1,194 tons	300	200	Gearhart 1991
Reporter	141-ft. schooner of 350 tons	165	160	Gearhart 1991
Mary Somers	iron-hulled sidewheeler of 967 tons	5000	400	Pearson et al. 1993
Gen. C.B. Comstock	177-ft. wooden hopper dredge	200	200	James et al. 1991
Mary	234-ft. iron sidewheeler	1180	200	Hoyt 1990
Columbus	138-ft. wooden-hulled 416 ton Chesapeake Sidewheeler	366	300+	Morrison et al. 1992
El Nuevo Constante	126-ft. wooden collier	65	250	Pearson et al. 1991
James Stockton	55-ft. wooden schooner	80	130	Pearson et al. 1991
Homer	148-ft. wooden sidewheeler	810	200	Pearson and Saltus 1993
Modern shrimp boat	segment 27 x 5 ft.	350	90	Pearson et al. 1991
Confederate obstructions	numerous wooden vessels with machinery removed and filled with construction rubble	110	long duration	Irion and Bond 1984
Single Objects				
pipeline	18-in. diameter	1570	200	Duff 1996
anchor	6-ft. shaft	30	270	Pearson et al. 1991
iron anvil	150 lbs.	598	26	Pearson et al. 1991
engine block	modern gasoline	357	60	Rogers et al. 1990
steel drum	55 gallon	191	35	Rogers et al. 1990
pipe	8 ft. long x 3 in. diameter	121	40	Rogers et al. 1990
railroad rail segment	4-ft. section	216	40	Rogers et al. 1990
Multiple Objects				
anchor/wire rope	8-ft. modern stockless/large coil	910	140	Rogers et al. 1990
cable and chain	5 ft.	30	50	Pearson et al. 1991
scattered ferrous metal	14 x 3 ft	100	110	Pearson et al. 1991

(after Pearson et al. 1991)

Survey Procedures

The remote-sensing phase of this project began on October 12, 2000. The positioning and remote-sensing instruments were installed and tested aboard the survey vessel. Transects were run parallel to the centerline at 100-foot intervals. As the survey vessel maneuvered down the transect, the navigation system determined vessel position along the actual line of travel every second. These positioning points along the line traveled were recorded on computer floppy disk.

The full project area was examined with the magnetometer where safely navigable. The survey vessel began each run outside each survey area, running parallel to the centerline. At the proper interval the vessel would reverse course and proceed down the next trackline. Survey transects were spaced at 100-foot intervals, with three transects in each area being necessary for complete coverage of each area. For ease of survey and data collection, the project area was broken down into nine separate survey areas (Figure 24).

Upon completion of the fieldwork, the data was reviewed. Contour maps were made of the magnetometer data, and magnetic anomalies were prioritized as to possible significance by evaluating signal characteristics. The pertinent signal characteristics for magnetic anomalies include strength, duration, and relative association with other remotely-sensed data.

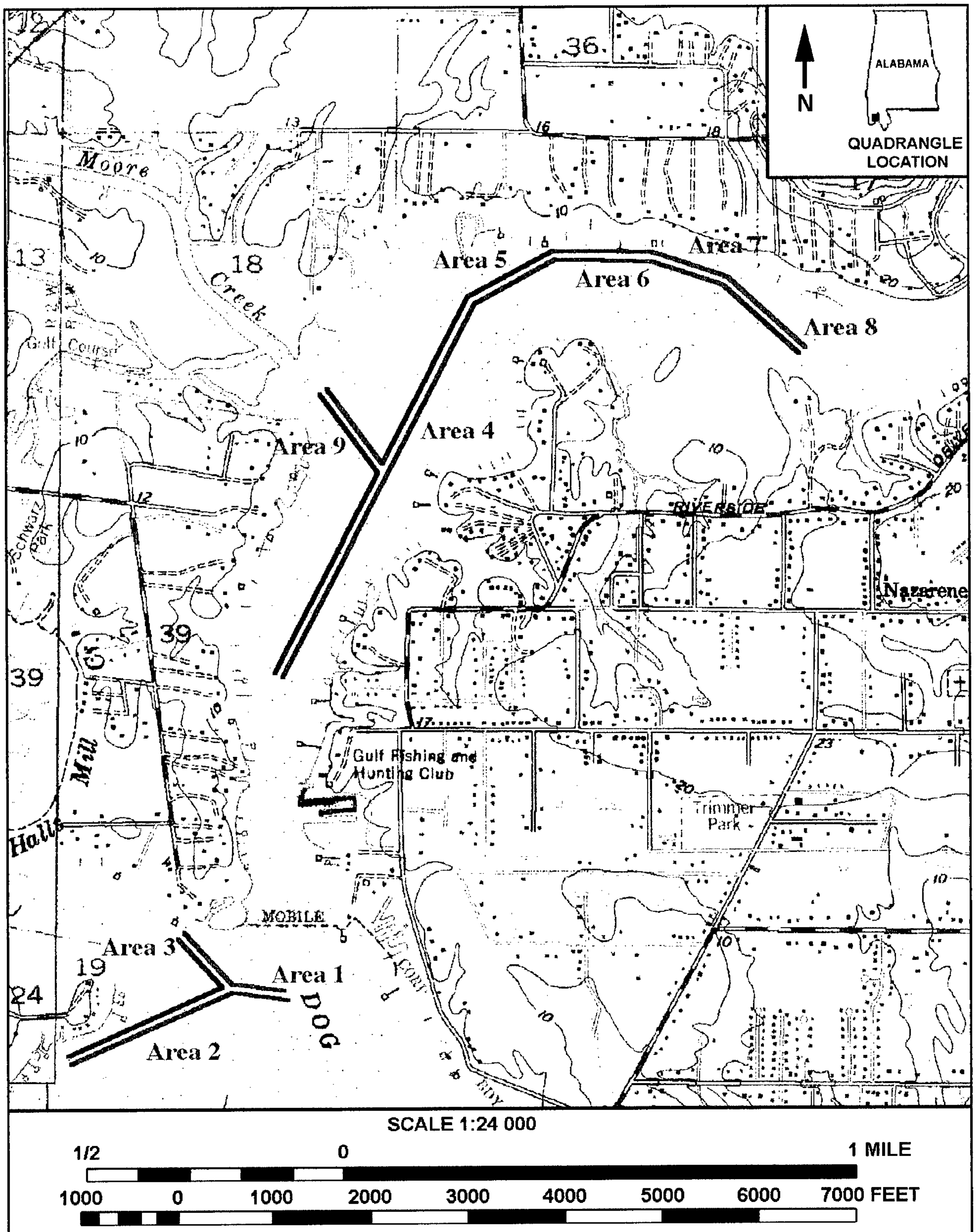

Figure 24. Map showing the nine separate survey areas (base map: 1953 U.S.G.S. Hollingers Island, AL 15' quadrangle [photorevised 1982]).

4. RESULTS

The remote-sensing phase of this project successfully collected data in all safely navigable areas within the project area. DGPS positioning data and magnetometer data were collected and digitally recorded on computer disk. Nine separate survey sections were defined for ease of data collection and a total of 29 transects were investigated, covering a total distance of more than three line miles. Due to the coverage given the project area, slight survey trackline deviations are not considered as a significant loss of data. Utilizing a 10-gamma contour interval, maps were generated from magnetometer and positioning data digitized during the survey and then processed following completion of the fieldwork using the computer program Surfer® 6.01.

Remote Sensing Survey

The remote-sensing survey phase of the project areas successfully collected positioning and magnetometer data for the entire project area, which was digitally recorded on computer disk. Three tracklines at a 100-foot spacing for the magnetometer survey were necessary to completely cover each of the nine areas. A total of seven anomalies were located during the survey. The anomalies are presented in Figures 25-27, in Table 3, and discussed below.

Table 3. Anomalies Located in the Dog River Project Area.

Anomaly	Easting	Northing	Gamma Strength	Deflection	Duration (feet)	Comments
1	221851	1776033	-86/0	86	60	Does not meet 50 gamma/80 ft. criteria.
2	222183	1775858	-106/+143	249	180	Across 3 lines. Part of Cluster 1. Recommended for further work.
3	222362	1775719	-17/+293	310	220	Across 3 lines. Part of Cluster 1. Recommended for further work.
4	221620	1776010	-31/+59	90	40	Does not meet 50 gamma/80 ft. criteria.
5	various	various	-200/+1195	1395	210	Across 9 lines. Recommended for further work.
6	215110	1772640	-40/+205	245	30	Does not meet 50 gamma/80 ft. criteria.
7	215050	1772970	0/+41	41	30	Does not meet 50 gamma/80 ft. criteria.

Analysis of the collected data revealed seven anomalies. Of these seven anomalies, four did not meet established criteria for the existence of a shipwreck. Two were in close enough proximity to each other that they were treated as a single anomaly cluster. This cluster, along with another anomaly, met the established 50 gamma/80 feet criteria, could not be associated with known object, and are recommended for further investigation.

Anomaly 1

Anomalies 1 is located in Area 9, and appeared on a refinement trackline midway between the northernmost and the center tracklines (Figure 25). It had a maximum gamma deflection of –86 for a total deflection of 86 gammas and a duration of 60 feet. Depth of water over the anomaly averaged five feet. This anomaly does not meet established magnetic criteria for the existence of a shipwreck, and is considered non-significant.

Anomaly 2

Anomaly 2 is located in Area 9, and appeared across two tracklines (Figure 25). It had maximum gamma deviations of –106 and +143 for a total deviation of 249, and a duration of 180 feet.

Depth of water over the anomaly averaged five feet. Anomaly 2 meets the established criteria for the existence of a shipwreck, and is recommended for further investigation as part of Cluster 1.

Anomaly 3

Anomaly 3 is located in Area 9, and appeared across two tracklines (Figure 25). It had maximum gamma deviations of –17 and +293 for a total deviation of 310, and a duration of 180 feet. Depth of water over the anomaly averaged five feet. This anomaly meets the established criteria for the existence of a shipwreck, and is recommended for further investigation as part of Cluster 1.

Anomaly 4

Anomaly 4 is located in Areas 9 and 4, and appeared on the westernmost trackline in each area (Figure 25). It had maximum gamma deflections of –31 and +59 for a total deflection of 90 gammas and a duration of 40 feet. Depth of water over the anomaly is roughly five feet. This anomaly does not meet magnetic criteria for the existence of a shipwreck, and is considered non-significant.

Anomaly 5

Anomaly 5 is located in Areas 2 and 3, and appears across the entire width of each survey area (Figure 26). This anomaly had maximum gamma deflections of –200 and +1195 for a total deflection of 1395 gammas and a duration of 210 feet. Depth of water over the anomaly is approximately four feet. This anomaly has magnetic characteristics indicative of a pipeline (i.e., length, linearity). However, historical records do not indicate a pipeline in this area. This anomaly is recommended for further work unless evidence of a pipeline at this location is found.

Anomaly 6

Anomaly 6 is located in Area 3, and appeared on the south trackline (Figure 26). This anomaly had maximum gamma deflections of –40 and +205 for a total deflection of 245 gammas and a duration of 30 feet. Depth of water over the anomaly is approximately four feet. This anomaly does not meet established magnetic criteria for the existence of a shipwreck, and is considered non-significant.

Anomaly 7

Anomaly 7 is located in Area 3, and appeared on the south trackline (Figure 26). This anomaly had maximum gamma deflections of +41 for a total deflection of 41 gammas and a duration of 30 feet. Depth of water over the anomaly is approximately four feet. This anomaly does not meet established magnetic criteria for the existence of a shipwreck, and is considered non-significant.

Cluster 1

Cluster 1 runs northeast to southwest along the north trackline in Area 9, stretching across two tracklines and two additional refinement tracklines (Figure 26). It is considered to represent the same source and is considered a single target. This cluster meets established criteria for the existence of a shipwreck. Due to the lack of evidence of modern debris or other modern items that would cause such an anomaly, this cluster is recommended for further investigation.

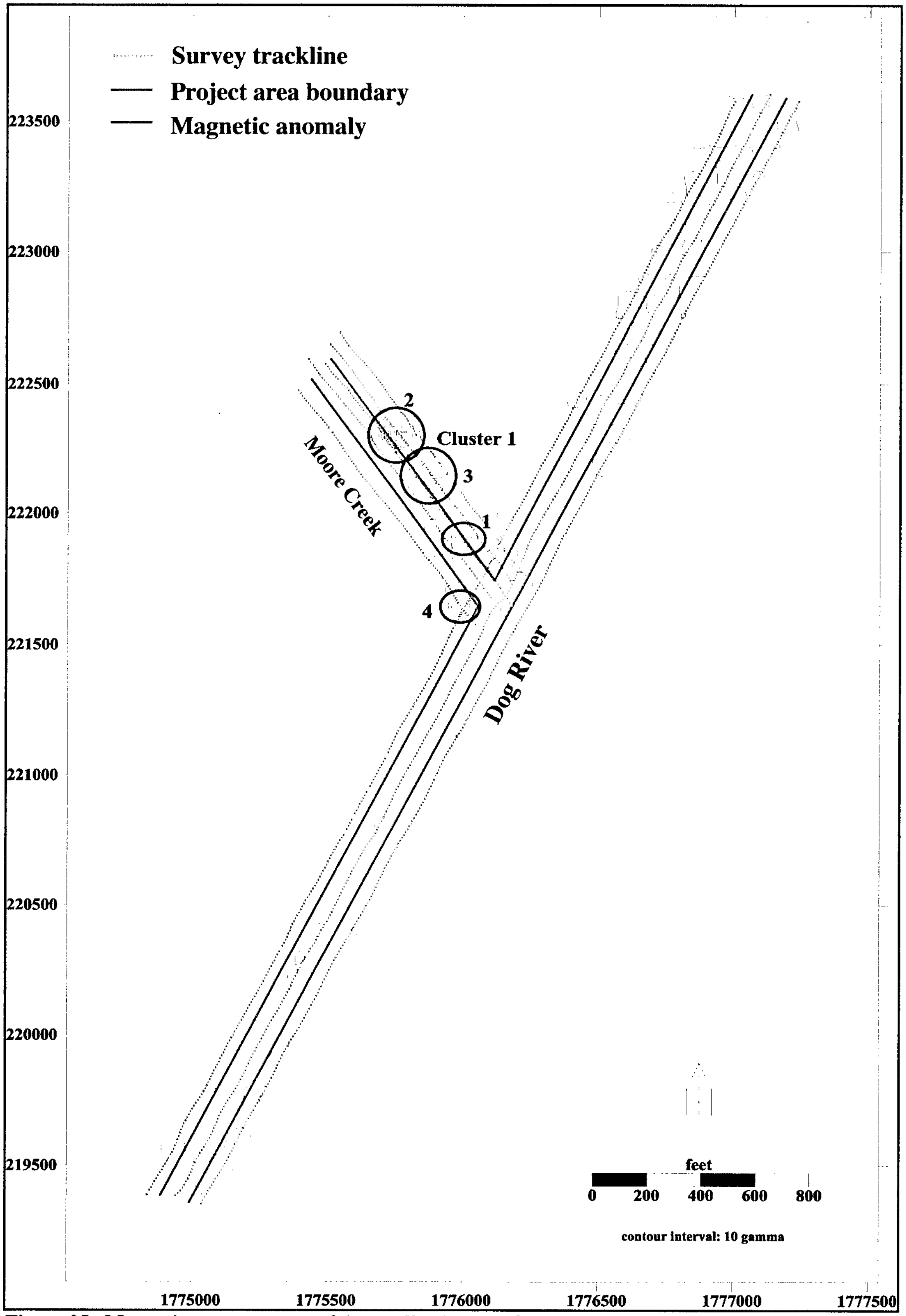

Figure 25. Magnetic contour maps of Anomalies 1-4 and Cluster 1.

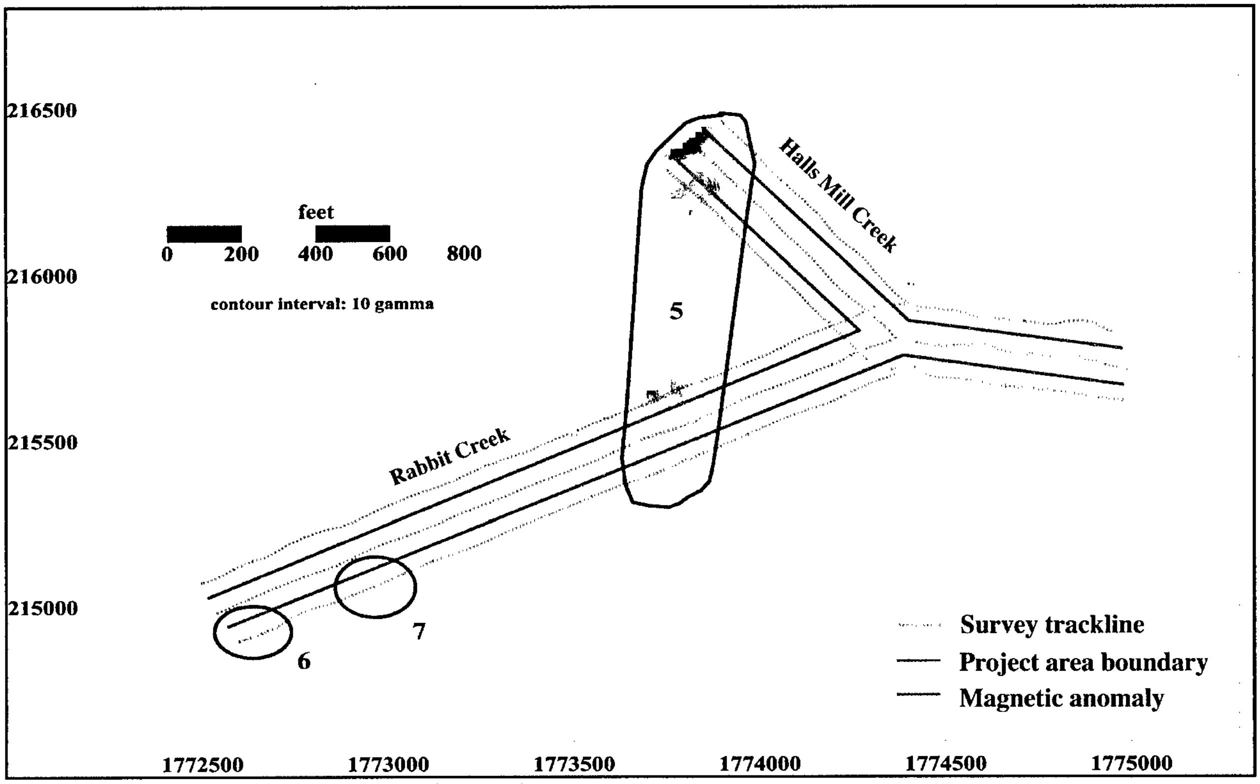

Figure 26. Magnetic contour map of Anomalies 5-7.

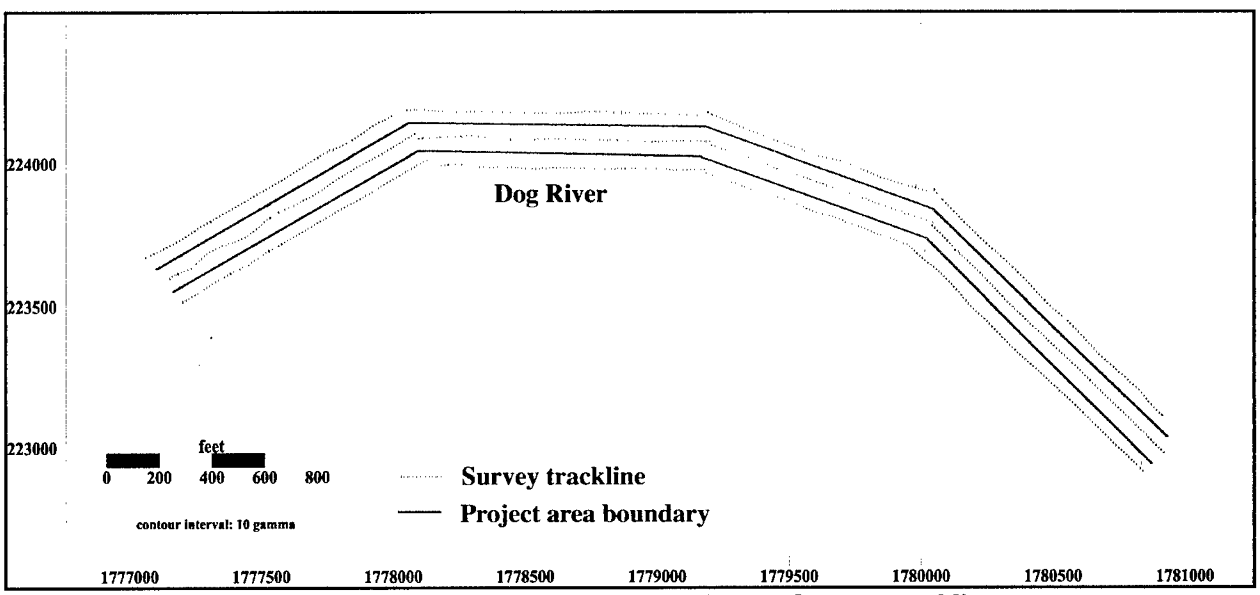

Figure 27. Magnetic contour map showing project area boundary and survey tracklines.

5. CONCLUSIONS & RECOMMENDATIONS

Following completion of the remote-sensing survey, a review of the data was conducted. The principal investigator selected those acoustic targets and magnetic anomalies with the greatest potential for representing submerged cultural resources. These selections were made by evaluating the characteristics of magnetic anomalies recorded during the survey. The signal characteristics used for the selection of magnetic anomalies included anomaly amplitude or deflection intensity; total area as determined by duration of an anomaly along a trackline, extension of that anomaly on adjacent lines, and relative association of a given anomaly to other anomalies (i.e., clustering). Two anomalies/anomaly clusters met these established criteria, and are considered to have potential to represent submerged cultural resources. Further work in the form of probing and/or diver investigation is recommended for Anomaly 5 and Cluster 1.

Of the seven anomalies detected during the remote-sensing survey, three were determined to have the potential to represent submerged cultural resources, and were flagged for further investigation. Of these three, two were in close enough proximity to each other that they were treated as a single anomaly cluster, representing the same object or objects which are closely associated with each other. The remaining anomaly has characteristics that, although they indicate a potential shipwreck, also indicate a potential pipeline. Since no documentary evidence of the existence of a pipeline in the area has been found, this anomaly, along with the previously mentioned cluster, is recommended for further work in the form of probing and/or diver investigation.

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APPENDIX

CURRICULUM VITAE OF PRINCIPAL INVESTIGATOR

ANDREW DAVID WILLIAM LYDECKER

EDUCATION

University of Wisconsin, Madison, Wisconsin
Archaeology
Master of Arts, 1995

University of Wisconsin, Madison, Wisconsin
Cartography and Geographic Information Systems
Master of Science, 1995

Mankato State University, Mankato, Minnesota
Anthropology and Geography
Bachelor of Science, 1990

HONORS AND CERTIFICATIONS

PADI Advanced Open Water Diver
PADI Underwater Photographer (pending)
Red Cross CPR and First Aid
Taylor Corporation Scholarship Award
Signe Chilstrom Scholarship Award

PROFESSIONAL ASSOCIATIONS

Society for Historic Archaeology

AREAS OF SPECIALIZATION

Underwater Archaeology
Computer Applications in Archaeology (GIS, GPS, CAD, etc)
Archival and Historical Research
Low-Visibility Diving

FIELD WORK

2000 Principle Investigator. Underwater Remote Sensing Survey, Dog River, Mobile County, Alabama. For U.S. Army Corps of Engineers, Wilmington District.

Field Director. Phase I Underwater Archaeological Survey Maple/Oregon Bridge Corridor and Area of Dredging, Sturgeon Bay Ship Canal, Door County, Wisconsin. For Teng and Associates, Inc., Chicago, IL.

Field Director. Phase I Archaeological Survey East of the Craney Island, Elizabeth River, Virginia. For U.S. Army Corps of Engineers, Wilmington District.

Field Director. Recording Portions of the Burlington Breakwater in Lake Champlain, City of Burlington, Chittenden County, Vermont, and Development of Signage and a Webpage in Connection with the Proposed Structural Repair

Activities. For U.S. Army Corps of Engineers, New York District. Under subcontract to Northern Ecological Associates, Inc, Canton, New York.

Digital Photographer/Image Processing Specialist. Color Digital Photography and Image Enhancement of portions of the Ohio Hopewell Collections of the Ohio Historical Society, Columbus, Ohio. For National Center For Preservation Technology and Training, and Christopher Carr, PhD., Arizona State University.

Maritime Archaeologist. Underwater inspection of two wrecks, Belmar Borrow Area 6, Atlantic Coast of New Jersey, Beach Erosion Control Project, Reach Asbury South, Belmar to Manasquan. For U.S. Army Corps of Engineers, New York District. Under subcontract to Northern Ecological Associates, Inc, Canton, New York.

Maritime Archaeologist. Underwater archaeological survey at the Charleston Harbor Deepening Project, Charleston, South Carolina. For U.S. Army Corps of Engineers, Wilmington District.

Maritime Archaeologist. Underwater Investigations of Site G.T. 3, Grand Turk, Turks and Caicos Islands, British West Indies. For Ships of Discovery, Corpus Christi, Texas.

Field Archaeologist. Recordation and mapping of National Historic Site of Cheshire Hall, Providenciales Island, Turks and Caicos Islands, British West Indies. For Ships of Discovery, Corpus Christi, Texas.

Field Archaeologist. Field survey and mapping of Southwest Harbor Bluff #1 and #2, locations of Inscriptions made by shipwrecked sailors ca. 18^{th} and 19^{th} centuries, Providenciales Island, Turks and Caicos Islands, British West Indies. For Ships of Discovery, Corpus Christi, Texas.

Digital Photographer/Image Processing Specialist. Color digital photography and Image Enhancement of portions of the Hopewell Collection of the Field Museum of Chicago, Chicago, Illinois. For Ohio State University Department of Geology and Christopher Carr, PhD., Arizona State University.

1999 Maritime Archaeologist. Diver Investigations for the *U.S.S. Col. Kinsman*, St. Mary's Parish, Morgan City, Louisiana. For U.S. Army Corps of Engineers, New Orleans Division under subcontract to Coastal Environments, Inc., Baton Rouge, La.

Maritime Archaeologist. National Register of Historic Places Eligibility Evaluations of 13 Potential Watercraft Targets Located Within Items 5-9 of the Upper Yazoo Projects, Quitman, Tallahatchie, and Leflore Counties, Mississippi. For U.S. Army Corps of Engineers, Vicksburg District.

Maritime Archaeologist. Investigation of potential historic structures along the Wolf River, Shelby County, Tennessee.

Image Processing Specialist. Digital Image Processing and Enhancement of Digital Photography of the Ohio Hopewell Collections of the Ohio Historical Society, Columbus Ohio; Ross County Historical Society, Chillicothe, Ohio; and Mound City National Historic Park, Chillicothe, Ohio. For Christopher Carr, PhD., Arizona State University.

1998 G.I.S. Specialist/Independent Consultant/Field Archaeologist. Design and construction of archaeological mapping system involving GIS and GPS. For Historic Preservation Office, Majuro Atoll, Republic of the Marshall Islands.

Field Archaeologist. Phase I Archaeological Survey of Kili Island, Republic of the Marshall Islands. For RMI Historic Preservation Office (HPO).

1997 Digital Photographer/Image Processing Specialist. Digital photography and image enhancement of portions of the Ohio Hopewell Collections of the Ohio Historical Society, Columbus, Ohio. For National Center for Preservation Technology and Training, and Christopher Carr, PhD., Arizona State University.

Digital Photographer/Image Processing Specialist. Digital photography and image enhancement of portions of the Ohio Hopewell Collections of Mound City National Historic Park, Chillicothe, Ohio. For National Center for Preservation Technology and Training, and Christopher Carr, PhD., Arizona State University.

Digital Photographer/Image Processing Specialist. Digital photography and image enhancement of portions of the Ohio Hopewell Collections of the Ross County Historical Society, Chillicothe, Ohio. For National Center for Preservation Technology and Training, and Christopher Carr, PhD., Arizona State University.

1996 Maritime Archaeologist. Underwater archaeological survey of the shipwrecks Manasquan and the Western World, Point Pleasant, New Jersey. For U.S. Army Corps of Engineers, New York District.

1993 Maritime Archaeologist. Underwater archaeological survey of the steamship Niagara, Port Washington, Wisconsin, for State Historical Society of Wisconsin, Madison, WI.

1992 Field School Participant. Underwater archaeological survey of the steamship Maple Leaf, Jacksonville, Florida. For East Carolina University, Greenville, North Carolina.

Field Archaeologist. Phase II archaeological assessment of Archaic site in Stevens Point, Wisconsin. For Midwest Archaeological Consulting, Inc, Madison, WI

1990 Field Archaeologist. Phase II archaeological assessment of three sites impacted by the construction of Blue Earth County Road 190, Blue Earth County, Minnesota. For Impact Services, Inc., Mankato, Minnesota.

Volunteer. Phase II assessment of multicomponent site at Myre/Big Island State Park, Albert Lea, Minnesota. For Minnesota Department of Natural Resources, St. Paul, Minnesota.

1989 Field Archaeologist. Phase II archaeological assessment of four sites impacted by the construction of Blue Earth County Roads 187 and 188, Blue Earth County, Minnesota. For Impact Services, Inc., Mankato, Minnesota.

LABORATORY AND MUSEUM EXPERIENCE

1996 – 1998

Director. Cartography and Digital Image Processing Laboratory, ASC Group, Inc., Columbus, Ohio

ADDITIONAL WORK EXPERIENCE

1991 – 1992

Research Assistant. Department of Anthropology, University of Wisconsin, Madison, and Gary A. Feinman, Professor of Anthropology.

1990 Teaching Assistant. Geography 280: Soils Geography. Department of Geography, Mankato State University, Mankato, Minnesota.

RESEARCH REPORTS

Andrew D.W. Lydecker and Michael C. Tuttle

2000a *Phase I Archaeological Remote Sensing Survey East of the Craney Island, Elizabeth River, Virginia.* For U.S. Army Corps of Engineers, Wilmington District.

2000b *Phase I Archaeological Remote Sensing Survey Maple/Oregon Bridge Corridor and Area of Dredging, Sturgeon Bay Ship Canal, Door County, Wisconsin.* For Teng and Associates, Chicago, IL.

Andrew D.W. Lydecker and Ann Cousins

2000 *Burlington, Chittenden County, Vermont, and Development of Signage and a Webpage in Connection with the Proposed Structural Repair Activities.* For U.S. Army Corps of Engineers, New York District under contract to Northern Ecological Associates, Canton, NY.

David D. McGehee, Steven R. James, Jr, Andrew D. W. Lydecker

2000 *Underwater Remote Sensing Survey of Naval Station Pascagoula..* For U.S. Army Corps of Engineers, Mobile District

Michael C. Tuttle, Andrew D. W. Lydecker

2000 *Underwater Archaeological Diver Services at the Thimble Shoal and Cape Henry Borrow Areas Near Virginia Beach, Virginia.* For the U.S. Army Corps and Engineers, Wilmington District.

Christopher Carr and Andrew D. W. Lydecker

1998 *Exploring the Possibility of Artwork on Ohio Hopewell Copper Artifacts (ca. 50 B.C. - A.D. 350) With High Resolution Digital Photography, Image Enhancement, and Electron Microprobe Chemical Analysis.* National Park Service website: http://www.nps.gov/hocu/carr%20and%20lydecker.htm

Andrew D. Lydecker

1995 *Coastal Geomorphology and the Spatial Patterning of Submerged Prehistoric Archaeological Sites.* Unpublished research paper written for Geography 329: Landforms and Landscapes of North America, Spring 1995.

1994a *Extending Penetration in Underwater Photography.* Unpublished research paper written for Geography 970: Seminar in Cartography, Spring 1994.

1994b *Water Penetration Photography and Digital Image Processing in Underwater Archaeology.* Unpublished Master's Thesis, Department of Geography, UW – Madison, Fall 1994.

1994c *A Multisensor Approach to the Mapping of Submerged Cultural Resources.* Unpublished research paper written for Anthropology 942: Archaeological Research Methods, Fall 1992.

1993 *Computer Mapping of Archaeological Data.* Unpublished research paper written for Geography 375: Computer Cartography, Fall 1993.

1992a *History and Archaeology: Blockade Running During the American Civil War.* Unpublished research paper written for Anthropology 942: Historical Archaeology, Spring 1992.

1992b *An Interpretation of Calusa Settlement Pattern.* Unpublished research paper written for Anthropology 310: Eastern North American Prehistory, Spring 1992.

1992c *Megaliths and Society.* Unpublished research paper written for Anthropology 800: Origins of Civilization, Spring 1992.

1992d *A Possible Explanation for the Occurrence of Long Barrows in Southern Great Britain.* Unpublished research paper written for Anthropology 309: European Prehistory, Fall 1992.

1991a *Stylistic Variability in Lithic Analysis: The Determination of Schools of Manufacture.* Unpublished research paper written for Anthropology 942: Ancient Technology and Invention, Fall 1991.

1991b *Symbolic Archaeology.* Unpublished research paper written for Anthropology 801: Archaeological Method and Theory, Fall 1991.

1990 *A Cultural Resource Survey of Helmer Myre State Park.* Prepared for the Minnesota Department of Natural Resources and Helmer Myre State Park, Albert Lea, Minnesota.

Richard A. Strachan, Kathleen A. Roetzel, Andrew D. Lydecker
1989 *A Cultural Resources Investigation of Four Sites Impacted by the Construction of Blue Earth County Roads 187 and 188, Blue Earth County, Minnesota.* Prepared for Blue Earth County by Impact Services, Inc., Mankato, MN.