

A. Robert Holcombe, Jr. THE EVOLUTION OF CONFEDERATE IRONCLAD DESIGN. (Under the direction of Dr. William N. Still, Jr.) East Carolina University, Department of History, April, 1993.

This thesis is an attempt to understand the construction and design evolution of the Confederate ironclad warship. It is based principally on little-known original builder's plans, specifications, and half-models, and to a lesser extent on scarce contemporary and near-contemporary manuscript sources. Discoveries made in the relatively new field of underwater archaeology have also contributed significantly to this study.

That the Confederate navy adopted the armor-plated warship in an innovative effort to counter the numerical advantage of its naval foe is a well-established fact. Despite considerable difficulties, over fifty such vessels were placed under construction; of these, approximately two dozen were completed and commissioned into service. Influenced by a poorly defined offensive mission, those ironclads commenced in 1861 lacked both standardization in design and suitability for operations in Southern waters. In 1862 a more realistic defensive strategy was adopted. This policy shift led to the development of two fundamental ironclad designs based on hull form, both of which were better suited to the navy's needs than the earlier models. As the war progressed these two standardized types went through an evolutionary process whereby improvements were made based on operational and combat usage, material shortages, and improved manufacturing facilities. As a result, those ironclads placed under construction in the latter part of the war were far better fighting machines than those built previously.

While several scholarly studies of the origins of the Confederacy's ironclad program and the operations and battles of the ships have been made, little has been written concerning their design and construction. This is not surprising, for with the exception of the Virginia, Albemarle, and several other of the better-known ironclads, very few technical accounts of the planning and building of these vessels were left by those involved. The

difficulty in researching the subject is further compounded by the apparent destruction of the chief naval constructor's papers and models on the 1865 evacuation of Richmond and similar occurrences at building sites throughout the South at the end of the war. Those few modern studies that have attempted to deal with ironclad design have been based primarily on incomplete, secondary sources and thus cannot be considered definitive.

Fortunately, a considerable number of original builder's drafts and several original builder's models survive at institutions scattered around the country. Although virtually ignored by most naval historians, these plans and models, when combined with other information, allow a far more thorough analysis of Confederate ironclad design than has ever before been possible. Moreover, this information permits the development of a more accurate classification system based on hull configuration and other criteria.

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OF
CONFEDERATE IRONCLAD DESIGN

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the Faculty of the Department of History
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In Partial Fulfillment
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CHAPTER I

GENESIS OF THE PROGRAM

In early June of the first year of the American Civil War Confederate naval secretary Stephen R. Mallory decided to build an armor-plated warship within the Confederacy. This pivotal decision was vindicated nine months later when the ironclad Virginia defeated the wooden warships of the Federal navy in Hampton Roads, Virginia, then fought the turreted Monitor to a draw the following day. From that moment forward the Confederate navy emphasized the construction of armored warships for the defense of its home waters, and the type has largely come to define the South's naval efforts. In consequence of Mallory's resolve, as many as fifty ironclads were laid down in the South during the course of the war. Of these, nearly two dozen were placed into commission, virtually all based on the Virginia's casemated design.¹

Despite its place in the annals of naval warfare, Hampton Roads marked not the beginning of a revolution in naval construction, as is often supposed, but capped one well underway. More accurately, the sinking of the Congress and the Cumberland by the Virginia symbolized the passing of the centuries-long reign of the wooden, sail-powered man-of-war, much as the second day's encounter between the Southern ironclad and its Northern counterpart was a harbinger of future naval combat. Indeed, the ironclad had actually been tested in battle seven years previous, when Britain and France joined forces to combat Russia in the Crimean region of the Black Sea. As a result, by the spring of 1862 approximately eighty-eight armored warships had been built or were under construction in Europe.²

The concept of protected warships predates even these immediate pre-Civil War efforts. Attempts to protect vessels of war by various means date back to the ancients, while in 1592 Korean Admiral Yi Sun-sin successfully used iron-plated, turtle-backed

vessels against the Japanese in the first recorded use of armored ships in naval combat.³ In subsequent years numerous proposals were made to construct shot-proof vessels. Apparently several such ships were built, but none made a lasting impression and only scant details survive of these early attempts at armor cladding. Prior to the second quarter of the 19th century there existed neither the incentive nor the technology to produce viable armored warships. Instead, a delicate balance prevailed between ship and weapon, with combatants rarely sinking the other by cannon fire. More often the battle was decided when a ship was captured by boarding, or struck her colors after damage to her rigging or steering, or after having her crew decimated by gun fire. This standoff was due primarily to the artillery used during the period, the smoothbore cannon. Firing a solid nonexplosive ball, this weapon often lacked the power to penetrate the thick wooden walls of the era's warships, and even when a vessel's hull was pierced the hole could easily be plugged. The introduction of the shipboard shell-firing cannon in 1824 upset this parity and caused a revolution in naval construction.⁴

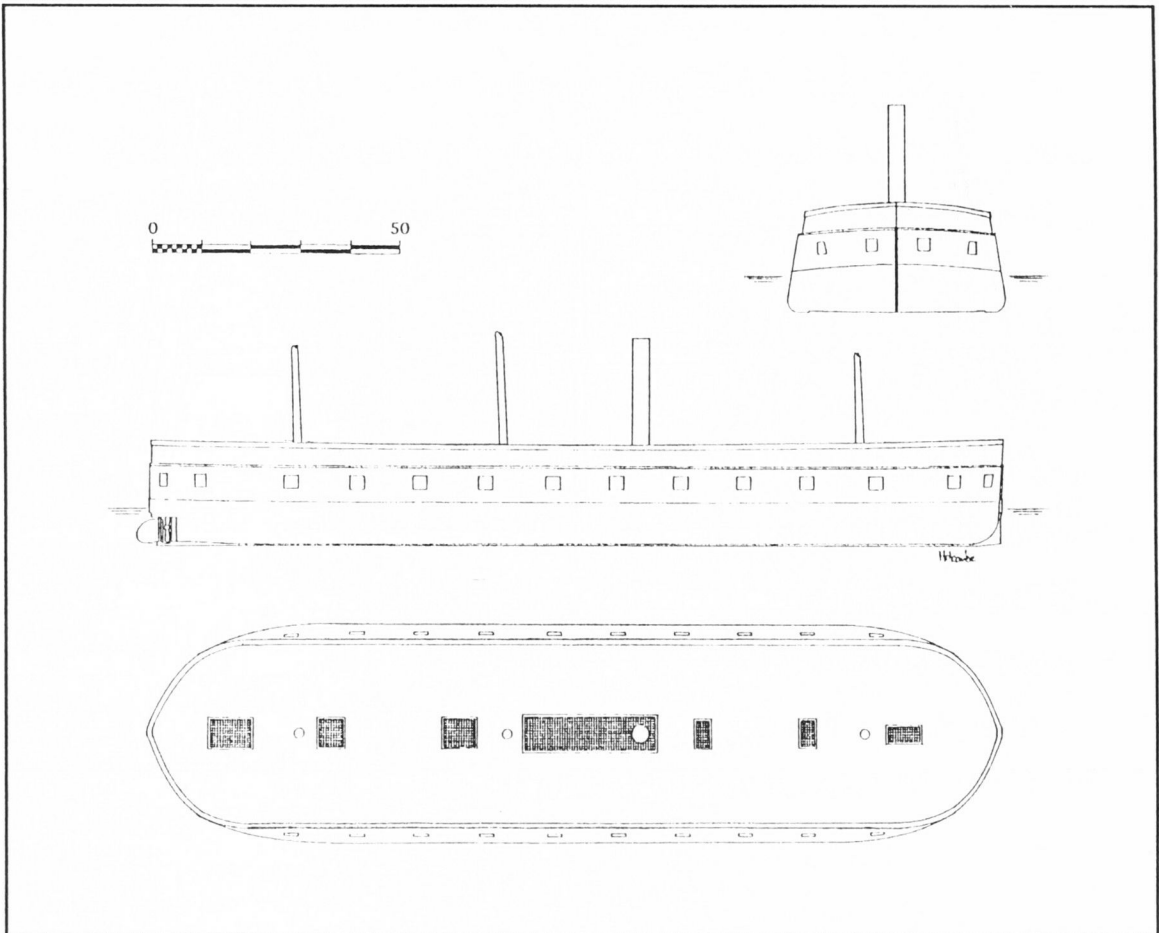
Credit for perfecting the naval shell gun belongs to French army officer Henri-Joseph Paixhans. Although shipboard guns firing explosive projectiles had been used as early as 1682, the weapon was generally considered impractical aboard ship because of the perceived danger of accidental explosion of the shells. Paixhans believed otherwise: that the shell gun was both safe and practical, and that vessels armed with such weapons would cause massive destruction and drive the wooden ship-of-the-line from the sea. Pursuant to his theories, he developed a 22-centimeter, 80-pounder shell gun, and beginning in January 1824 tested the weapon against an old 80-gun ship-of-the-line. These and other experiments vindicated Paixhans, and later that year the shell gun was approved for use by the French Navy.⁵

The Battle of Sinope in 1853 demonstrated for the first time to the general public the destructiveness of the explosive shell against wooden warships. At Sinope, a Russian fleet

consisting of nine warships, many armed with shell guns, scored a signal victory when it annihilated all but one vessel of a thirteen-ship Turkish squadron. Following this action France and Britain joined forces with Turkey against Russia in what became known as the Crimean War. A year later the catastrophic effects of the shell against unarmored wooden vessels was repeated during the bombardment of Sevastopol, when Russian shell guns severely damaged several of the attacking allied fleet. The Battle of Sinope, followed by the allied rebuke at Sevastopol, prompted French and British interest in finding means to protect warships against the shell and led to the first combat use of armor-plated vessels in modern naval warfare.⁶

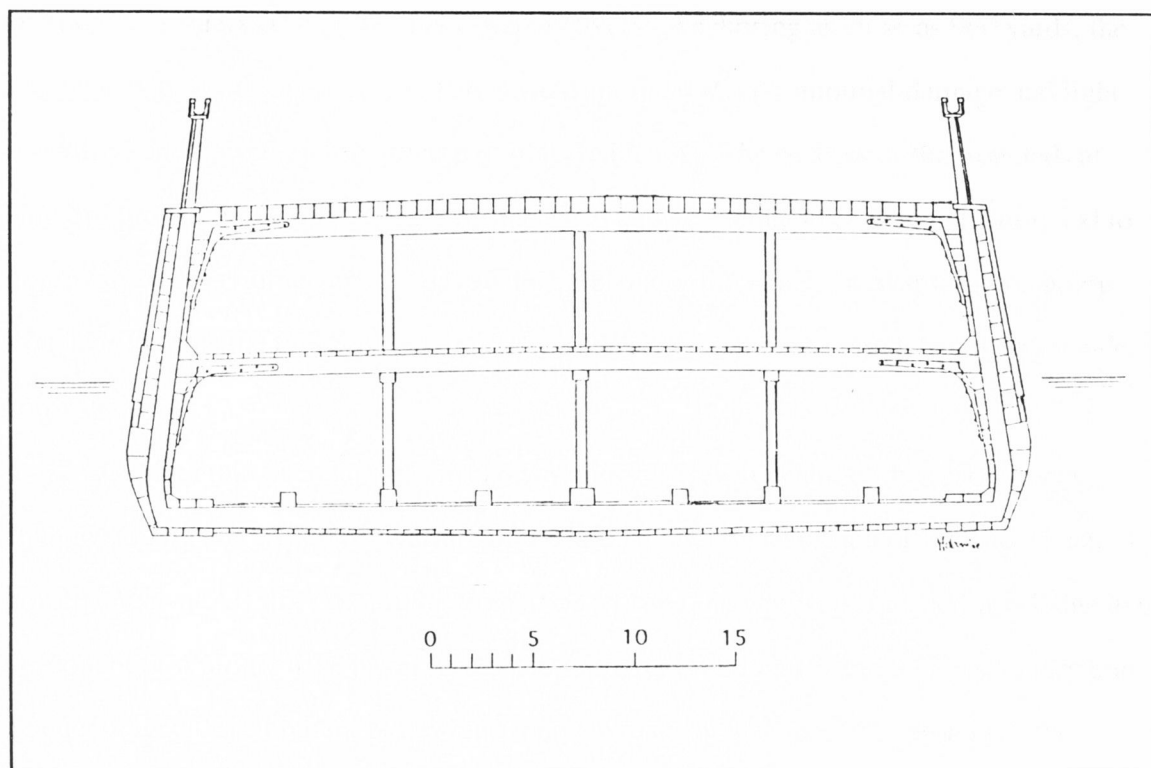
Armor cladding had been advocated as protection against the shell gun in 1825 by Paixhans as a result of his experiments. Additional tests were afterwards conducted in France and Britain to determine the best method of defense against the shell, but no armored warships were built. The first attempt at building a practical shot- and shell-proof vessel occurred in America in 1842 when Robert L. Stevens convinced the U.S. Congress to allocate funds for the construction of a 1500-ton ironclad steamer of his own design. Although this powerful vessel was never completed, its funding and construction placed the United States momentarily in the forefront of naval technology. After the Sinope debacle the French resumed experiments to find the best manner of iron plating wooden hulls. As a result, in the summer of 1854 the French Minister of Marine, Theodore Ducos, authorized the construction of five ironclad floating batteries. The English soon followed with an order to build five additional vessels based on the French plans.⁷

The French design called for an ungainly, flat-bottomed vessel with rounded bow and stern and virtually no sheer. The five ironclads were to measure approximately 167 feet, 4 inches long between perpendiculars, slightly over 43 feet in beam, 8 feet, 7 inches in depth of hold, and were designed to draw 8 feet, 4 inches of water. Hull displacement



Plan 1. British Crimean Battery, three-view.

was intended to be 1575 tons, while sixteen 50-pounder guns were to comprise the armament. Their armor consisted of four inches of wrought iron plate which protected the sides of the hull to a depth of nearly thirty inches below the waterline. Although these vessels were steam-powered, they were not meant to be ocean-going craft; instead, they were fitted with temporary masts and towed to the Black Sea, where they would then steam under their own power to the combat zone and fight at anchor. The British batteries deviated in detail but otherwise appear to have been very similar to the French prototypes (Plans 1 and 2). Their lengths varied from 172 feet, 8 inches to 173 feet, 6 inches between



Plan 2. British Crimean Battery, midsection.

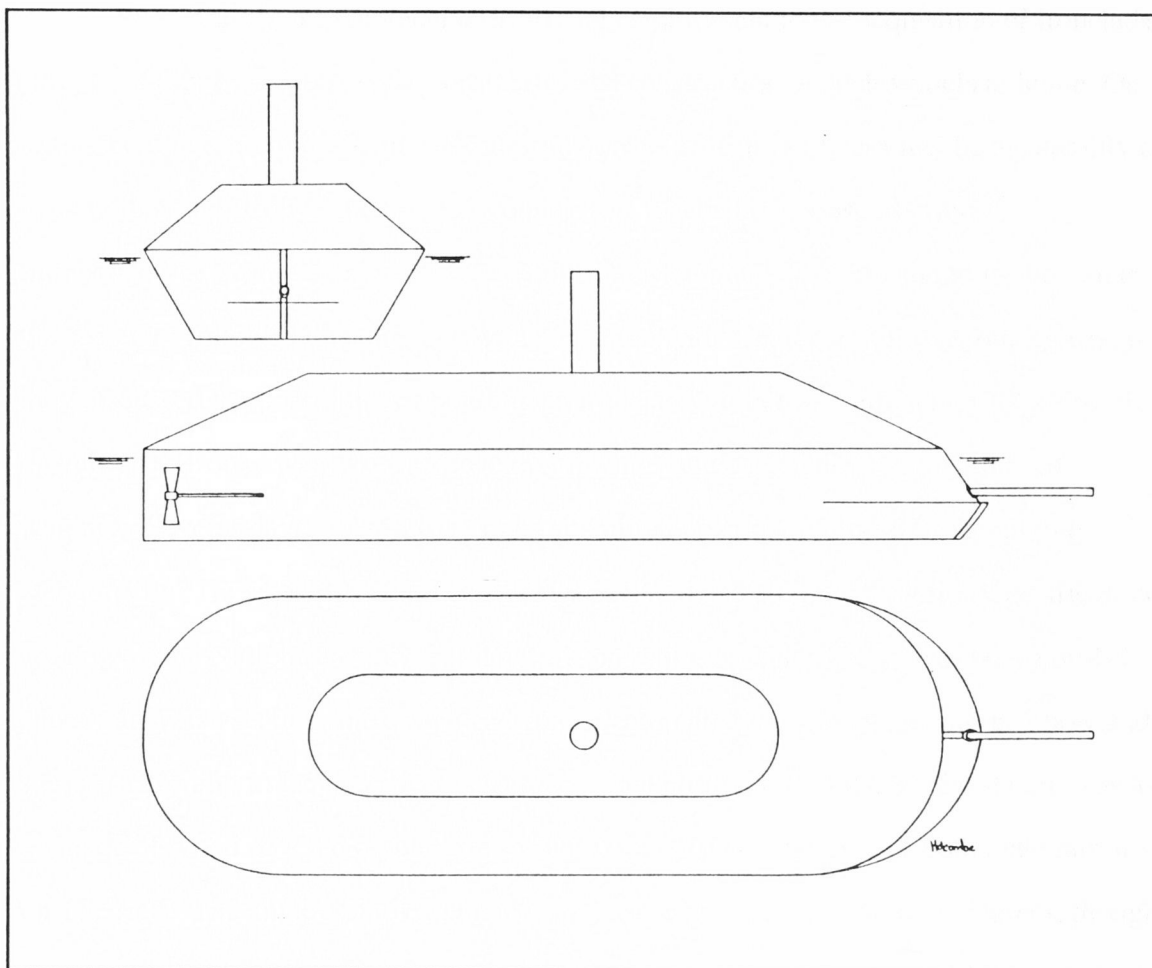
perpendiculars, with extreme beams of from 43 feet, 11 inches to 45 feet, 2 inches. Their maximum intended draft was eight feet, nine inches, while their depth of hold was approximately fourteen feet, seven inches. The British ironclads mounted heavier guns than did the French (68-pdrs. of 95 cwt.), but reduced the number carried to fourteen in order to maintain a shallow draft. Armor protection remained the same: four inches of iron backed with about twenty inches of wood. The sides of the hull were nearly vertical, with about eleven degrees of tumblehome.⁸

Despite poor handling qualities and less than desirable speed, the French ironclads Devastation, Lave, and Tonnante left for the Black Sea in July and August of 1855. They were joined in late October by the British Glatton and Meteor. On October 17, the three French batteries participated in an attack on the Russian fortification of Kinburn, which

guarded the estuary of the Bug and Dnieper Rivers. Anchoring as close as 960 yards, the ironclads withstood four hours of heavy fire from the fort with minimal damage and light casualties, and played an important part in its reduction. The success of the ironclads at Kinburn proved the worth of armor against shell and accelerated the change from wood to iron by the major European navies. By the outbreak of the American war large seagoing ironclads such as the French Gloire and British Warrior had been completed or were under construction.⁹

Confederate Secretary of the Navy Mallory was well aware of the revolutionary changes taking place in naval warfare in the late 1850s. As chairman of the U.S. Senate's powerful Naval Affairs Committee from 1853 to 1861, he was a strong and knowledgeable proponent of a progressive naval force. He supported funding for the Stevens battery and he encouraged development of new and innovative naval weapons. He promoted the construction of a series of modern sail and steam gunboats that, ironically, were to give the U.S. Navy a significant edge at the outbreak of the Civil War. Furthermore, he worked diligently to reform the service in personnel and disciplinary matters. Thus when empowered to produce a navy for the fledgling Confederacy in early 1861, Mallory's appreciation of the naval innovations in progress, and the industrial liabilities that prevented the South from rapidly building a conventional fleet, led him to consider the construction of armored warships a priority.¹⁰

Mallory was not alone in this assessment. As early as February 2, 1861, nineteen days before Mallory was named navy chief, Congressman William P. Chilton of Alabama proposed the construction of at least two ironclads. Two months later boatbuilder E.C. Murray of Kentucky submitted a plan for an armorclad vessel, while on May 4 naval officer John Mercer Brooke urged the purchase of an ironclad in Europe. Apparently numerous other schemes were offered by experienced shipwrights and laymen alike for Mallory was afterwards criticized for not accepting them. Regrettably, virtually no details



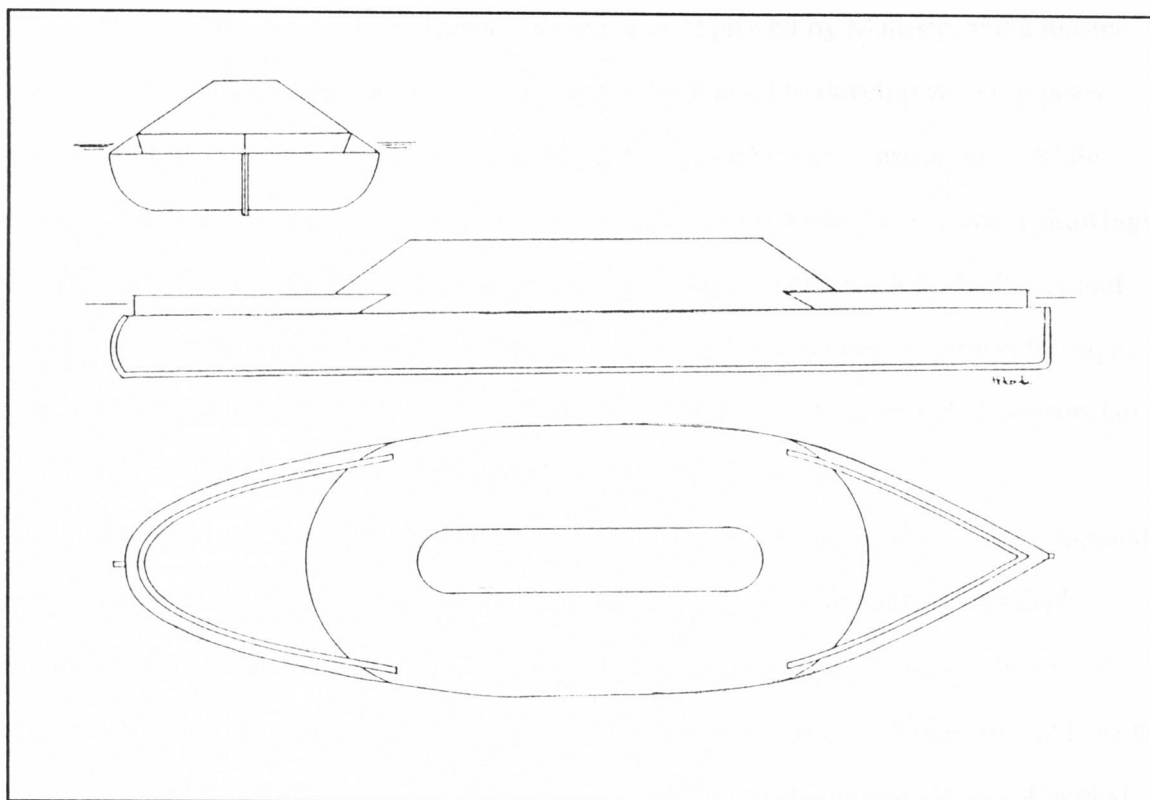
Plan 3. Steam Battering Ram, three-view.

of these early designs survive although the drawing illustrated in Plan 3 is indicative of what was being proposed to the Navy Department at the time. Mallory's first known advocacy for the construction of an ironclad is thought by some to be his April 26 report to the President in which he proposed "to build a class of vessel hitherto unknown to naval services." There is no doubt of his intent ten days later when he wrote the Chairman of the Committee on Naval Affairs "I regard the possession of an iron-armored ship as a matter of the first necessity." That same day Congress appropriated two million dollars for the purchase of one or two ironclads in France or England.¹¹

Even prior to the Confederacy's official commitment to the acquisition of ironclads abroad, Mallory was apparently considering the construction of such vessels at home. On May 4 he ordered Capt. Lawrence Rousseau at New Orleans to determine the availability of two and one-half to five-inch thick wrought iron, ostensibly for use as armor.

Immediately after the removal of the capitol from Montgomery to Richmond in early June the secretary followed this directive with a meeting with Lieutenant Brooke during which they discussed the possibility of building an ironclad within the Confederacy. As a result, on June 10, Brooke was asked to develop drawings and calculations of an armored warship. Several days afterward, Brooke submitted his drawings of an ironclad to the Department. Those plans were subsequently patented and along with written specifications are now in the National Archives (Plan 4). Consisting of a plan view, an inboard profile, and a transverse section, the drawings depict a casemated vessel with submerged bow and stern. According to the specifications, the casemate (often referred to as the shield) was to be made of wood covered on the exterior with iron. The thicknesses of both materials are unspecified. The angle of the casemate is given as between forty and fifty degrees, though by measurement it is about thirty-five degrees. The caves, or knuckles, of the casemate and the fore and aft ends were to be two feet below the waterline. The unique characteristic of the design is the projecting submerged ends, which extend beyond the casemate.

According to Brooke, this feature was to give the hull the sharpness needed for high speed, provide buoyancy without increasing draft, and protect the unarmored bow and stern by placing them under water. Brooke proposed constructing a breakwater - which he called a false bow and stern - on the submerged ends to prevent water from backing up into the centerline gunports and hindering their use. Within the breakwaters he planned to install tanks which when filled with water, or pumped free, would lower or raise the draft of the vessel as desired. A light deck might then be placed on the breakwaters as long as they did not interfere with the firing of the guns. Brooke made no mention of the number or type of



Plan 4. John M. Brooke's Ironclad, three-view.

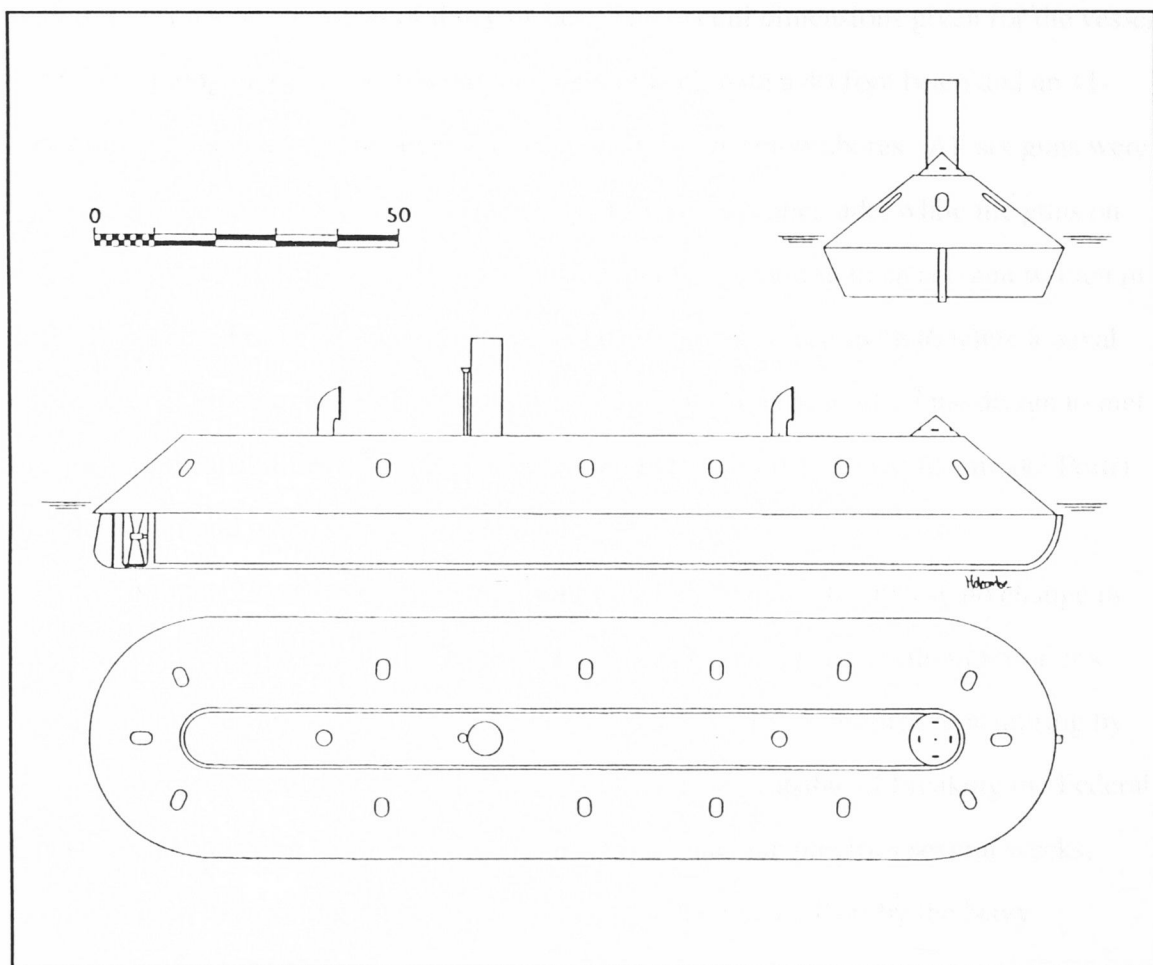
ordnance to be carried, but he did suggest a ram be fitted to the underwater portion of the stem.¹²

Brooke never intended his plan to be a scale working drawing; rather, his intent was schematic, to demonstrate the salient features of his proposal. For that reason no dimensions or calculations are given other than those in the written specifications. Nevertheless, some clues to the vessel's intended size can be determined by measuring the drawing. It is possible the views were drawn to a scale of 1/120 (1 in. = 10 ft.), which gives an approximate fifty-five-foot beam. Based on this assumption, other pertinent dimensions would be about 192 feet, 6 inches in length (length to beam ratio of 3.5 to 1), 10 feet in depth of hold, and a loaded draft of 14 feet, 6 inches. Using this same scale, the armored casemate stretches for about 115 feet of the ship's length, centered amidships.¹³

By Brooke's account, his ironclad design was approved by Mallory, and a master carpenter was ordered from Gosport Navy Yard to Richmond to develop working plans and detailed specifications so that the vessel might be placed under construction. While some calculations were produced, the carpenter was unable to make the necessary drawings and returned to Portsmouth. Mallory then ordered Naval Constructor John L. Porter and Chief Engineer William P. Williamson to report and assist in carrying the project through. When he arrived in Richmond on June 23, Porter brought with him a model of an ironclad of his own design, developed independently of Brooke's efforts.¹⁴

Porter's ironclad model shared several characteristics with Brooke's. Both adopted as their principal characteristic the inclined, armored casemate, with a nearly identical thickness of material and angle of inclination. This is not surprising, since the theory of angling armor to increase resistance against ordnance was an old one, dating back at least to the War of 1812 in America, and further abroad. The Stevens battery made use of angled structures to better deflect projectiles, and their use had been advocated in several technical treatise just prior to the Civil War. Furthermore, experiments had been conducted in England comparing the relative merits of vertical versus inclined armor, though few details were apparently available to the Confederates in 1861. Although there were disadvantages, both Brooke and Porter likely chose the angled casemate for its simplicity. In a region with few industries geared to naval construction at the outset of hostilities, the casemate offered an ease of fabrication that the more complex, conventionally armored vessel could not match. For this reason the casemate became the distinctive feature of the Confederacy's home-water armorclads.¹⁵

Despite these similarities, the two designs differed significantly in other aspects. Most noticeably, Porter's model (Plan 5) lacked the peculiar submerged bow and stern of Brooke's. Rather, the hull ended abruptly under the ends of the casemate, and thus was comparatively blunt fore and aft. Porter later defended this characteristic by stating that his



Plan 5. John L. Porter's Harbor Defense Ironclad, three-view.

model "was not calculated to have much speed, but was intended for harbor defense only" The vessel's bottom was flat for a width of thirty-three feet and had hard chines with sides angling out at about sixty-six degrees from the horizontal. Eight feet above the floors (nine feet above the bottom of the keel), and two feet below the waterline (same as Brooke's design), the sides of the hull met the casemate and formed the knuckle. The casemate sides then angled inward at forty degrees to a height of thirteen feet above the knuckle, forming a narrow casemate roof, or spar deck as it was sometimes called. Its ends were to be circular, like Brooke's. The structure was to be built of wood covered

with iron, for a total thickness of thirty inches. The overall dimensions given for the vessel are 150 feet long on deck and 144 feet in length of keel, with a 40-foot beam and an 11-foot draft. The intended armament was to be six 11-inch smoothbores. All six guns were to be pivot-mounted; the four broadside weapons to fire to either side, while the guns on the ends were to fire from centerline and quarter-ports. According to an account written in 1892 by his son, Porter based the design on one he had conceived in 1846 while a naval constructor at Pittsburgh. With the outbreak of the war Porter simplified the design to meet the needs and capabilities of the Confederacy and built a model. It was this model Porter took to Richmond when summoned by Mallory.¹⁶

The June 23 conference between Mallory and his three officers saw no change in the secretary's resolve to build an ironclad based on Brooke's plan. Although Porter's harbor defense design was examined, Mallory was apparently committed to acquiring by purchase or by construction an offensive seagoing ironclad capable of breaking the Federal blockade and attacking Northern ports. The actions taken the previous several weeks, culminating in the meeting of the 23rd, set in motion the initial effort by the Navy Department to build an armored warship, though decisions made in the following eighteen days would radically alter the secretary's original intentions. On a broader scale, the decisions of June 1861 would also shape naval strategy and affect ironclad design for the next nine months.

ENDNOTES

¹William N. Still, Jr., Iron Afloat: The Story of the Confederate Armorclads (1971; reprint, Columbia, S.C.: University of South Carolina Press, 1985), 227. Still gives the number of completed ironclads as twenty-two. For a list of planned, commenced, and commissioned Confederate ironclads, see the appendix "Confederate Ironclad Classes."

²James P. Baxter, Introduction of the Ironclad (Cambridge: Harvard University Press, 1933), 209. Baxter tallies more than forty seagoing ironclads, thirty armored coast defense vessels, and eighteen partially armored gunboats built, building, or authorized in Europe in March 1862, at the time of the Battle of Hampton Roads.

³George M. Hagerman, "Lord of the Turtle Boats," U.S. Naval Institute Proceedings 93 (Dec. 1967): 66-75. Hagerman describes the turtle boats, or Kohbukson, as averaging 90 to 110 feet in length, 25 to 30 feet in beam, and of traditional Oriental construction. They were powered exclusively by oar, and armed with up to 26 cannon ranging in caliber from 2.2 to 5.5 inches. The convex turtle-back was formed of 4-inch wood planking covered with 3/8-inch thick wrought iron cut in hexagons and riveted together. Spikes and other sharp objects attached to the armor discouraged boarding; *ibid.*, 67-69.

⁴For early efforts at armor cladding, see Baxter, Introduction of the Ironclad, 4-10. For early naval ordnance, see Spencer Tucker, Arming the Fleet: U.S. Navy Ordnance in the Muzzle-Loading Era (Annapolis, Md.: Naval Institute Press, 1989), 177-78; and Frederick Leslie Robertson, The Evolution of Naval Armament (1921; reprint, London: Harold T. Storey, 1968). The inability of solid shot to penetrate the thick oaken hull of the U.S.S. Constitution during the War of 1812 earned her the now-famous sobriquet "Old Ironsides."

⁵Tucker, Arming the Fleet, 178-80; Baxter, Introduction of the Ironclad, 18-25. Although approved, the shell gun did not begin entering French service until 1827, *ibid.*, 26.

⁶Helmut Pemsel, A History of War at Sea (Annapolis, Md.: Naval Institute Press, 1979), 90; Alan Palmer, The Crimean War (New York: Dorset Press, 1987), 30-32; Baxter, Introduction of the Ironclad, 17-23. Sinope was not the first time shell guns had been used at sea. As early as 1682 the French had used mortar vessels firing explosive shells at high angles in combat, and in 1779 the British successfully employed horizontal shell fire using 24-pounder guns during the siege of Gibraltar. And while numerous proposals were afterwards made, and experiments conducted, and even some additional combat-use made of shell-firing, seagoing guns, it was the sheer devastation caused by the Russian fleet at Sinope that brought home to the public for the first time the tremendous power of the explosive shell against wooden hulls.

⁷Baxter, Introduction of the Ironclad, 26; 48-52; 73-76. An excellent account of the Stevens ironclad is Spencer C. Tucker, "The Stevens Ironclad Battery," American Neptune 51 (Winter 1991): 12-22. Stevens' original plan called for a vessel 250 feet long,

40 feet in beam, and 28 feet in depth of hold. It was to be plated with 4.5 inch thick iron plates, and armed with six or more guns of large caliber. Twin screws were to propel the vessel at speeds higher than any contemporary warship. The Stevens Battery went through many delays and design changes before finally being broken up unfinished in 1881.

⁸The first five French batteries built were the Congreve, Devastation, Foudroyante, Lave, and Tonnante. Their dimensions taken from Baxter, Introduction of the Ironclad, 79-80. Metric dimensions have been converted to English measurement, thus are approximate. Afterwards, several other classes were laid down by the French but none saw service in the Crimean War. The five British batteries were Aetna, Glatten, Meteor, Thunder, and Trusty. Aetna accidentally burned prior to launching and was never completed. Dimensions of British batteries: ibid., 80; and plans of Meteor and Thunder, National Maritime Museum, Greenwich, London, England.

⁹Baxter, Introduction of the Ironclad, 82-85. Damage to the French batteries included bent armor plates and creased wooden spar decks - no shots penetrated the three ironclads. Casualties were two killed and thirteen wounded on the Devastation when three shells entered open ports and hatches, while nine men were wounded on the Tonnante by shell fragments entering ports. The British ironclads arrived too late to take part in the action at Kinburn.

¹⁰Joseph T. Durkin, Confederate Navy Chief: Stephen R. Mallory (Chapel Hill, N.C.: University of North Carolina Press, 1954): 61-65.

¹¹For Chilton's proposal, see Still, Iron Afloat, 11. Murray's assertion that he designed an ironclad early in the war is in the Official Records of the Union and Confederate Navies During the War of the Rebellion (Washington, D.C.: Government Printing Office, 1921), series II, volume 1: 757 (hereafter cited as ORN, with references to series I unless otherwise noted). Murray later claimed his plan was stolen and applied to the Merrimack. For Brooke's appeal to purchase and ironclad abroad, see Still, Iron Afloat, 11. Criticism of Mallory for not accepting proposals to build ironclads is J. B. Jones, A Rebel War Clerk's Diary (Philadelphia: Lippencott, 1866), I: 43. Drawing by William R. Scott of Algiers, La., for a "Steam Battering Ram or Steam Punch," dated July 28, 1862, Wilmington, N.C., but likely drawn earlier, is in RG 27, Volume 49, Governors' Records, Administration of Gov. John J. Pettus (Nov. 21, 1859 - Nov. 16, 1863) Mississippi Department of Archives and History, Jackson, Miss. Scott's ironclad was to be plated with railroad iron and unarmed except for a steam-powered ram, or punch. In theory the vessel with its steam-driven, reciprocating ram would stand several feet off its intended victim and batter it to pieces. Scott wanted to build the ram on the Yazoo River and clear the Mississippi of Union warships but apparently never received permission from the Navy Department to construct the vessel.

Stephen R. Mallory to Jefferson Davis, April 26, 1861, ORN, II, 1: 51; Still, Iron Afloat, 11, believes Mallory is advocating the construction of ironclads, while Baxter, Introduction of the Ironclad, 224, maintains he is referring to commerce raiders. Joseph T. Durkin, Mallory's biographer, fails to mention this specific passage. Mallory to C. M. Conrad, May 10, 1861, ORN, II, 1: 69. Ultimately no ironclads could be purchased in Europe and naval agents had to contract with yards in Britain and France for their construction from the keel up. The only one to reach Confederate hands was the Stonewall, which arrived in Havana too late to take part in the war.

¹²Still, Iron Afloat, 11-13. Later in May Mallory also ordered Capt. Duncan Ingraham to determine if armor plates could be manufactured in the South. Brooke's initial meeting with Mallory was late on the evening of June 4, the same day the secretary arrived from Montgomery. Sequence of events in development of Brooke's ironclad design is in John M. Brooke, "The Virginia, or Merrimack: Her Real Projector," Southern Historical Society Papers 19 (January 1891): 3-34. Patent drawings and specifications for Brooke's "Improved Iron-Clad Vessel" are in "File AD," Subject File of the Confederate States Navy, National Archives, Washington, D.C. (Subject File references hereafter cited with prefix NASF, followed by the National Archives code for the specific file). While the specifications fail to give the thickness of armor and wood backing of the ironclad, Brooke's biographer gives it as 3 inches of iron backed with 2 feet of wood; see George Mercer Brooke, Jr., John M. Brooke: Naval Scientist and Educator (Charlottesville: University Press of Virginia, 1980): 233. Mallory's preoccupation from late February to late April with organizing the department, assigning personnel, establishing facilities, and acquiring existing ships for conversion to gunboats, probably accounts for his initial delay in pursuing the acquisition of ironclads.

Born in Florida, John M. Brooke (1826 -1906) joined the U.S. Navy in 1841 and graduated from the Naval Academy in 1847. During his pre-war service Brooke was involved in survey work and developed an underwater sounding device. He resigned from Federal service on April 20, 1861, and, after a brief stint in the Virginia Navy, was accepted into the Confederate Navy on May 2. Following his involvement with the conversion of the Merrimack he became chief of the navy's Ordnance and Hydrography Bureau in 1863, a position he held until the end of the war. After the war Brooke taught at the Virginia Military Institute until his retirement in 1899.

¹³Brooke's "Improved Iron-Clad Vessel," NASF-AD.

¹⁴Brooke, "The Virginia," SHSP, 4, 21-22; Stephen R. Mallory to Thomas S. Bocoek, March 29, 1862, in ibid., 15-16. Brooke's account of the sequence of events which led to the acceptance of the Confederate Navy's first ironclad design differs from that given by Porter and his son. Brooke's version is supported by copies of correspondence, orders, and other documents, and is accepted by the author as the most reliable and dispassionate. Brooke also had access to his wartime journal for specific dates and events; see Brooke, John M. Brooke, 232-36. For Porter's version, see John L. Porter, "The Plan and Construction of the Merrimac," in Robert V. Johnson and Clarence G. Buell, eds., Battles and Leaders of the Civil War (New York: Century, 1887), I: 716-17; and John W.H. Porter, A Record of Events in Norfolk County, Virginia, from April 19th, 1861, to May 10th, 1862, with a History of the Soldiers and Sailors of Norfolk County, Norfolk City and Portsmouth Who Served in the Confederate States Army or Navy (Portsmouth, Va.: W. A. Fiske, 1892): 329-34.

Many narratives, especially those based on Porter's accounts, identify the master carpenter ordered from Gosport as Joseph Pierce (Pearce), who was later appointed to the rank of acting naval constructor and involved in the design and construction of the C.S.S. Louisiana and other Confederate warships. Brooke, however, states that the carpenter in question was not Pierce but another, whom he fails to identify; see Brooke, "The Virginia," SHSP, 26.

John L. Porter (1813 -1893), a native of Virginia, had obtained civilian employment with the U.S. Navy by 1846 and was superintending warship construction in Pittsburgh. In 1859 he was appointed to the rank of naval constructor. After resigning

from Federal duty May 1, 1861, he entered Confederate service with the same rank the following month. He was made Chief Naval Constructor January 7, 1864, a rank commensurate with the duties he had been performing since 1861 in designing the Confederacy's warships. After the war Porter worked in several shipyards and iron works before becoming superintendent of Norfolk County, Virginia, ferries.

Born in Norfolk, Virginia, William P. Williamson (1810 - 1870) studied mechanical engineering in New York City as a youth. He obtained employment at Gosport Navy Yard and by 1842 had charge of a machine shop there. That same year he was appointed a chief engineer in the U.S. Navy. After refusing to take the oath of allegiance he was dismissed from the navy May 6, 1861. He entered Confederate service as the navy's ranking engineer and was made its engineer-in-chief September 17, 1861. Williamson worked after the war at the Vulcan Iron Works in Baltimore and the Atlantic Iron Works in Norfolk before his untimely death.

¹⁵Brooke, "The Virginia," SHSP, 18. Baxter, Introduction of the Ironclad, 162-64, 226-28. According to the British, the primary disadvantages of inclined armor were: additional weight because of the increased area to be plated; reduced space on the weather deck for working the ship; improper spacing of channels for supporting the masts; instability in rough seas; enlarged gunports; inferior living conditions; and insufficient space for working the guns.

Immediate prewar papers dealing with armor plating are John Gross Barnard, Notes on Sea Coast Defence (New York: Van Nostrand, 1861), and "Ironclads Ships of War," Blackwood's Edinburgh Magazine, 88 (Nov. & Dec. 1860): 616-49.

¹⁶Schematic drawings and dimensions of Porter's harbor defense ironclad are in Porter, A Record of Events in Norfolk County, 329-31, 347. Porter's son claims that his father developed the design as early as April 1861, and that the State of North Carolina passed a bill to have several vessels built on the plan. When the that state joined the Confederacy (May 20), however, this decision was rescinded. A writer who apparently examined original plans of the vessel states that they are dated June 1, 1861; see Alan B. Flanders, The Merrimac: The Story of the Conversion of the U.S.S. Merrimac into the Confederate Ironclad Warship, C.S.S. Virginia (Portsmouth, Va.: Friends of the Portsmouth Naval Shipyard Museum, 1982): 105.

Porter's comment on speed being unnecessary for harbor defense is in Richmond Examiner, April 11, 1862, quoted in Still, Iron Afloat, 102. Another reference to speed and harbor defense is Light-Draught Monitors: Report of the Joint Committee on the Conduct of the War, at the Second Session Thirty-Eighth Congress (Washington, D.C.: Government Printing Office, 1865): 85.

CHAPTER II

CONVERSIONS

After the unanimous acceptance of John Mercer Brooke's ironclad plan, Mallory promptly directed the group to determine the availability of steam machinery with which to power the vessel. On June 25, Brooke, Porter, and Williamson reported back to the secretary. Finding no acceptable engines or boilers, and believing that the time entailed in constructing them from scratch would be too great, the trio recommended raising and reconstructing the remains of the U.S.S. Merrimack into the armor-plated warship.¹

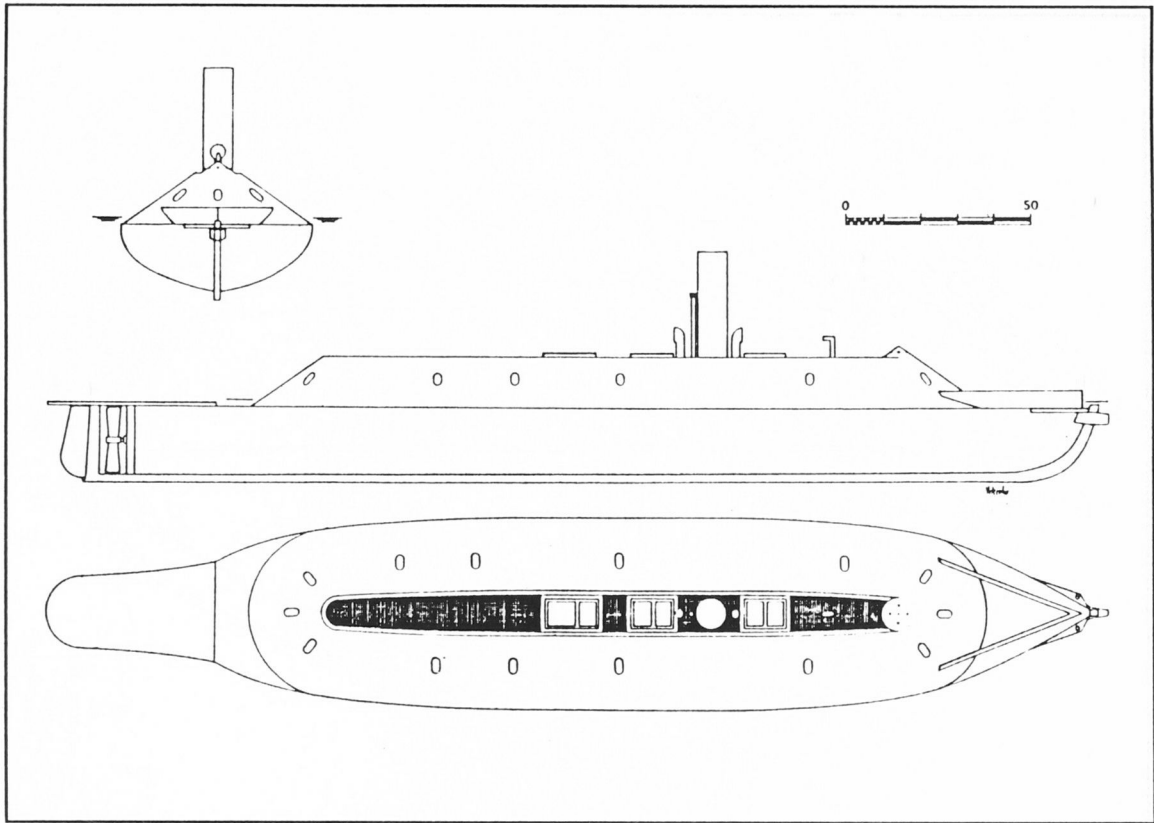
A 275-foot long screw frigate built in 1856, the Merrimack had been burned to her waterline at Gosport Navy Yard on April 20 by retreating Union sailors. The three officers believed that "the bottom of the [Merrimack's] hull, and heavy and costly parts of the engine" were little injured by fire, and that she could be made into an "efficient [shot-proof steam battery] mounting ten heavy guns - two pivot and eight side guns" ² Mallory concurred in this assessment and immediately instructed Porter to produce plans for an ironclad based on the frigate's hull. At the same time, he directed Williamson to superintend the refurbishment of the Merrimack's steam machinery, and assigned Brooke the dual tasks of arranging her armor and ordnance. With the completion of Porter's plans on July 11, Mallory ordered the transformation to "proceed with all possible dispatch" until completed. Later, the Secretary completed the metamorphosis of the Merrimack by renaming her the Virginia.³

The ironclad created as a result of these actions was a compromise that adapted features from both Brooke's and Porter's earlier designs to the ex-Union warship's hull. According to the plans developed, Porter had the Merrimack's hull cut down to a height of nineteen feet above the keel forward and twenty feet aft. He initially intended to make a level cut at nineteen feet but found that if he did the ship's large seventeen-foot, four-inch

diameter screw would require trimming; consequently, to clear the propeller, Porter raised the level of the cut aft by one foot. With the junction of the casemate and hull positioned two feet below the waterline, this operation set the Virginia's draft at twenty-one feet forward and twenty-two feet aft. Both Brooke and Porter considered this excessive but believed that there was no alternative if the new craft was to be based on the Merrimack's hull.⁴

Porter then erected on the hull a strong wooden casemate with round ends, which he adopted from his and Brooke's earlier designs. This structure measured 194 feet, 8 inches in overall length, and was fabricated of wood approximately 2 feet in thickness. Its sides and ends sloped at about thirty-five degrees - an improvement over the previous models that increased the casemate's ability to deflect projectiles. Fore and aft of the casemate the Virginia's ends were submerged two feet underwater, a design feature obviously borrowed from Brooke's plan. On the forward end, a four-foot high breakwater prevented water from piling up and pouring into the forward gunport. Aft, a heavy wooden fantail covered the vulnerable rudder and propeller, but offered little serious defense against ramming (Plans 6 & 7).⁵

For armor protection, Brooke first proposed covering the shield with three layers of one-inch thick by eight-inch wide rolled iron plate, but experiments conducted in early October convinced him of the need for greater resistance. As a result, he increased the armor to four inches, using two-inch plate in addition to the one-inch already in production. His plans also called for three inches of iron to cover the hull below the knuckle to a depth of three and one-half feet, as this was judged the ship's weakest point. But the lack of time, as well as delays in the shipment of iron, prevented the application of no more than a one-inch horizontal course, and the area was still considered extremely vulnerable when the Virginia steamed into action in early March 1862. Subsequently, a layer of two-inch plate was attached vertically, overlapping the knuckle and providing what was believed to be

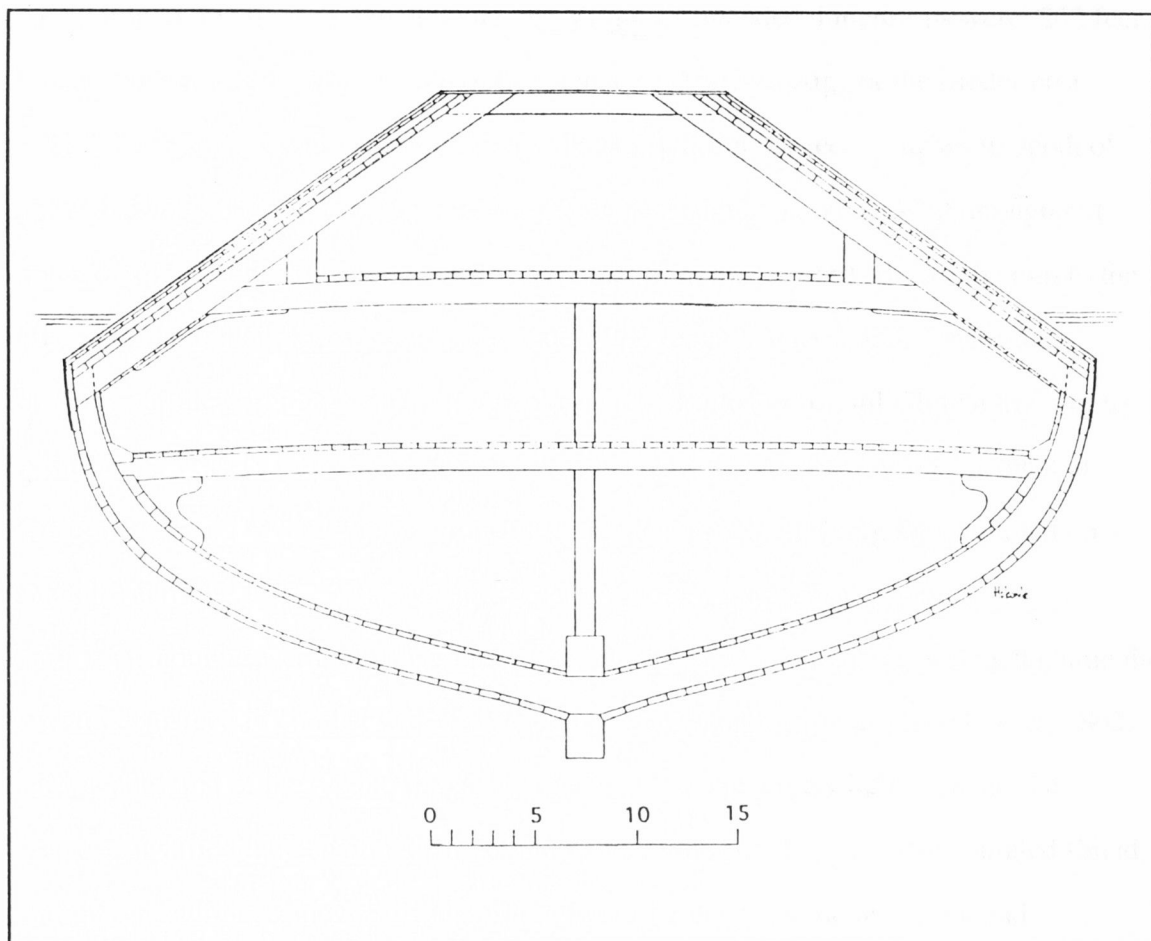


Plan 6. *Virginia* (*Merrimack*), three-view.

sufficient protection.⁷

Ten guns comprised the *Virginia*'s main offensive punch. Six were 9-inch Dahlgren smoothbores from the *Merrimack*'s original complement. The remaining four were rifled cannon designed by Brooke specifically for the vessel. Made of cast iron, these weapons were characterized by a reinforcing band of two-inch thick wrought iron, heat-shrunk around the breech to provide greater strength against the higher pressures produced by tight-fitting rifle projectiles. Two Brooke rifles (as they were named) of 7-inch caliber were positioned as pivot guns in the bow and stern. The remaining two had 6.4-inch bores and were placed in broadside with the Dahlgrens.⁷

As an additional offensive weapon, Porter attached a 1500-pound cast iron ram to



Plan 7. *Virginia* (*Merrimack*), midsection.

the Virginia's stem about three feet below the waterline. When this prow was broken off after ramming the U.S.S. Cumberland during the first day's battle at Hampton Roads, Porter replaced it with a stronger, more securely attached ram made of wrought iron tipped with steel.⁸

Several original drafts of the Virginia exist, including Porter's initial working plan. This latter drawing consists of profile, plan, and midship section views, but no hull lines. While most of the views are drawn in ink, the fantail and quarter panel gunports are roughly penciled in, suggesting their addition after the initial plan was formulated.

According to notations on the drawing, the Virginia's intended dimensions were: 262 feet, 9 inches in length from the aft side of the stem to the forward edge of the rudder post (length between perpendiculars); 51 feet, 2 inches in beam; 21 feet, 5 inches in depth of hold to lower edge of rabbet; and 167 feet, 7 inches length on gun deck. Although not noted on the plan, the total length of the Virginia, from the forward edge of the ram to the aft end of the fantail, measured approximately 280 feet, 9 inches.⁹ Other surviving drawings of the Virginia include a gun deck plan by Porter, apparently drawn in order to position the vessel's ordnance, and a plan produced by the gun carriage department at Gosport showing several views of one of the ironclad's 9-inch Dahlgrens mounted on a Marsilly carriage.¹⁰

Although several other casemated ironclads were under construction by the time the Virginia engaged in combat with the Federal fleet at Hampton Roads, March 8 - 9, 1862, she was the first of the type to be tested under fire. The relatively light damage she received justified the department's decision to adopt the simple-to-construct angled shield, and the structure became the distinguishing feature of the Confederate armorclad.

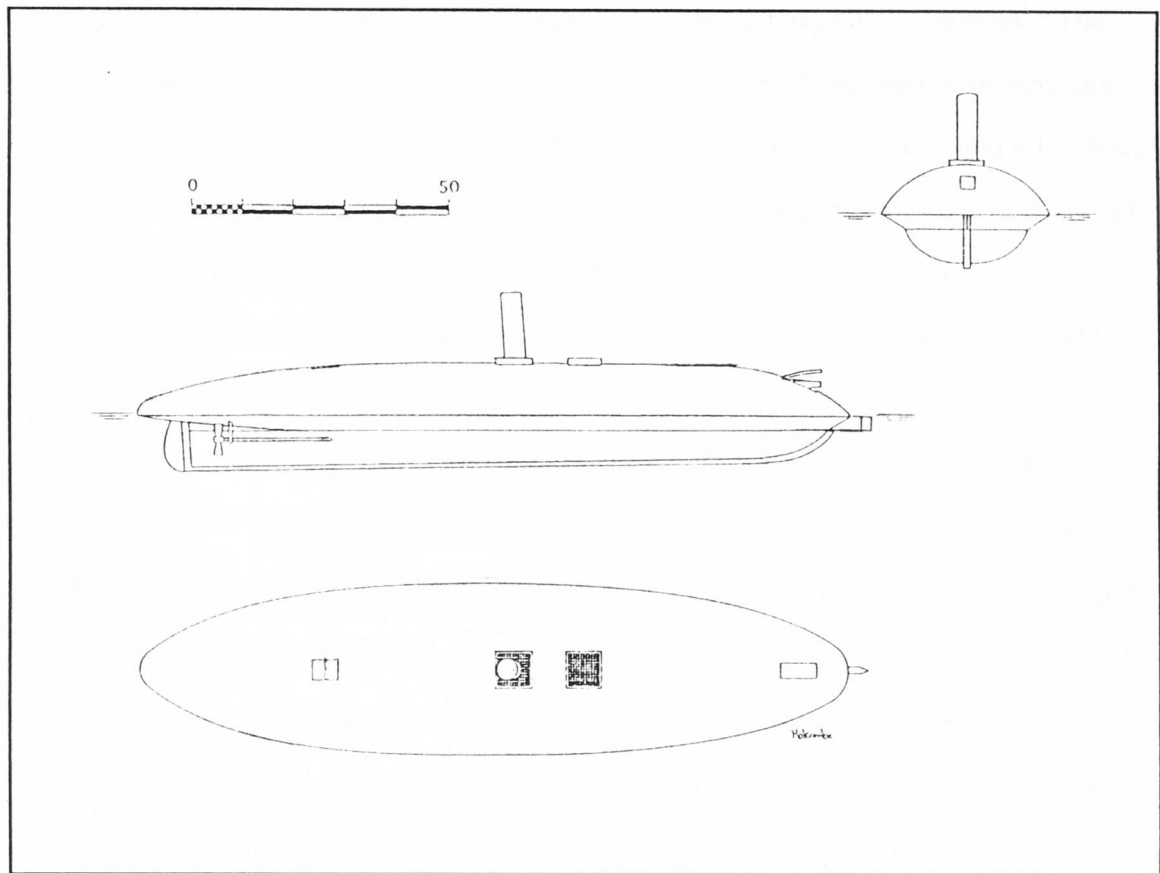
Despite popular belief, the Virginia was not the first armor-plated warship to render service in the Civil War. That honor belongs to the diminutive Manassas, an unusual craft whose design contrasts sharply with that of the Virginia.¹¹

The Manassas was not based on a Navy Department plan; instead, she was the brainchild of a consortium of New Orleans businessmen. Headed by steamboat captain John A. Stevenson, in mid May 1861 this group raised \$100,000 for the purchase of a steamer to convert into a privateer. The vessel selected was the ex-Boston harbor towboat Enoch Train, which had been built in 1855 at Medford, Massachusetts, by James O. Curtis. The Enoch Train's registered dimensions were 128 feet between perpendiculars, 26 feet in moulded beam, and 12 feet, 6 inches in depth of hold. Her tonnage was 385. She was strongly built with powerful engines and the then unusual feature of twin

screws.¹²

The conversion from towboat to ironclad began at the Algiers, Louisiana, shipyard of John Hughes soon after the vessel was purchased. Working in conformance to a design conceived by Captain Stevenson and Charles W. Austin, Hughes razed the Enoch Train's upper works, then constructed over the main deck a convex wooden shield about twelve inches thick. This shell, or turtle-back, was then plated with flat railroad strap iron about one and one-half inches thick. A three and one-half-foot thick wooden sponson was built on either side of the hull, serving both to support the shell and to protect the vessel's waterline. The Manassas' principal weapon was a ram attached to her heavily reinforced bow. Almost as an afterthought, a single 9-inch Dahlgren smoothbore was placed in the forward extremity of the shield. This weapon protruded from a slot-like opening so small that the gun could neither be traversed nor elevated. It could be aimed only by pointing the ship directly at the intended target. When the Dahlgren was retracted for loading, the port cover - a sort of trap door-like device - fell in place and conformed to the profile of the turtle-back. In consequence of the alterations, the Enoch Train's original dimensions were expanded to 143 feet in overall length, 33 feet in extreme beam, and 17 feet in depth of hold. Her draft is estimated to have been about ten feet, six inches. Once afloat, with her arched back protruding about ten feet above the water, the Manassas resembled a giant prehistoric monster laboriously moving at some eight knots down the Mississippi (Plan 8).¹³

Although the general scheme of the Manassas' conversion is documented, many details remain obscure. Contemporary descriptions and illustrations are often contradictory in their depictions of certain features, such as the number and placement of hatches and smokestacks, the shape of the gunport shutter, and the existence of a pilot house. The absence of builder's drafts compounds the confusion. Probably the most reliable



Plan 8. *Manassas*, three-view.

illustration of the ram was sketched by John Horry Dent, a young naval engineer who, while attached to the C.S.S. McRae, had ample opportunity to observe her. Dent portrays the Manassas with apparently only one stack, though the angle drawn - dead abeam - leaves some question. A simple hinged gunport cover is shown forward, while a pilot's hatch with a somewhat similar hinged cover is depicted in the extreme stern, - the latter supporting at least one other description which places the pilot's position aft. The drawing is insufficiently detailed to clarify other discrepancies.¹⁴

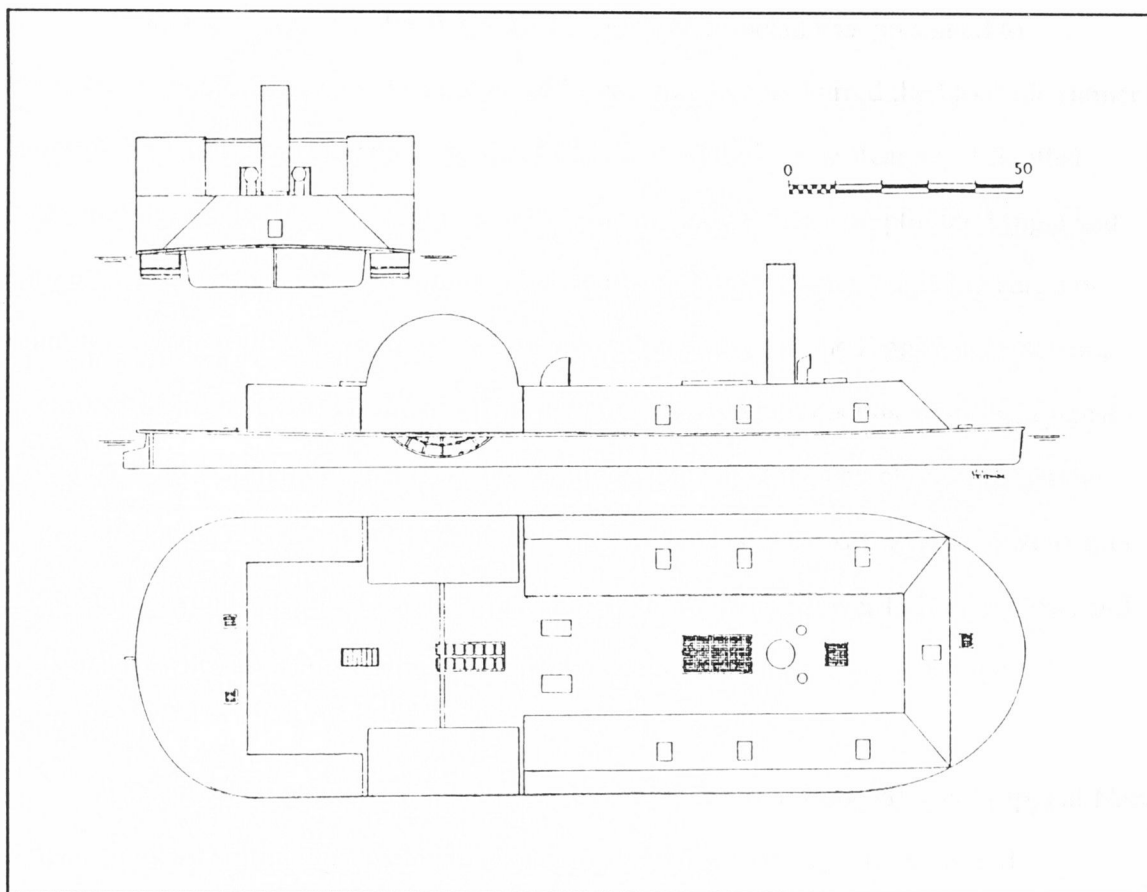
The lower hull of the Manassas is better documented. The uniqueness of the Enoch Train's propulsion system, combined with the prominence of her designer, Samuel H.

Pook, caused the vessel's lines to be published in a contemporary nautical journal. The hull form depicted possesses moderate deadrise with slack bilges and nearly straight sides with no tumblehome. Considering the Enoch Train's intended use as a tow and relief boat, her lines were relatively sharp fore and aft. She had a gracefully curving stem and counter stern. Her sheer was pronounced with both ends rising approximately fifteen inches. Dimensions given in the accompanying text are: length on loadline, 125.50 feet; breadth moulded, 24.66 feet; and depth, 12 feet.¹⁵

Along with private organizations, such as the one in New Orleans, several state governments were caught up in the early-war clamor to build armored warships, although the rationale was self-defense rather than mercenary. Alabama apparently became the first state to enter into the ironclad building business when on November 9, 1861, her General Assembly voted \$150,000 for the "construction of an iron clad gun-boat and ram for the defense of the bay and harbor of Mobile."¹⁶ This act specified that the vessel was to be steam propelled, carry two guns of at least 68 pounds caliber, be plated with iron, armed with an iron prow or ram, and have a draft no greater than 7 feet.¹⁷

The committee formed to carry out the assembly's wishes moved quickly. On December 13, they purchased the sidewheel steamer Baltic, a Mobile Bay cotton lighter with registered dimensions of 176.5 feet in length, 37.3 feet in beam, and 7.6 feet in depth of hold. In less than a week the process of transforming her into a modern man-of-war was underway. In five months the conversion was completed, and on May 27 the Baltic was turned over to the Confederate Navy at Mobile.¹⁸

Few details exist of the design applied to the Baltic. A contemporary engraving of dubious accuracy depicts the vessel with a somewhat typical Confederate casemate mounted on the main deck, extending from the extreme bow to the paddleboxes aft of amidships. A single smokestack is shown forward on the spar deck, but no pilot house is visible. Although records indicate that two-inch thick, seven-inch wide, and fifteen-foot



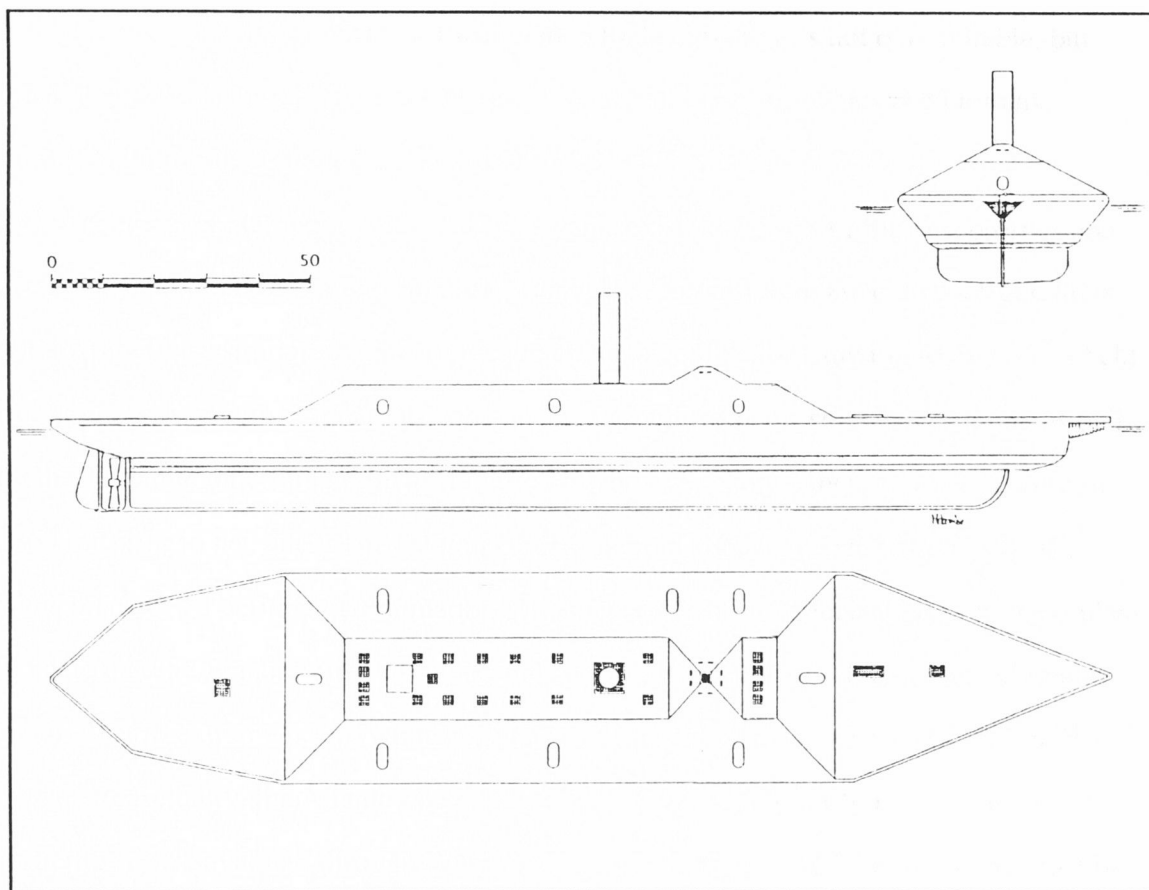
Plan 9. *Baltic*, three-view.

long rolled iron plate was purchased from Scofield and Markham Rolling Mill in Atlanta, the total thickness of armor applied to the Baltic is unknown. Federal reports credit the Baltic with carrying four guns: two Dahlgrens (9-inch?) and two 6.4-inch rifles in her casemate, and two small brass pieces on top. Confederate sources relating to the Baltic are virtually nonexistent (Plan 9).¹⁹

For about a year, until the completion of the Huntsville and the Tuscaloosa, the Baltic operated as the only ironclad on the Mobile Station. By mid-1864, however, she had served out her usefulness as a warship and was stripped of iron and armament, and decommissioned.²⁰

A unique opportunity for the construction of an ironclad was presented to Confederate authorities when Federal naval forces successfully barred the blockade runner Fingal from exiting the Savannah River. A fast, iron-hulled screw steamer of Scottish build, measuring 178 feet in length, 25 feet in beam, and 18 feet in depth, the Fingal had slipped into Savannah on the morning of November 13, 1861, with a valuable cargo of munitions. The following month, loaded with cotton and resin, the Fingal made several attempts to exit the Georgia coast but was thwarted by vigilant Federals guarding against just such a bid. Convinced that it would be impossible to get the vessel out through the easily-blockaded coastal channels around Savannah, the Navy Department decided to alter the steamer to an ironclad. Consequently, the Fingal was turned over to brothers Asa and Nelson Tift who, as agents of the department, became solely responsible for the conversion.²¹

The Tifts had previously constructed the large 285-foot ironclad Mississippi at New Orleans under a similar arrangement. Conceived by the brothers, with plans and specifications provided by Naval Constructor Porter, the Mississippi was unconventional in form, using angles instead of curves in order to simplify and quicken her fabrication (see Chapter III). As far as possible, the Tifts applied the same design philosophy to the Fingal - or Atlanta as she was eventually renamed. Beginning in the spring of 1862, the ship's bulwarks were cut down and a thick wooden deck was placed over the original. On either side of the hull an eight-foot thick knuckle, made of numerous layers of foot square timber, was attached. Amidships, a 107-foot, 6-inch long casemate was built. The sides and ends of this structure were sloped at an extreme thirty degrees, the same angle used on the Mississippi. The casemate walls were built using thirteen-inch thick vertical wooden frames covered with two layers of planking totaling seven inches in thickness. On the casemate exterior protection was provided by two layers of two-inch rolled iron plate, while a single layer of similar plate covered the horizontal decks and overlapped the



Plan 10. *Atlanta*, three-view.

knuckle to a depth of four feet below the waterline (Plan 10).²²

The Atlanta's offensive power was supplied by a small but potent battery of four Brooke rifles: two of 6.4-inch caliber in broadside and a 7-inch gun at each end of the casemate, pivot-mounted to fire from one of three ports. In addition, the forward overhang of the knuckle formed an eight-foot long ram. Later, a spar torpedo - an explosive device containing powder and contact fuses, mounted on a long pole, or spar, which could be lowered into the water with the intention of being detonated against the hull of an enemy ship - was fastened on the Atlanta's bow. Besides her excellent armor protection and offensive capabilities, the Atlanta possessed probably the finest power plant of any

Confederate-built ironclad. Her vertical twin-cylinder engine was not only reliable, but drove the heavy man-of-war at an average of eight knots - respectable speed for any ironclad, Union or Confederate.²³

Several contemporary plans of the Atlanta exist. Two sets of inboard profiles and deck plans, both located in the National Archives, depict different knuckle configurations but are otherwise similar. A midship section plan, a companion drawing to one set, is held by Mariners' Museum. Apparently one of these groups of plans shows the Atlanta as built by the Tifts, the other the vessel as modified by the U.S. Navy either after her capture in 1863, or prior to her sale to the Haitian Government in 1869. The lack of dates on the plans precludes a definite determination of sequence. Measurements taken from these plans indicate that the Fingal's original dimensions were expanded to 207 feet in overall length and 41 feet in extreme beam, while her draft was increased to a considerable 16 feet.²⁴

Regrettably, the Atlanta's potential strengths were never fairly tested. While sortieing from Savannah through Wassaw Sound on June 17, 1863, she grounded fast in close proximity to two Union monitors. The resulting twenty-degree list not only prevented the Atlanta's guns from being trained on target, but negated her sharply angled casemate's ability to deflect cannonballs. Four hits from the powerful 11- and 15-inch guns of one of the monitors led to the Atlanta's inglorious surrender. Recognizing her strength as an ironclad, the Federals repaired the Atlanta and placed her into service. She operated primarily on the James River as a part of the North Atlantic blockading squadron for the remainder of the war.²⁵

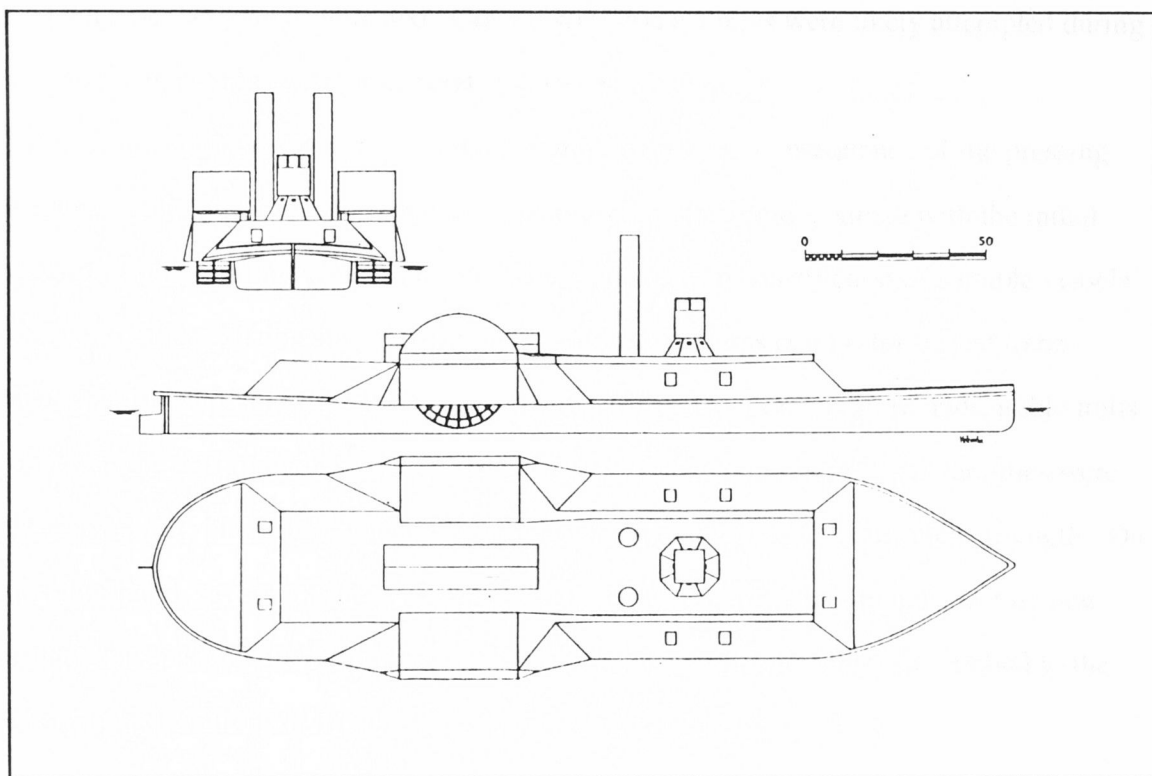
The Navy Department attempted the conversion of at least one other ship, the screw steamer Mobile. Built in 1860 at Philadelphia, the Mobile measured 139 feet, 6 inches between perpendiculars, 28 feet in moulded beam, and 7 feet, 6 inches in depth of hold. She had been acquired by the Confederates in mid-1861 and converted to a protected gunboat at New Orleans. After the loss of the lower Mississippi River the following

spring, she was taken up the Yazoo River and decommissioned August 1 for conversion to an ironclad at the Yazoo City, Mississippi, Navy Yard. The inability of the navy to acquire armor plate, either in rolled form or as railroad T-rails, delayed her completion and she was still unfinished when destroyed May 21, 1863, to prevent capture by approaching Federals. No plan or description of the Mobile's intended design has been located and her ultimate configuration as an ironclad is a mystery.²⁶

A second steamer at Yazoo City often reported to be undergoing conversion to an ironclad was the sidewheeler Republic. Contemporary Confederate accounts indicate, however, that the 249-foot vessel was instead being stripped of her machinery for use elsewhere.²⁷

The War Department also became involved in ironclad construction when, on October 31, 1861, Secretary of War Judah P. Benjamin authorized Gen. Leonidas Polk to purchase the steamer Eastport for conversion to an ironclad "if thought worth the \$12,000 demanded."²⁸ Accordingly, Polk purchased the former Florence - New Orleans sidewheel packet and had her taken to Cerro Gordo, on the Tennessee River just above the Mississippi line, for alteration. At the same time, Polk requested from Secretary of the Navy Mallory a naval officer to supervise the work. Lieut. Isaac Newton Brown, then purchasing steamers at Nashville for conversion to gunboats, was assigned the task. By early January the process of dismantling the Eastport was well underway. Scarcely a month later she was captured by a small Union flotilla steaming up the Tennessee after the capture of Ft. Henry. Stripped of her upper works, but with boilers dropped in her hold, side casemate frames erected, and a considerable quantity of timber, armor plate, and other construction material piled on her main deck, the Eastport was towed to Cairo, Illinois. There she was completed and taken into Federal service.²⁹

Although no contemporary Union or Confederate plans of the Eastport have been located, a photograph of the vessel while under Union colors exists. This image depicts a



Plan 11. *Eastport*, three-view.

large casemated ironclad with considerable sheer fore and aft, twin smokestacks amidships, and side paddlewheels well aft. A multi-sided pilot house, likely armored, is located just forward of the stacks and is surmounted by a larger rectangular house apparently intended for noncombat use. While only four guns are visible - two protruding from the forward end of the casemate and two from the starboard casemate forward of the paddlebox - Federal records indicate a total of eight guns were normally carried. Type and thickness of armor plate are unknown. In all probability the ironclad intended by the Confederates closely matches that ultimately constructed by the Federals from the partially completed hull of the Eastport (Plan 11).³⁰

One other serious proposal is known to have been made to produce an ironclad from an existing vessel, at Pensacola, but the evacuation of the city in early 1862 prevented

the plan from being consummated. Other conversion attempts were likely attempted during the early stages of the war but concrete evidence is lacking.³¹

Conventional ships were converted into ironclads in consequence of the pressing need to acquire a viable naval force in the shortest possible time, coupled with the initial industrial shortcomings which prevented the rapid keel-up construction of suitable vessels. In order to alter existing ships into modern armored warships compromises had to be made. As a result, all of the ironclads so built suffered from one or more undesirable traits forced on the design by the existing structure. The most common of these liabilities were excessive draft, inadequate machinery, poor maneuverability, and insufficient strength. On the other hand, several of these vessels served well as experimental models, testing new design concepts and providing constructional and operational data that was applied to the following generations of ironclads.

Of the four converted ironclads that became operational, none had a more marked influence on subsequent design than did the Virginia. Her armored casemate, characterized by its composite wood construction, thirty-five-degree inclination, and four-inch, laminated armor plate, became the distinctive feature of the Southern ironclad. Although its thickness and angle varied slightly on following models, the armored shield as used on the Virginia remained virtually unchanged for the balance of the war with only one significant exception: the substitution of simplified angular casemate ends for the Virginia's more complex rounded ends.

Likewise, the perceived ease with which the Virginia rammed and sank the anchored U.S.S. Cumberland at Hampton Roads convinced naval personnel of the value of ramming tactics and added impetus to the trend already underway of equipping ironclads with rams or reinforced bows. Afterward, most (though certainly not all) Confederate armorclads were provided with rams, and the device has come to be considered characteristic of the class.

First designed for use on the Virginia, the Brooke rifled cannon also became standard armament for Southern warships. Mallory, as well as many of his officers, believed that rifled cannon, with their superior range, accuracy, and penetrating power, would give Confederate men-of-war an advantage in combat and assist in redressing their disparity in numbers. First produced with a single reinforcing band, in 6.4- and 7-inch calibers, later models were double- and even triple-banded. Some double-banded 8-inch rifles were also manufactured. Many ironclads were armed exclusively with Brookes, most using 7-inch rifles as pivot-mounted bow and stern chasers, and 6.4-inch Brookes in broadside. Others were provided with a mixed battery of Brooke rifles and smoothbore guns - particularly 9-inch Dahlgrens - as some officers believed that the explosive power of smoothbore shells was more effective against wooden warships. During the latter part of the war double-banded Brooke smoothbores of 10- and 11-inch calibers were produced and supplied to some ironclads. These seem most often to have been used in combination with rifles.³²

Although the Virginia served in many ways as the prototype of the Confederate ironclad, some aspects of her design were atypical. In addition to the rounded casemate ends previously alluded to, the Virginia's submerged fore and aft ends were never to be seen again. Instead, low flush decks appeared forward and aft of the casemate to provide much needed space for the handling and storage of ships' gear. Other singular characteristics, such as her hull configuration (which at the waterline was her weakest point), her excessive draft, and her poor speed and maneuverability, were not intended but rather were compromises made necessary by using the Merrimack's hull.

The builders of the Manassas applied innovative solutions to the problems involved in converting the towboat Enoch Train into a shot-proof warship. Even so, the Manassas was an aberration. Her futuristic-appearing convex shell was a peculiarity not seen on any subsequent ironclad. This stems largely from the structure's complex curved shape which,

while offering some advantages in deflective capabilities, lacked the simplified form and construction of the angular casemate. Except, perhaps, to intensify the ramming craze, the Manassas contributed little to Confederate ironclad design. Ironically, she is far better remembered today as a marine curiosity because of her distinctive appearance than for her role as the first armor-plated warship to engage in combat in the Civil War.³³

The most successful of the conversions was the Atlanta. Her design combined excellent protection, with a thirty-degree shield angle and a thick built-on knuckle; good offensive power, with a ram, four Brooke rifles, and a spar torpedo; and better than average speed as a result of her fine British-made steam machinery. Unfortunately, in order to obtain these desirable qualities, the Tifts had to accept an excessive sixteen-foot draft. This was far too great for the shallow coastal waters around Savannah, and it was the direct cause of her embarrassing loss. Yet this defeat was perhaps the Atlanta's greatest contribution to Confederate ironclad design, for it forced upon Mallory and his constructors recognition of certain design deficiencies and caused measures to be taken to rectify them, as will be seen in Chapter IV.

Despite the faults of these early war conversions, several served well as interim warships. They established the Confederate navy as a progressive force with which the Federals would have to contend, they served as experimental craft, providing much needed experience which could be applied to following designs, and they defended vulnerable coastal areas until purpose-built ships could be completed and placed into service.

ENDNOTES

¹Stephen R. Mallory to Thomas S. Bocoock, March 29, 1862, ORN, II, 2: 174-75; Brooke, Brooke, 236. Brooke credits Williamson with suggesting the hull and machinery of the Merrimack be used as the basis of an ironclad; see Brooke, "The Virginia," SHSP, 5.

²William P. Williamson, John M. Brooke, and John L. Porter to Stephen R. Mallory, June 25, 1861, in Brooke, "The Virginia," SHSP, 11-12. Data on the Merrimack from Paul H. Silverstone, Warships of the Civil War Navies (Annapolis, Md.: Naval Institute Press, 1989), 27.

³Stephen R. Mallory to French Forrest, July 11, 1862, in Brooke, "The Virginia," SHSP, 12-13.

⁴John L. Porter, "A Short History of Myself During the War of 1861: Memoirs of the Constructor of the Confederate Ironclad Warship Virginia," ed. Alan B. Flanders, Olde Times 2(Spring 1987): 3. Porter, "Plan and Construction of the Merrimac," Battles and Leaders, I: 717. Greville Bathe, Ship of Destiny: A Record of the U.S. Steam Frigate Merrimac, 1855-1862 (St. Augustine, Fla.: n.p., 1951), 7. Brooke, "Plan and Construction of the Merrimac," Battles and Leaders, I: 716.

⁵Length of casemate taken from reconstruction drawing of the Virginia in Sumner B. Besse, Ironclad Virginia: With Data and References for a Scale Model (Newport News, Va.: Mariners Museum, 1937). Thickness of wooden casemate backing varies depending upon source. Porter variously refers to the structure being built of 16-inch yellow pine frames covered with 4 inches each of pine and oak, totaling 24 inches, or 16-inch frames covered with a 5-inch layer of pine and a 4-inch layer of white oak, for a 25-inch thickness. Catesby ap R. Jones, the Virginia's executive officer, states that the casemate was composed of frames 12 inches thick covered with layers of pine and oak 8 and 4 inches thick respectively, for a total of 24 inches. In all three examples the oak planking was directly under the armor. See John L. Porter, "C.S.S. Virginia (Merrimack): Story of Her Construction, Battles &c," undated typescript at The Museum of the Confederacy, Richmond, Va., 4; Porter, "A Short History of Myself," 4; Catesby ap R. Jones, "Services of the Virginia (Merrimac)," Southern Historical Society Papers 11(1883): 65.

References to casemate angle also vary. Porter gives the angle as 35 degrees, as do most other sources, yet Jones says the inclination was 36 degrees, and Mallory gives it as 38. See Porter, "C.S.S. Virginia: Story of Her Construction," 4; Jones, "Services of the Virginia," 65; and Stephen R. Mallory to James D. Bulloch, April 30, 1862, ORN, II, 2: 186. Measurements taken from surviving plans of the Virginia suggest that 35 degrees is the correct angle; see drawing "9-inch Shell Gun Fitted to Steam Battery Merrimack, Gun Carriage Makers Department, Gosport, Va., Decmr 4th 1861," Navy Plans File (reference number unavailable), Record Group 19, National Archives, Washington, D.C. Plans in Navy Plans File, Record Group 19, hereafter cited with the prefix NPF, followed by the appropriate file number.

⁶Charles B. Dew, Ironmaker to the Confederacy: Joseph R. Anderson and the Tredegar Iron Works (New Haven, Conn.: Yale University Press, 1966), 115-16; Jones, "Services of the Virginia," 66-67; Porter, "A Short History of Myself," 5; and Stephen R. Mallory to R.M.T. Hunter, April 9, 1862, quoting April 7, 1862, report of John L. Porter,

ORN, VII: 764. According to Jones more than two-thirds of the plates put on the Virginia were 2 inches thick.

Experiments conducted at Jamestown Island, Virginia, showed that three layers of 1-inch iron plate, mounted on a target made of 24 inch thick wood, and angled at 30 degrees to the horizon, could not resist an 8-inch solid shot fired at 300 yards range. A second similar target, but plated with two layers of 2-inch iron plate, resisted both 8-inch solid shot and 9-inch shell. See testimony of John M. Brooke at the investigation of the Navy Department, February 26, 1863, ORN, II, 1: 785-86; and Baxter, Introduction of the Ironclad, 230.

⁷Dew, Ironmaker to the Confederacy, 188-19; Jones, "Services of the Virginia," 66. The Merrimack's original armament included two 10-inch s.b., fourteen 8-inch s.b., and twenty-four 9-inch Dahlgren s.b. See Silverstone, Warships of the Civil War Navies, 27; and Donald L. Canney, The Old Steam Navy: Frigates, Sloops, and Gunboats, 1815-1885 (Annapolis, Md.: Naval Institute Press, 1990), 173.

⁸Jones, "Services of the Virginia," 66; Porter, "A Short History of Myself," 5. According to Porter, the first ram was "about five feet in length, projecting [from] the stem about two feet, and coming back on the bow three feet. The metal in the flanges was three inches thick and the depth 2 feet." The second ram ran back on the ship's sides ten feet and did not project so far over the bow. See Porter to R.L. Page, March 11, 1874, Area 7 File, Record Group 45, National Archives, Washington, D.C. (hereafter cited as "Area File" with appropriate file number). Measurements taken of first ram depicted in Porter's drafts of the Virginia suggest it was larger than indicated in his letter to Page - or that the drawing is incorrect.

⁹Copy of original general configuration plan in NASF-AD. Other dimensions given include: length from tiller to lower edge of shield, 55 feet; length from stem to shield 29 feet, 6 inches; beam on deck from waterway to waterway, 29 feet, 5 inches; and draft, 21 feet. These dimensions should not be considered precise representations of Virginia's measurements as built, for changes were probably made during the course of her construction. Overall length of Virginia taken from reconstruction plan in Besse, C.S. Ironclad Virginia due to inability of the author to acquire scale copy of original draft.

¹⁰Gun deck plan of Virginia, dated 1861, is in NASF-AD; a tracing of this drawing by W.G. Hughes, dated 1891, is in NPF #76-2-45. Ordnance drawing labeled "9-inch Shell Gun Fitted to Steam Battery Merrimack, Gun Carriage Makers Department, Gosport, Va., Decmr 4th 1861," NPF, reference number unavailable.

¹¹The Manassas, accompanied by several other Confederate gunboats, attacked Union naval forces at head of Passes in the Mississippi River on October 12, 1861 - almost five months prior to the Virginia's sortie into Hampton Roads. See William M. Robinson Jr., The Confederate Privateers (New Haven, Conn., Yale University Press, 1928), 153-64; Edwin C. Bearss, "The Fiasco at Head of Passes," Louisiana History 4(Fall 1963): 301-11; and "The First Ironclad," Southern Historical Society Papers 30 (1902): 196-204.

¹²Charles L. Dufour, The Night the War was Lost (Garden City, N.J.: Doubleday, 1960), 71; Robinson, Confederate Privateers, 155. Enoch Train's dimensions from Enrollment Document No. 36, Port of Boston, March 20, 1855, Bureau of Marine Inspection and Navigation Records, Record Group 41, National Archives, Washington,

D.C. (hereafter cited as RG41). The Manassas was seized by the Confederate navy just prior to the Head of Passes affair; see Still, Iron Afloat, 46, and Confederate Navy payment voucher to J.A. Stevenson for \$100,000 for purchase of Manassas, dated March 11, 1862, in NASF-AY.

¹³Accounts with contradictory thicknesses for wood frame of convex shell include: 12 inches, John Thomas Scharf, History of the Confederate States Navy (New York: Rogers and Sherwood, 1887), 264-65; 20 inches, Charles W. Read, "Reminiscences of the Confederate States Navy," Southern Historical Society Papers 1(1876): 334; 5 inches, Alfred T. Mahan, Gulf and Inland Waters (New York: Scribners, 1883), 6-7.

Use of flat railroad iron, known as strap iron: Papers of Lieut. A.F. Warley (commander of the Manassas), July 1865, in ORN, 18: 338. Reference to railroad iron, without explanation of type, is New Orleans Daily Picayune, September 19, 1861.

Various thickness of iron include: 3/4-inch to 1-inch, Mahan, Gulf and Inland Waters, 6-7; 1 1/2-inch bar iron, Scharf, History of the Confederate States Navy, 265; 2-inch, Read, Reminiscences of the Confederate States Navy, 334; and 4-inch, James Morris Morgan, "The Pioneer Ironclad," U.S. Naval Institute Proceedings 42(October 1917): 2276.

References to first gun on Manassas being a 9-inch Dahlgren, Daily Picayune, Sept. 9, 1861; testimony of E.M. Tidball at the investigation of the Navy Department, February 28, 1863, ORN, II, 1,792. Reference to later use of 32-pdr. carronade is J.K. Mitchell to Stephen R. Mallory, August 19, 1862, ORN, 18: 292.

Dimensions of Manassas from application for issuance of Letter of Marque, September 12, 1861, ORN, II, 1: 382-84. Draft estimate is based on a reconstruction drawing of the Manassas by the late Earle Geoghegan of the Smithsonian Institution. Speed from description of trial run in Daily Picayune, Sept. 19, 1861; speed upstream during the battle of April 24, 1862, was 2 1/2 knots, Warley Papers, ORN, 18: 338.

¹⁴Many conflicting descriptions of various details might be in consequence of extensive repairs and modifications made to Manassas after the Head of Passes battle; see numerous vouchers for material and labor in NASF-AC. One postwar document states that the Manassas was equipped with only one smokestack; see J.A. Chalaron to H.B. Littlepage, March 31, 1904, NASF-AD.

Drawing by Dent is in John Horry Dent Papers, Special Collections, University of Alabama, Tuscaloosa, Alabama, Reference to pilot house, or hatch, in stern is Scharf, History of the Confederate States Navy, 265.

¹⁵"Propellor Enoch Train, of Boston," U.S. Nautical Magazine and Naval Journal, III:221.

¹⁶Clyde E. Wilson, "The Gun Boat Baltic," compiled under W.P.A. Project 3821, January 4, 1938, in Gunboat Baltic Papers, Public Information Subject Files - Navy SG11146 - Folder 10, Alabama Department of Archives and History, Montgomery, Alabama (hereafter cited as Baltic Papers).

¹⁷Ibid.

¹⁸Date of purchase, ibid. Dimensions of Baltic from Enrollment Document, January 13, 1866, Mobile, Alabama, RG41. Date of transfer of Baltic to C.S. Navy, telegraph, P. Hamilton to Gov. Shorter, May 27, 1862, Baltic papers.

¹⁹Illustration of Baltic reproduced in Caldwell Delaney, Confederate Mobile: A Pictorial History (Mobile, Alabama: Haunted Book Shop, 1971), 123. Dimensions of armor plate in Scofield and Markham to J.D. Johnston, February 22, 1862, Baltic Papers. Armament is given in R.B. Hitchcock to G.V. Fox, July 31, 1862, ORN, 19: 103.

²⁰Charles C. Sims to Catesby ap R. Jones, July 4, 1864, Area 6 File; Still, Iron Afloat, 212.

²¹Fingal's dimensions provided by A.S.E. Browning, Keeper, Glasgow Museum of Transport, to Robert Holcombe, March 22, 1979, in possession of the author, Columbus, Georgia. Account of Fingal from Thomas R. Neblett, "Major Edward C. Anderson and the C.S.S. Fingal," Georgia Historical Quarterly 52 (June 1968): 132-58; see also Nelson Tift to John Thomas Scharf, June 9, 1890, NASF-AD. The Fingal was built in 1861 by J. & G. Thomson, in Govan, near Glasgow, Scotland.

²²Specific date of commencement of Fingal's conversion has not been determined. Vouchers in NASF-AD suggest the work started no later than March 31, 1862; see voucher no. 11, to James Reilly, July 7, 1862; voucher no. 62, "men on the Fingal," 1st quarter 1862; voucher no. 20, to George C. Heywood, May 14, 1862. The Tifts could not have arrived in Savannah until the latter part of April, or early May, at the earliest, for they were in New Orleans building the Mississippi until the fall of the city April 25. The Atlanta was commissioned November 22, 1862, see diary of Dabney M. Scales, Duke University, Durham, North Carolina.

Specifications of Atlanta from contemporary mid-section, Mariners' Museum, Newport News, Virginia (same as ORN, 14: 290), and NPF #81-12-2D. Armament from ordnance report, C.S.S. Atlanta, n.d., Savannah Squadron Papers, Emory University, Atlanta, Georgia. Reference to spar torpedo, Still, Iron Afloat, 105.

²³References to speed trials contained in Scales diary, entries of December 22, 29, 30, 1862, January 1, 4, 16, and March 20, 1863. According to Scales, the Atlanta's initial trial runs were made with and without her smokestack, resulting in speeds of 5 1/2 and 3 1/2 knots respectively. After mechanics altered her blowers to increase their revolutions, speed improved to 8 knots.

²⁴Plans of Atlanta are NPF #81-12-2D, inboard profile and main deck plan. A companion midship section is at Mariners' Museum. A second set of plans with a different knuckle shape is NPF #78-8-8, inboard profile and main deck plan; #78-8-9, plan of fore and aft berth decks, hold, magazines, and shell room; and #78-8-10, midship section. Measurements used in text taken from former set of plans.

²⁵For details of Atlanta's capture, see ORN, 14: 256-66.

²⁶Dimensions of Mobile from Temporary Enrollment Document, November 12, 1860, Philadelphia, Pennsylvania, RG41. For early history of C.S.S. Mobile, see United States Navy Department, Civil War Naval Chronology (Washington, D.C.: Government Printing Office): VI: 271-72 (hereafter cited as CWNC). Decommissioning date from Francis E. Sheppard to John W. Nixon, October 11, 1862, NASF-AR. Best account of Mobile's conversion is William N. Still, Jr., "Confederate Shipbuilding in Mississippi,"

Journal of Mississippi History 30 (November 1968): 291-303.

²⁷Still, "Confederate Shipbuilding in Mississippi," 302; File R-6, Republic, Papers Pertaining to Vessels of or Involved with the Confederate States, "Vessel Papers," Record Group 109, National Archives, Washington, D.C. (hereafter cited as "Vessel Papers," with appropriate file number). Charleston Courier, June 20, 1863, quoting from Yazoo Southern Banner, June 5, 1863; Frederick Way, Jr., Way's Packet Directory 1848-1983 (Athens, Ohio: Ohio University Press), 391. The Republic's machinery was supposedly intended for a large sidewheel ironclad being built at Selma, Alabama, by John T. Shirley and David DeHaven.

²⁸File E-36, Eastport, "Vessel Papers."

²⁹Way, Packet Directory, 137; Still, Iron Afloat, 42; S.L. Phelps to A.H. Foote, February 18, 1862, ORN, 22: 615; Phelps to Foote, February 10, 1862, ibid., 571-74. Eastport operated first as a part of the Western Flotilla, later the Mississippi Squadron, until April 26, 1864, when she was destroyed to prevent capture after striking a torpedo; see United States Navy Department, Dictionary of American Naval Fighting Ships (Washington, D.C.: Government Printing Office, 1977), II: 320 (hereafter cited as DANFS).

³⁰Photograph of Eastport in Public Library of Cincinnati and Hamilton County, Ohio; ordnance from Silverstone, Warships of the Civil War Navies, 156. Eastport's registered dimensions were 230 ft. between perpendiculars, 32 ft. moulded beam, 8 ft. depth of hold, and 570 tons; see Enrollment Document No. 2, March 23, 1857, Paducah, Kentucky, RG41.

³¹John W. Crary, a citizen of Pensacola at the outbreak of the war, claims to have proposed to Confederate authorities the conversion of a razed schooner into an armorclad warship covered with railroad iron. This vessel was to have carried a single rifled gun firing a unique delayed-action explosive projectile of Crary's design. It was to be used to reduce and capture Ft. Pickens, near Pensacola. According to Crary, the evacuation of Pensacola in the spring of 1862 prevented his plan from being carried out. Crary also claimed that the idea for armor plating a ship-of-war was his, and that he should have received credit for the conversion of the Merrimack into the Virginia, rather than John Mercer Brooke; see John Williamson Crary, Sr., Reminiscences of the Old South From 1834 to 1866 (Pensacola, Florida: Perdido Bay Press, 1984), 86-90, 112, 116.

³²Stephen R. Mallory to James D. Bulloch, April 30, 1862, ORN, II, 2: 186; Brooke, Brooke, 242, 262-64; Dew, Ironmaker to the Confederacy, 118-19.

³³The Manassas, with probably no more than 2 inches of armor, achieved most of her strength from the shape of her egg-shaped shield. Lieutenant Warley feared 10-inch smoothbores and 7-inch rifles would sink his command, but the Manassas resisted all shot thrown at her at Head of Passes in October and at the Passage of the Forts the following April, until she was ultimately penetrated during the final stages of the latter battle; see Warley Papers, ORN, 18: 340-41, 344.

CHAPTER III

EARLY NONSTANDARD DESIGNS

With the conversion of the Merrimack well underway at Gosport Navy Yard, Mallory soon initiated the construction of several ironclad warships from the keel up. These early designs had little in common but the armored sloping shield first adopted for use on the Virginia, and can best be described as nonstandard types. In general, they were heavily armed with ten or more guns, dimensionally large, and often unorthodox in construction. These characteristics resulted from an untested offensive strategy that required them to operate in both shallow harbors and rivers and at sea against Federal blockaders. This strategy ultimately proved to be incompatible with the South's naval capabilities, but for the first year of the war it would have a significant influence on ironclad design.¹

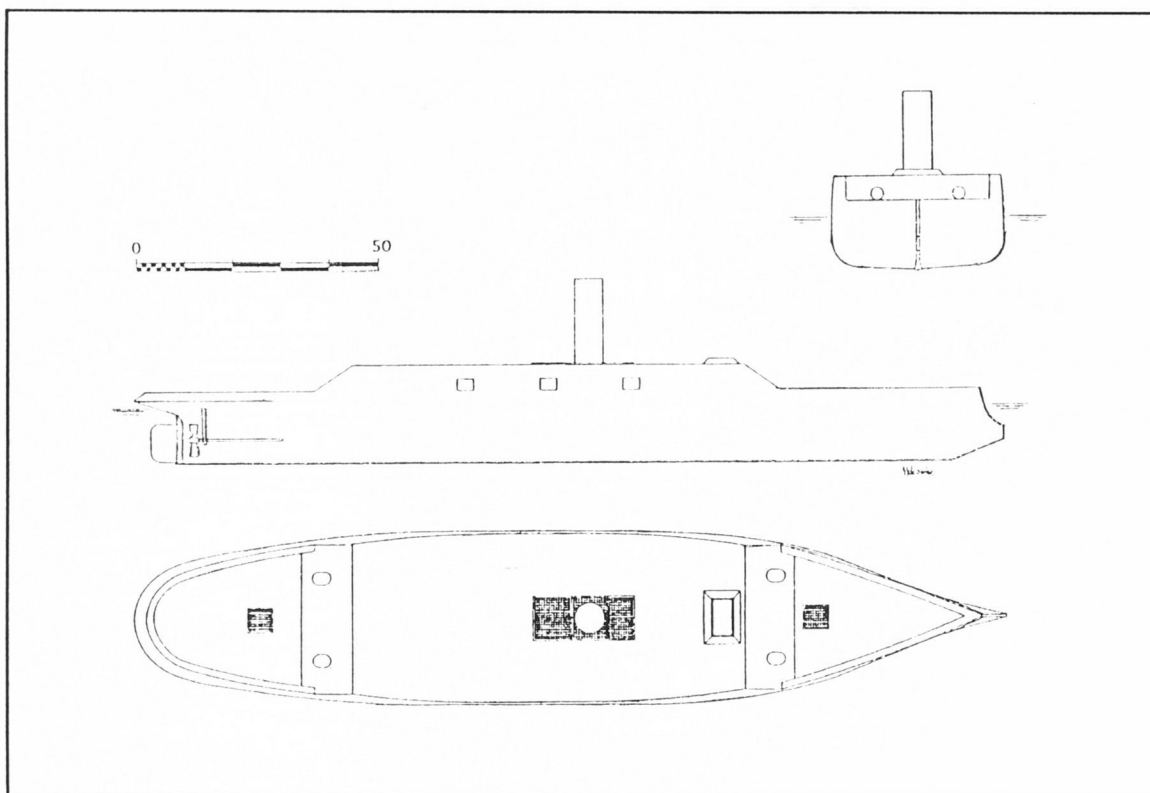
Concern over Federal naval construction on the upper Mississippi and Ohio Rivers prompted the construction of the first of these warships when Congress appropriated \$160,000 on August 23, 1861, "For the Construction, Equipment, and Armament of Two Ironclads, for the Defense of the Mississippi River and the City of Memphis."² The following day, the Navy Department signed a contract with John T. Shirley, a Memphis steamboat builder, for the construction of two ironclad rams at that strategic Mississippi River port. The specifications accompanying this contract called for armored vessels 165 feet in length between perpendiculars, 35 feet in moulded beam, and 12 feet in depth of hold. They were to be powered by two horizontal, direct-acting, noncondensing engines, each driving independently of the other a single six-foot, nine-inch diameter propeller. These engines were to be thirty inches in diameter and twenty-four inches in stroke of piston, and were to be capable of producing seventy-five to eighty revolutions per minute with a steam pressure of from seventy-five to ninety pounds per square inch. Steam was to

be furnished by four boilers with a heating surface of four thousand square feet.³

The initial design of the Memphis ironclads possessed several unique features that appeared on no other known Southern ironclad. The casemate, while angled on its fore and aft ends at thirty-five degrees - the same as the Virginia - had vertical sides, thus lacked the extra protection afforded by inclination. Furthermore, the structure was intended to be built without a roof and was exceptionally vulnerable to plunging fire and shell fragments. Low, two-foot high bulwarks on the fore and aft flush decks provided an unusual, but not exclusive, characteristic that was more typical of ocean-going ships than those intended for inland waters. What the vessels lacked in defensive strength they made up in offensive bite. Each was planned for eight guns, three on each broadside and one at each end. A large cast iron ram was to be attached to the bow below the waterline.

Eventually named the Arkansas and Tennessee, these gunboats went through a series of modifications after their building commenced that were intended to increase their strength and power. First, the casemate was enclosed with a light wooden roof covered with a thin layer of iron, then compressed cotton was placed between the frames of the vulnerable vertical casemate sides. Second, the armament was increased by two guns, with an additional gun being placed at each end of the casemate. Finally, the power plant was improved with the addition of two boilers (for a total of six), and enlarged engine and propeller dimensions.⁴

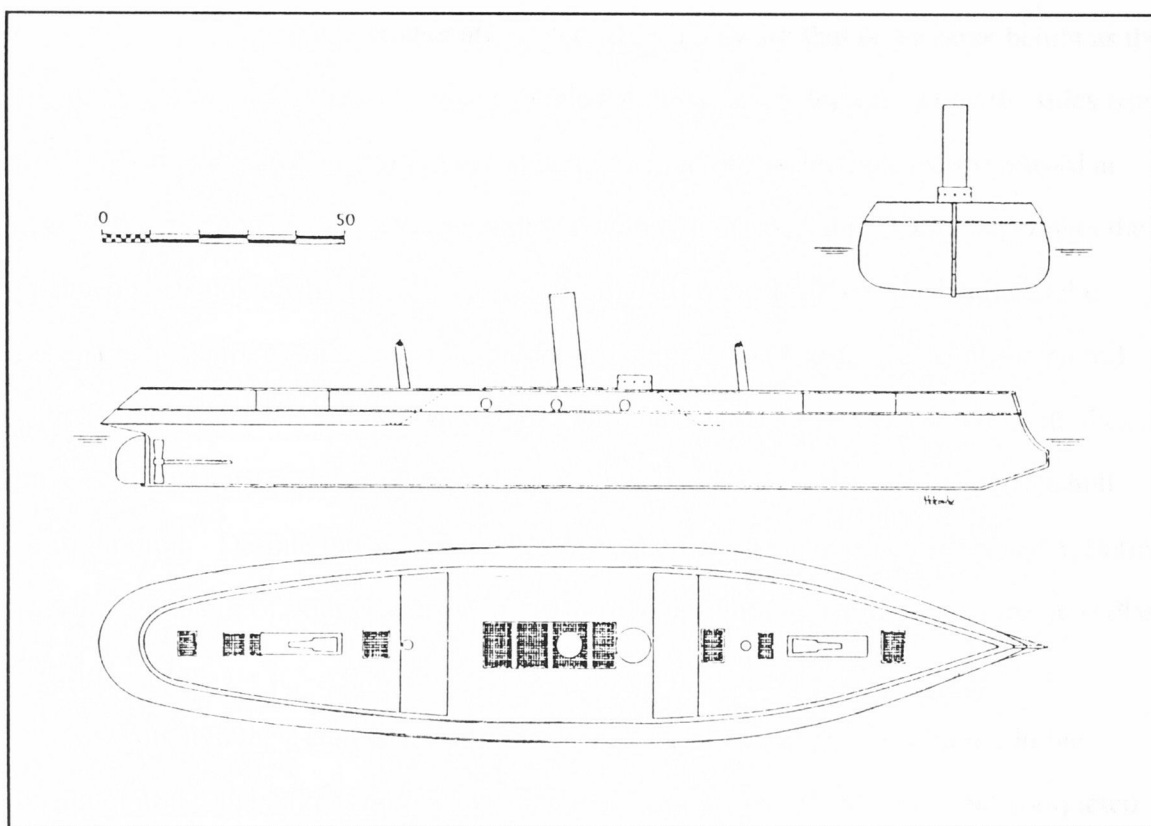
Attempts to acquire rolled iron plate for the Arkansas and Tennessee were unsuccessful, so railroad T-iron was substituted. On the casemate ends the rail was laid vertically, with the first course being bolted down base first and the second course inserted in the gaps in an inverted position. By so doing, a relatively flush exterior surface was formed, with a total thickness of about four inches. A similar course was laid horizontally on the casemate sides, while one-inch thick plate iron was attached to the stern and counter.



Plan 12. *Arkansas*, three-view.

This improvised use of T-rail and thin plate iron for armor was resorted to on occasion by the Confederate navy, particularly in the western theater where industrial facilities were scarce and rail connections with manufacturing centers in the east tenuous or nonexistent.⁵

No builder's drafts of these two vessels have been found, but at least three contemporary sketches by officers who served on board survive. These drawings substantiate the numerous contemporary and postwar eyewitness descriptions of the Arkansas, the only one of the two to be completed. They depict an armorclad warship with vertical casemate sides and sloping ends. A low pilot house is located on the extreme forward end of the shield and a large smokestack protrudes not far aft. The casemate is centered on the hull for about two-thirds of its length. No hatches are visible on the shield deck. Low bulwarks enclose the short fore and aft flush decks. A drawing by Acting



Plan 13. 180-foot Seagoing Ironclad, three-view.

Master Samuel Milliken shows a small capstan on each flush deck with what appears to be a mooring bit in the extreme bow (Plan 12).⁶

The designer of the Arkansas and Tennessee is believed to be Naval Constructor Porter. An original plan in the National Archives thought to have been conceived by Porter bears a strong resemblance to descriptions of the original design of the two Memphis ironclads, though its dimensions are slightly greater and other differences exist. With half-breadth, deck, and inboard profile plans, the twin-screw ironclad illustrated measures 180 feet between perpendiculars, 40 feet in moulded beam, and 12 feet in depth of hold. Draft is given as ten feet. The casemate, enclosed on the top, is slightly over sixty feet in length and carries six guns, three on each broadside. Two additional guns are carried outside the

casemate, one forward and another aft, protected by a bulwark that is the same height as the casemate. The ends of the casemate are angled at thirty-seven degrees, while the sides rise from the waterline at an eighty-degree angle to a height of five feet, then slope inward at about fifty-five degrees. The vessel is shown with two masts, but in lieu of a sail plan the intended rig is unknown. In profile, with fore and aft bulwarks the same height as the casemate, the ship resembles a common ocean-going, sail and steam vessel of the period with an unbroken sheer from stem to stern. The characteristic most in common with the three contemporary sketches of the Arkansas alluded to above is its above waterline hull configuration. Despite this similarity, however, there is no conclusive evidence that Porter was the originator of both designs, nor that the two designs are in any way connected (Plan 13).⁷

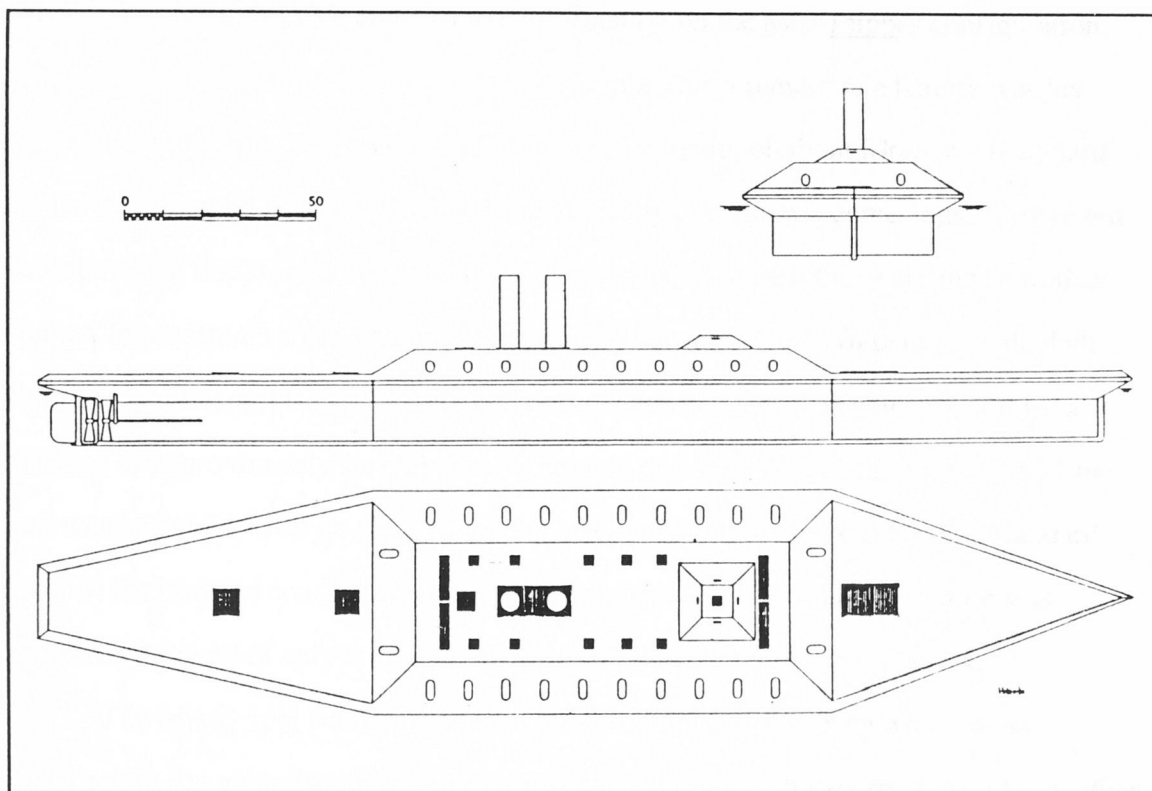
Although the Tennessee was destroyed on the stocks to prevent capture in the spring of 1862, the Arkansas was towed up the Yazoo River, Mississippi, and completed there under circumstances rendered difficult by the area's remoteness. Later (July 1862) the vessel was engaged in extensive combat with Union forces on the Yazoo and Mississippi Rivers. Those battles revealed numerous deficiencies, particularly in resistive and motive powers, in an interim design that was already obsolete.⁸

The August 23 bill that appropriated funds for the construction of Shirley's ironclads also provided \$800,000 for naval construction at New Orleans. Resulting from this additional funding were the two most unorthodox ironclads built on either side during the Civil War, the Mississippi and the Louisiana. The Mississippi was the first to be approved, and typical of several of the early war nonstandard designs, she was conceived outside the Navy Department by individuals with little experience in naval architecture.⁹

In late August brothers Asa and Nelson Tift, prewar friends of Mallory, communicated with the Secretary and offered to build a war vessel according to plans previously submitted and approved, "without pecuniary compensation from the

Government."¹⁰ By the first of September Mallory had determined to allow the brothers to construct the vessel at New Orleans as agents of the Navy Department. The brainchild of Nelson Tift, a South Georgia planter, politician, and business entrepreneur, the Mississippi was novel in that all of her surfaces were either flat or straight, with no intricately curved frames or bent planks. Realizing that the South would be woefully short of experienced shipwrights, Nelson conceived the design with simplicity of construction paramount so that even house carpenters could build it. Convinced of the merit of his concept, he constructed a model and with brother Asa traveled to Richmond where the plan was submitted for approval to a board of naval officers appointed by Mallory. Gaining the board's approval, the Tifts left for New Orleans in early September with builder's plans prepared by Naval Constructor Porter. On October 14, 1861, the first plank of the Mississippi was laid.¹¹

The ironclad conceived by the Tifts was the largest laid down in the Confederacy. Initially intended to be about 240 feet between perpendiculars, 58 feet in extreme beam, and 15 feet in depth of hold, it was increased in length by another 20 feet when a second row of boilers had to be added to supply the requisite steam. An armored casemate built of wood two feet in thickness was to be covered with three layers of one and one-quarter-inch thick rolled iron plate on its sides and ends, while two layers covered the underside of the knuckle, and a single layer covered the spar deck and fore and aft flush decks. The sides and ends of the 120-foot long casemate were first designed with a 36-degree angle, but this was altered to 30 degrees when it was found the gun muzzles would sufficiently clear the gunport sills. Likewise, the initial armament of eighteen guns - eight 9-inch Dahlgren smoothbores on each broadside and one 7-inch single-banded Brooke rifle pivot-mounted on each end - was increased by two with the addition of a rifle on each end of the casemate. A cast iron ram on the forward end of the knuckle completed the Mississippi's offensive punch.¹²



Plan 14. *Mississippi*, three-view.

The Mississippi's motive power was as exceptional as any other aspect of her design. Three engines with thirty-six-inch bores and thirty-inch strokes drove triple eleven-foot diameter propellers. Steam for these engines was to be provided by eleven boilers, each thirty feet long and forty-two inches in diameter. This was later increased to two rows of eight boilers, each thirty feet long and forty-two inches in diameter. The change purportedly produced about 1500 horsepower and an optimistically projected top speed of 14 knots. Although this system was never tested, it was one of the first triple-propeller ships constructed.¹³

While no original builder's drafts of the Mississippi have been located, two schematic plans by the Tifts, along with voluminous testimony given before a Joint Special Committee of both houses of the Confederate Congress to investigate the affairs of the

Navy Department, provide considerable information on the Mississippi's configuration. This material leaves little doubt that the Mississippi's most remarkable feature was her simplified hull form. With perfectly flat floors for a width of about forty-two feet, hard chines were formed by the hull sides rising vertically at a ninety-degree angle. About ten feet above the floors solid built-on knuckles, intended to protect the waterline as well as support the casemate sides, extended the beam by seventeen feet. In plan view the hull sides run parallel amidships for 120 feet, then at each end the sides angle inward for a distance of approximately seventy feet to the stem and stern post. The framework of the hull was laid solid, with no space, then planked - a feature that was to become standard practice for ironclad construction in the Confederate navy. The entire structure was completely devoid of curves and was most unshiplike in appearance (Plan 14).¹⁴

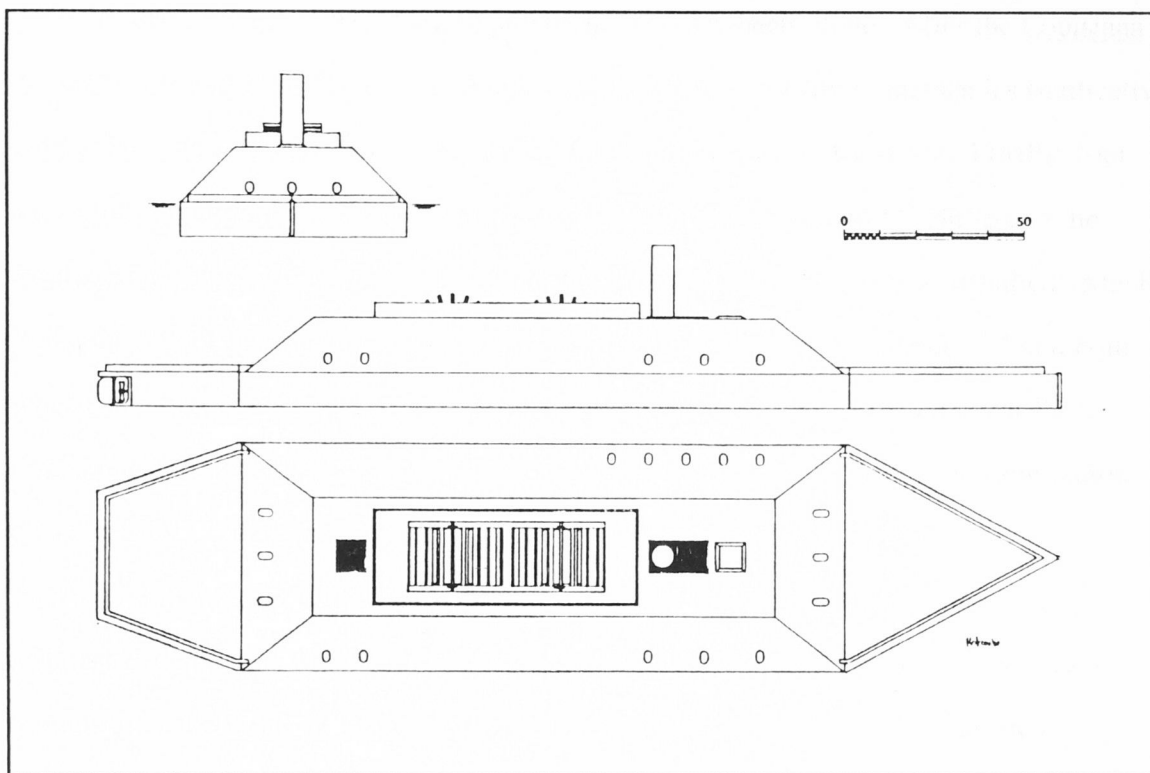
The Mississippi was destined never to be completed, but even while under construction she gained a reputation for power and strength that exceeded that of any other armored warship built in the South. Belief among the populace of the Crescent City was that she alone could save New Orleans from capture if only finished in time. Naval officers both North and South believed that had she been completed the Mississippi would have turned the tide of battle for the Confederacy. Her intended captain, Arthur Sinclair, described her as "a formidable ship, the finest of the sort I ever saw in my life;" furthermore, he believed that "she would . . . not only have cleared the river of the enemy's vessels, but raised the blockade of every port in the South." Even Federal Admiral David Farragut, who would have opposed the Mississippi in combat had she been completed, considered her a potential "terror of the seas." So great was the faith placed in her abilities that the anger and shock caused by her destruction nearly cost the Tifts their lives at the hands of a furious lynch mob who were convinced that only treachery by the Northern-born brothers could have caused the loss of the already legendary ram.¹⁵

The Louisiana was begun at an adjacent yard one day after the Mississippi's keel

was laid. This second immense ironclad was the brainchild of E.C. Murray, a native of Paducah, Kentucky, with 20 years experience in building steamers and sailing vessels. According to Murray, he approached the Navy Department as early as April 1861 with plans for an ironclad like the Merrimack, which "by some jeremy diddling, [was] attributed to Lieutenant Brooke." Five months later, on September 18, Murray received a contract to build an ironclad warship for \$196,000.¹⁶

The specifications accompanying the contract called for a vessel that virtually equalled the monstrous Mississippi in size: 264 feet long overall, 62 feet beam extreme, 7 feet depth in the clear, and a maximum draft of 6 feet. Displacement was calculated at 2751 tons. Similarly, she had an unconventional hull form, with flat floors and perpendicular sides, but without the solid built-on knuckles to protect the waterline. The armored casemate, constructed of wood twenty-eight inches thick, was to be covered with railroad T-iron and pierced for twenty-two guns - although she would eventually carry only sixteen. The casemate angle was set at thirty-eight degrees on all four sides, though some accounts suggest it was altered to forty-five degrees. A recessed platform for sharpshooters was prescribed for the casemate roof but apparently not built; instead, a four- to five-foot high iron breastwork was constructed and used for the same purpose. The forward end of the ship was built solid for fifteen feet for ramming, and a 7.8 ton iron "nose" was cast but probably not attached before the Louisiana's destruction.¹⁷

The builder's plans originally annexed to the contract and specifications are not known to exist. Several contemporary and near-contemporary drawings have survived, including a schematic plan view showing the Louisiana's gun and machinery arrangements. Combined with the written specifications, these views provide enough information for a reasonably accurate reconstruction of the vessel's unusual appearance, as shown in the accompanying plan (Plan 15).¹⁸



Plan 15. *Louisiana*, three-view.

The Louisiana's propulsion system ranks as one of the most unusual devised in the early history of steam navigation. The specifications called for four engines and six boilers. Two of the engines, taken from the Mississippi River steamboat Ingomar, were to drive two twenty-seven-foot diameter by nineteen-foot wide paddlewheels mounted in tandem in a wheel well that stretched about 114 feet forward from the stern. The wheels were enclosed within a box in the casemate, but their buckets protruded above the spar deck and were unprotected. Two smaller purpose-built engines were arranged to drive four-foot diameter propellers on either side of the paddlewheel well. They were intended as auxiliary motive power, primarily to aid the twin rudders in steering the vessel. The apparent power of such a propulsion system was in reality the Louisiana's greatest defect. When hurriedly placed into service before she was completed, the vessel was unable to

stem the swift current of the Mississippi with her paddlewheels alone. After the Louisiana was towed down river to contest Farragut's fleet as a floating battery, mechanics frantically worked to install the remainder of her machinery and prepare her for battle. Finally, four days after the Union navy had fought its way past Forts Jackson and St. Philip and the Confederate forces afloat, the remainder of the Louisiana's machinery was installed. Much to the dismay of her crew, with "as much steam as the boilers would stand . . ." and both wheels and propellers operating, she would not budge even in the still water near the river's bank. Unable to move, she was destroyed to prevent capture after the capitulation of the nearby Confederate forts.¹⁹

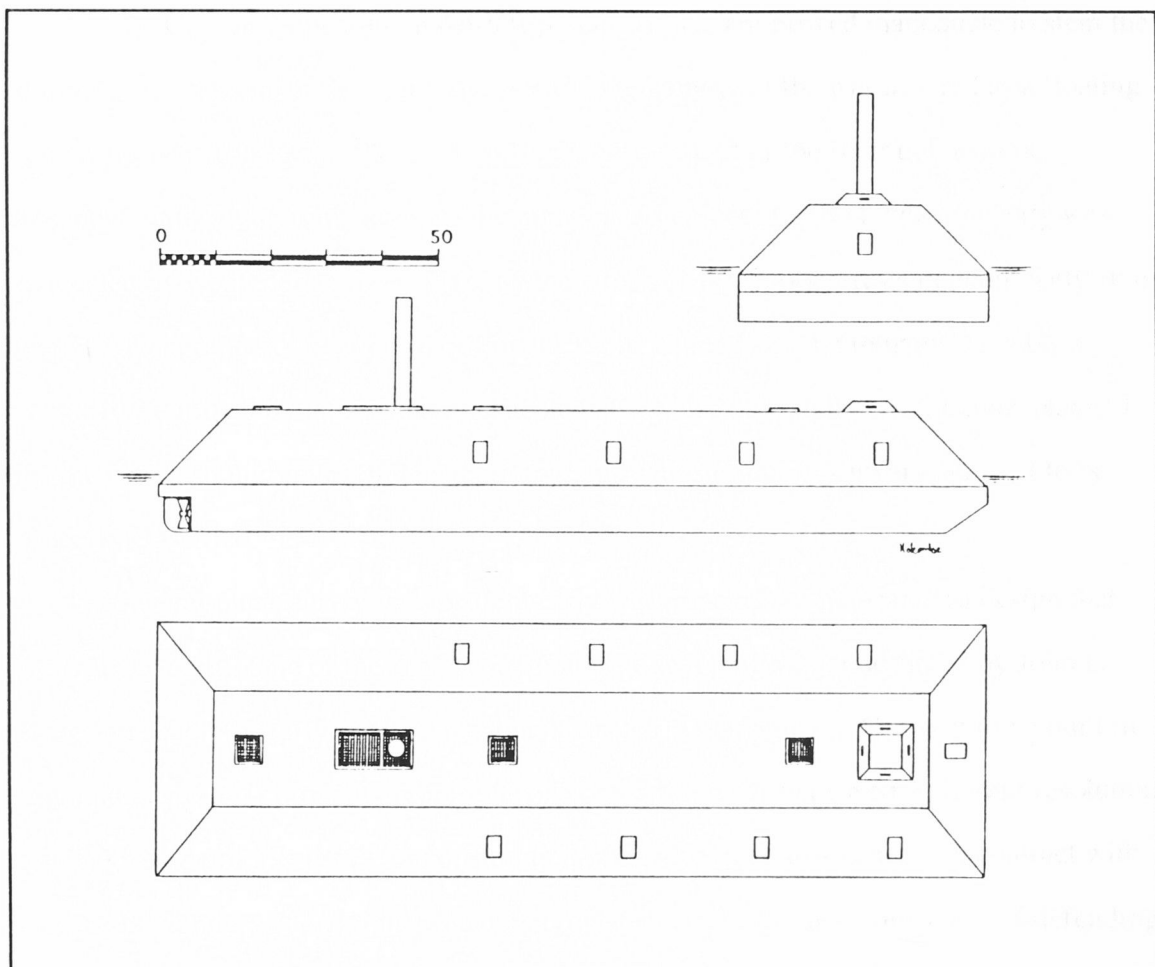
In other respects the Louisiana was a success. She withstood the fire of the heaviest Federal guns with only superficial damage. Engaging in combat less than two months after the Battle of Hampton Roads, her resistive strength further vindicated Mallory's faith in the casemated design first tested by the Virginia. In contrast, the Louisiana's problems with underpowered machinery were symptomatic of engineering and manufacturing inadequacies that would plague the Confederate navy through most of the war.²⁰

Although laid down considerably later than other nonstandard ironclads, the Georgia qualifies for inclusion in this category on the basis of meager information, which suggests that her design was unorthodox. The Georgia was conceived at Savannah during the winter or early spring of 1862 as a self-powered, armored floating battery to aid in the defense of nearby Fort Pulaski, which was then being invested by Federal forces. Details concerning the Georgia's inception are few and often contradictory, but her construction apparently was commenced sometime in March 1862 at Harding's shipyard, near Miller's Foundry, in Savannah. Her constructors were state troops under the overall command of Gen. Henry R. Jackson. Vague records imply that she was built at the request of a group of local women, but for certain by early April the Ladies Gunboat Committee (as the

organization came to be called) was raising funds statewide for the vessel's construction. It is equally evident that this was strictly a private endeavor, with little or no input from naval authorities. When the state troops were disbanded and placed in Confederate service in mid-April, the committee assumed control of the work and successfully launched the "battery" the following month.²¹

The design of the Georgia is attributed to A.N. Miller, a local foundryman with little practical experience in naval architecture. Few detailed descriptions and no known plans survive to give an accurate picture of the Georgia. Even her overall dimensions are shrouded in mystery, with eyewitnesses estimating her size at from 150 feet in length and 50 feet in beam, to 250 by 60 feet.²² The best of these descriptions is given by a young soldier who apparently examined the Georgia in detail. Writing to a younger sister, he recorded the vessel's casemate as being constructed of solid timber about fifteen inches in thickness, covered with a double layer of railroad T-iron, which in turn was coated with a composition of iron filings and "some kind of cement . . . so as to cover the inequalities and to make it solid and keep it from shaking." Over this was placed a thick layer of grease "to prevent any possibility of boarding her and also to help glance the balls." The casemate, he surmised, was inclined at about forty-five degrees and was to contain ten guns. Her machinery consisted of "a double engine" and two propellers.²³

The only known images of the Georgia are several illustrations in Union newspapers - journals not known for accuracy when depicting Confederate ironclads. Despite minor discrepancies, however, these portrayals do agree in depicting the Georgia as a floating casemate with no visible fore and aft flush decks, very similar in appearance to John L. Porter's earlier harbor defense ironclad design, but with flat rather than rounded ends (see Chapter I). Indeed, there is evidence of Porter's involvement in the vessel's design. Josiah Tattnall, commodore of the Savannah Squadron, declared that prior to his leaving the city in late March 1862 to take command of the Virginia, he had formed a board



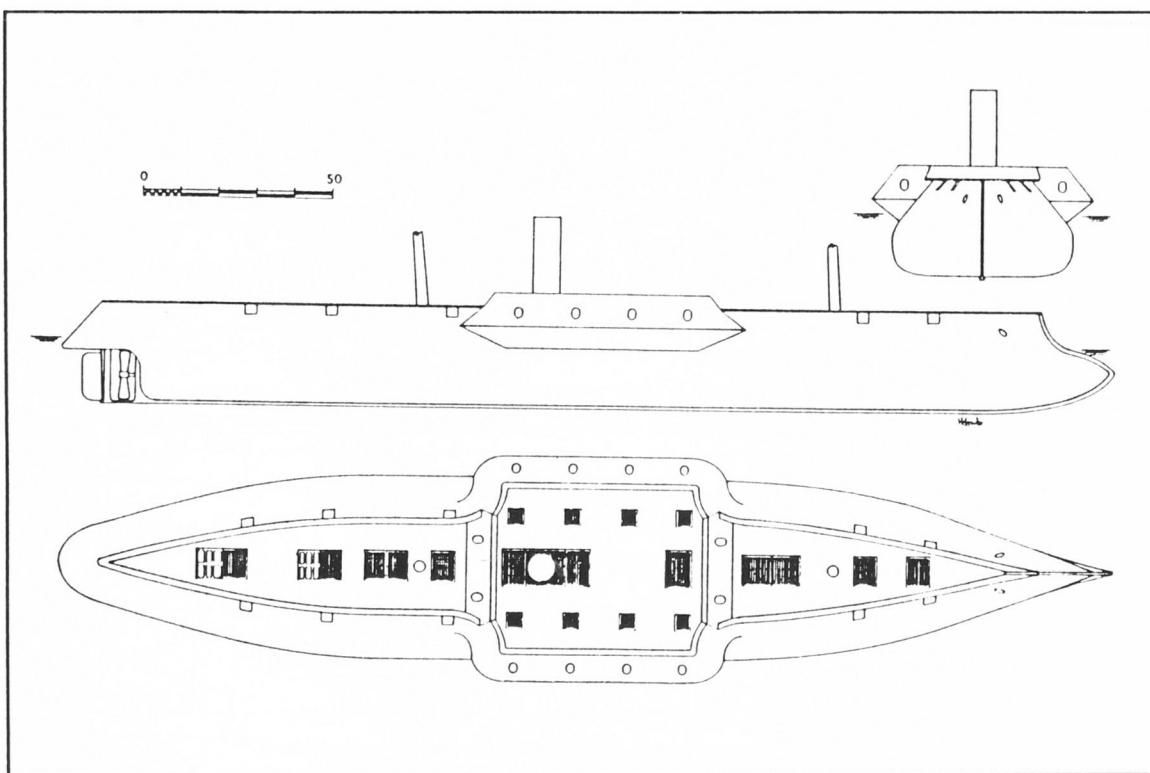
Plan 16. *Georgia*, three-view.

consisting of local citizens, shipbuilders, and army and navy officers to propose a plan for a floating battery. "One was suggested," he wrote, "and forwarded to Richmond for the consideration of the Chief Naval Constructor" Unfortunately, Tattnell fails to elaborate and there is no other evidence of Porter's involvement with the design of the Georgia, or that her design was based on his 1861 harbor defense model. No matter who her designer, considering the quickness with which she was built (about four months), there seems little doubt that the Georgia's form was extremely simple - perhaps being based on an already existing craft such as a barge (Plan 16).²⁴

The Georgia's apparent makeshift propulsion system proved inadequate to stem the current of the Savannah River and she spent the remainder of the war moored as a floating battery near Fort Jackson. She served effectively as a part of the river defenses of Savannah until scuttled by her crew the night of December 20, 1864, when the city was evacuated by Confederate forces. Today the wreck of the Georgia rests in about forty-five feet of water some 700 feet north of Fort Jackson. Since 1969 the remains have been cursorily examined by underwater archaeologists. More thorough investigations planned for the future should reveal much about this ship's mysterious design and allow it to be properly classified.²⁵

Several plans survive of apparent early war ironclads of nonstandard design that were never built. One of these plans is for a large seagoing vessel designed by John L. Porter, probably in early 1862. The plan is labeled "G.N. Sanders Contract to be built in England of iron." It probably represents one of six ironclads approved by a joint resolution of Congress April 19, 1862, for construction in Europe in conformance to a contract with George N. Sanders of Virginia. Sanders proposed to operate these ships as self-defending freight and mail transport steamers between the Confederacy and Europe. They were also intended to operate as commerce raiders during their cross-Atlantic runs, with Sanders receiving one-third the value of prizes captured en route. The Confederate government would appoint their commanders, but Sanders would employ the crews. These ambitious vessels were never built, probably because of a conflict with Britain's neutrality laws which prevented the construction and sale of such warlike craft.²⁶

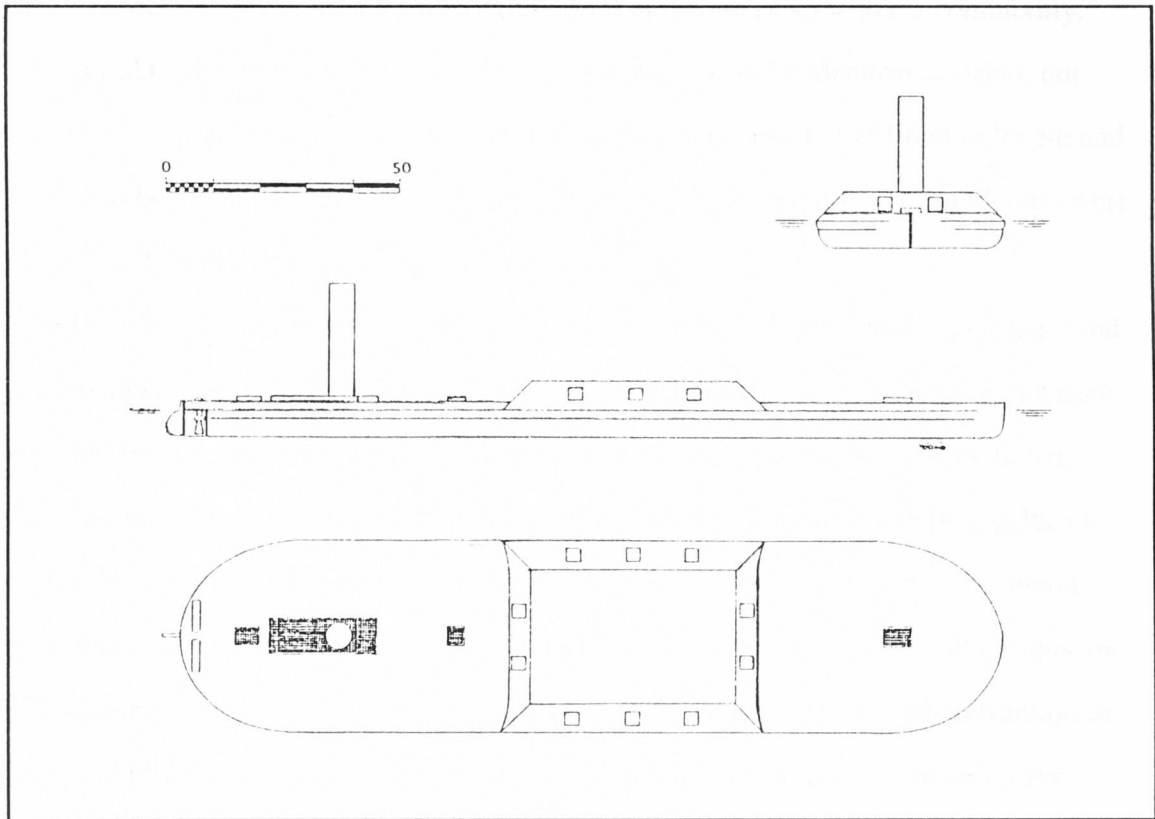
Consisting of inboard profile and half-breadth views, the builder's draft of these vessels depicts a large single-screw, casemated ironclad with two masts. It measures 234 feet long between perpendiculars and 277 feet overall, with a beam of hull of 47 feet, 6 inches and an extreme beam of 58 feet, 6 inches. Depth of hold is twenty feet, while draft of water is seventeen feet. A short sixty-nine-foot long casemate is amidships with its



Plan 17. 234-foot Seagoing Ironclad, three-view.

sides forming sponsons extending outward about six feet, six inches on either side of the hull. In appearance these sponsons are similar to those formed by sidewheel paddleboxes. The sides and ends of the casemate are angled at fifty-two degrees. Contrary to contemporary records, which indicate the vessels were to each carry six guns, the plans illustrate eight: four pivot-mounted in each casemate corner, and two on each broadside. A large ram formed by an underwater extension of the stem is shown forward (Plan 17).²⁷

John Meicer Brooke also designed an ironclad intended for construction abroad. In July 1862 Secretary Mallory ordered Brooke to prepare plans of a seagoing ironclad based on a report previously submitted by the brilliant young ordnance officer. Consequently, drawings and details were developed with the assistance of Acting Naval Constructor William A. Graves, and a few months later taken to England. Apparently neither plans nor



Plan 18. Shallow-draft, Twin-screw Ironclad, three-view.

specifications of Brooke's design survive, and no ships were built accordingly.²⁸

An unusual ironclad plan believed by National Archives staff to be Confederate is that for a shallow-draft, twin-screw vessel mounting either six or ten guns. Bearing neither label nor designer's signature, the vessel illustrated has a hull length of 175 feet, a hull beam of 40 feet, an overall beam of 41 feet over the knuckles, a depth of hold of approximately 5 feet, 6 inches, and a draft of 6 feet. A fifty-five foot, six-inch long casemate is coated with four and one-half inches of iron backed with twelve inches of oak. The casemate sides and ends are sloped at forty-five degrees. Considerable use is made of metal stanchions and diagonal bracing in the vessel's construction. This fabrication technique suggests a Northern provenance for the design, for it is doubtful that anyone in

the Confederacy would have been so extravagant in the use of so scarce a commodity. Another plan apparently by the same designer shows a virtually identical ironclad, but smaller. Captioned "Iron Cased Steamer for Rivers," this vessel is 153 feet in length and 28 feet in beam, and mounts 4 guns. Apparently no vessels, Union or Confederate, were constructed from these two designs (Plan 18).²⁹

The early nonstandard ironclads - in particular the Arkansas class, Louisiana, and Mississippi - were largely experimental vessels, and as such it is not surprising that each suffered from design flaws. The most prominent of these weaknesses was their size. Reflecting the Navy Department's initial requirement for offensive warships capable of high seas operations, they were often too large and had too great a draft for the inland waters in which they were ultimately required to work. The unorthodox hull designs and propulsion systems of the two New Orleans ironclads were of questionable advantage at best, and in the case of the Louisiana an outright failure. In firepower and defensive strength the Louisiana was more than a match for any Union warship in Farragut's fleet (as no doubt the Mississippi would have been had she been completed), and her success further engendered faith in the basic casemated design.

The small, relatively light-draft Arkansas was better suited to riverine warfare but suffered from poorly constructed steam machinery that plagued her throughout her short operational career and which eventually was the cause of her untimely demise. Her vertical casemate sides were a serious design shortcoming that caused her to be far less resistive to damage than if they had been inclined. As a result, the Arkansas was the only Confederate ironclad to have its casemate completely penetrated by an artillery projectile. The success she achieved against the combined Federal fleets above Vicksburg was a testament more to the skill and daring of her commander than to the strength of her model.³⁰

The Georgia represents a local plan developed for a specific local need: the relief of Fort Pulaski. Although rapidly constructed to an apparent simplified design, she was

finished too late to save Pulaski from capture. Furthermore, her engines proved incapable of providing adequate power and she had to be used as a stationary floating battery. With improved second-generation armor-plated warships already under construction as she entered service, the Georgia had no discernible influence on future Confederate ironclad design.

Like the conversions being built concurrently, the construction of these early warships not only provided the fledgling Confederate navy with much needed experience in producing ironclads, but resulted in the establishment of subsidiary facilities for the production of such necessary component parts as armor plate, ordnance, and steam machinery. Recognition of many of the shortcomings of the early designs, combined with a shift in strategy that emphasized river and harbor defense, resulted in ironclads being placed into production in the spring of 1862 which attempted to address these inadequacies. This was the beginning of a war-long effort by the Navy Department to improve its primary weapon afloat, as experience demanded and capabilities allowed.

ENDNOTES

¹William N. Still, Jr., "Confederate Naval Policy and the Ironclad," Civil War History 9 (June 1863): 151.

²Journal of the Congress of the Confederate States of America, 1861-65 (Washington, D.C.: Government Printing Office, 1904), vol. 1, 396. The Congressional appropriation was approved August 23 and signed by the President the following day.

³Contract with specifications is Contract #473, Entry 59, "Civil, Military, and Naval Contracts," Record Group 365, Treasury Department Collection of Confederate Records, National Archives, Washington, D.C.; hereafter cited as "Contracts," RG365.

⁴John J. Guthrie to Thomas Jordan, March 22, 1862, NASF-AC; Isaac N. Brown, "The Confederate Gunboat Arkansas," in Battles and Leaders, III: 572; Dabney M. Scales to Alfred T. Mahan, March 22, 1883, Area 5 File. According to Guthrie, who was sent to Memphis to inspect the two vessels while under construction, the stroke of the engines was increased by six inches and the propellers increased in diameter to eight feet. Guthrie claimed the cast iron ram weighed 1800 pounds. A sketch of the Tennessee's ram is in Henry Walke, Naval Scenes and Reminiscences of the Civil War in the United States on the Southern and Western Waters During the Years 1861, 1862, and 1863 (New York: R.F. Read, 1877), 303.

The Arkansas' machinery was built in Memphis by the Union Foundry and Machine Shop, Watt C. Bradford, proprietor, and was roundly criticized by several of the vessel's officers; see George W. Gift, "The Story of the Arkansas," Southern Historical Society Papers 12 (1884): 49. Dave Dermon, II, to Robert Holcombe, February 16, 1981, in possession of the author, citing entries in the 1860 Memphis City Directory.

The Arkansas was ultimately fitted with a mixed battery of various caliber smoothbores and rifled and banded 32-pdrs. The largest guns aboard were two 9-inch Dahlgren smoothbores; see Scales to Mahan, March 22, 1883, Area 5 File.

⁵Brown, "Confederate Gunboat Arkansas," 572; Scales to Mahan, March 22, 1883, Area 5 File; Guthrie to Jordan, March 22, 1862, NASF-AC.

⁶Contemporary drawings of the Arkansas include those by Acting Master Samuel Milliken, Midshipman Dabney M. Scales, and Lieutenant George W. Gift. Sketches by the former two officers appear in CWNC, VI:194 and II: 87, respectively. Gift's minute sketch is in George W. Gift to Ellen Shackelford, January 29, 1863, George Washington Gift Letters, Southern Historical Collection, University of North Carolina, Chapel Hill, North Carolina.

⁷Draft of the 180-foot ocean-going ironclad is NPF #81-12-2J. Armor thickness is not included in the views. Side casemate angles taken from reconstructed body plan by William E. Geoghegan, Smithsonian Institution, 1962. Geoghegan used these plans, in particular the hull configuration, in his 1964 Smithsonian Institution reconstruction plans of the Arkansas. There is no evidence that a ship was constructed according to the 180-foot ocean-going ironclad plans.

⁸Best of numerous accounts of the Arkansas include William N. Still, Jr., "The

Confederate Gunboat Arkansas," Collegere 2 (1967): 28-34; Gift, "Story of the Arkansas," 115-19, 163-70, 205-12; Edwin C. Bearss, Rebel Victory at Vicksburg (Vicksburg, Miss.: Centennial Commemoration Commission, 1963); Brown, "Confederate Gunboat Arkansas," 572-80.

⁹Journal of the Congress of the Confederate States, I: 396; Still, Iron Afloat, 16.

¹⁰Asa and Nelson Tift to Stephen R. Mallory, August 26, 1861, ORN, II, 1: 571. The Tifts (Asa, 1812 - 1889; Nelson, 1810 - 1891) were natives of Connecticut who moved south in their youths. Asa eventually settled in Key West and became active in numerous business endeavors, including ship repair, warehousing, and merchandising. Nelson settled in southwest Georgia where he established the town of Albany and pursued railroading, planting, and other business and political interests.

¹¹Still, Iron Afloat, 16; testimony of Nelson Tift, September 23, 1862, at the investigation of the Navy Department, ORN, II, 1: 531-32, 546-47; testimony of John L. Porter, March 3, 1863, ibid., 803.

¹²Dimensions from Pierce's testimony at the investigation of the Navy Department, September 23, 1862, ORN, II, 1: 541; reference to increase in length made necessary by additional boilers is Asa and Nelson Tift to Stephen R. Mallory, October 9 and 10, 1861, ibid., 575; for armor plate and its attachment, ibid., November 27 and December 6, 1861, 581; for casemate angles, see ibid., November 4, 1861, 579; changes in armament, ibid., January 10, 1862, 596; forward knuckle of cast iron, ibid., December 6, 1861, 583. Reference to 9-inch Dahlgren, A.C. Gunnison and G.T. Raoul to Tifts, n.d., ibid., 584; and Tifts to Mallory, November 4, 1861, ibid., 579. Brooke rifles made for Mississippi in Brooke, John M. Brooke, 254.

¹³For machinery data see Jackson and Co. to Stephen R. Mallory, September 25, 1861, ORN, II, 1: 572; Tifts to Mallory, October 9, 1861, ibid., 579, and ibid., October 29, 1861, 577-78. For a detailed description of the Mississippi's propulsion system, see diary of John Roy, Special Collections, Howard-Tilton Memorial Library, Tulane University, New Orleans, La. The first multi-screw warship built for the U.S. Navy, the twin-propeller Pawnee, entered service in 1860, Canney, The Old Steam Navy, 84-87. Possibly the first warship to be fitted with triple-screws was the British Crimean battery Meteor, which had two wing shafts fitted with her original centerline shaft in May 1855, see G.A. Osbon, "The First of the Ironclads: The Armored Batteries of the 1850's," Mariners' Mirror 50 (August 1964): 193, 195.

¹⁴General description of the Mississippi's hull from the only known contemporary drawings of the vessel: an inboard plan view showing boiler arrangement, and a partial midsection view, ORN, 18: 354, 356. Specific dimensions for portions of the Mississippi's hull from a reconstruction plan by W.E. Geoghegan, Smithsonian Institution, 1963.

¹⁵Comments on Mississippi's potential strength from testimony of Arthur Sinclair at investigation of the Navy Department, September 15, 1862, ORN, II, 1: 489; David G. Farragut to Gideon Welles, May 6, 1862, ORN 18: 158.

Tifts' near lynching from testimony of Felix Senac at investigation of the Navy

Department, September 17, 1862, ORN, II, 1: 509-10. There is no evidence that the Tifts purposely delayed the Mississippi's construction, nor that their Southern sympathies were other than genuine. After the fall of New Orleans they moved to Savannah where they quickly and efficiently altered the blockade runner Fingal into the ironclad Atlanta, one of the finest warships constructed in the Confederacy. Best accounts of the Mississippi's construction are in Still, Iron Afloat, Dufour, Night the War was Lost, and Maurice Melton, The Confederate Ironclads (New York: Thomas Yoseloff, 1968).

¹⁶Louisiana's contract in Report of Evidence Taken Before a Joint Special Committee of Both Houses of the Confederate Congress to Investigate the Affairs of the Navy Department (Richmond, Va.: G.P. Evans, 1863), 487-88 (hereafter cited as Report of Evidence); Date of Louisiana's commencement in Dufour, Night the War was Lost, 179. Dufour indicates that the Louisiana was laid down parallel to the river and launched sideways. Biographical information on E.C. Murray from an historical marker in Paducah, Ky., text furnished by Jack C. Cowart, December 24, 1991, in possession of author; and Murray's testimony at the investigation of the Navy Department, February 20, 1863, ORN, II, 1: 757.

¹⁷Specifications in "Contracts," #470, RG365. Reference to armament change is William N. Still, Jr., "Confederate Behemoth: The C.S.S. Louisiana," Civil War Times Illustrated 16 (November 1977): 20; gun deck plan in ORN, 18: 288, which shows the armament actually mounted; and the written specifications, which call for an original armament of twenty-two guns.

References to forty-five degree angle include William C. Whittle, Jr., in Scharf, History of the Confederate States Navy, 283 (fn.); and John Wilkinson, Narrative of a Blockade Runner (New York: Sheldon, 1877), 31.

References to a ram bow are Francis T. Chew to Richard H. Bacot, June 2, 1862, Bacot Family Papers, South Caroliniana Library, University of South Carolina, Columbia, South Carolina; and voucher to Leeds and Co., April 22, 1862, NASF-OL.

¹⁸Drawings of the Louisiana include a contemporary gun deck plan, ORN, II, 1: 288; and Battles and Leaders, II: 48, 54. The latter illustrations were likely based on eyewitness descriptions.

¹⁹Machinery descriptions include specifications in "Contracts," #470, REG365; Chew to Bacot, June 2, 1862, Bacot Family Papers; and various testimony during the investigation of the Navy Department, ORN, II, 1, in particular that of E.C. Murray, February 20, 1863, ibid., 754, 760. The Louisiana's twin-screw engines were made by Robert Kirk of New Orleans.

²⁰For description of damage to Louisiana during the naval battle of April 24, 1862, see testimony of John K. Mitchell during the investigation of the Navy Department, September 11, 1862, ORN, II, 1: 456.

²¹The best account of the Georgia's genesis and construction is Samuel J. Lawson, "The Mud Tub: The Story of the Confederate Floating Battery Georgia," (Savannah, Ga.: U.S. Army Corps of Engineers, 1978). A committee formed of several local citizens, headed by prominent Savannah businessman Gazaway B. Lamar, was appointed by the women to handle financial matters and oversee the Georgia's construction, ibid., 6. The Georgia was successfully launched without guns, armor, or machinery, May 19, 1862,

George A. Mercer Diary, entry of May 20, 1862, Southern Historical Collection, University of North Carolina, Chapel Hill, N.C. Unfortunately, the Georgia was launched too late to save Ft. Pulaski, which fell April 11.

²²Savannah Republican, October 21, 1862. A.N. Miller operated the Savannah Iron and Brass Foundry, adjacent to the Georgia's construction site. During the war Miller engaged primarily in ordnance work for the Confederate Army.

Estimates of the Georgia's size from A.G. Turner to James O. Morton, June 3, 1862, Miscellaneous Soldiers' Letters, Confederate States Archives, Perkins Library, Duke University, Durham, N.C. (Turner was a soldier in the 18th Georgia Infantry Battalion stationed in Savannah and apparently saw the Georgia up close); and Port Royal (S.C.) The New South, January 24, 1863.

²³John Elliott to Hesse Elliott, June 11, 1862, in John Barnwell, "Civil War Letters of Lieutenant John Elliott," Georgia Historical Quarterly 65 (Fall 1981), 207. By "double engine" it is not known if Elliott meant a single twin-cylinder engine or two single-cylinder engines. Elliott was apparently serving in the 18th Georgia Infantry Battalion at the time he wrote the letter, though he later transferred to an artillery battery.

The Georgia's railroad T-iron was seized from the Macon & Western Railroad, see H.H. Waters to Isaac Scott, July 3, 1862, G.B. Lamar File, Roll 563, Confederate Civilians File: Confederate Papers Relating to Citizens of Business Firms, Microfilm Publication M-346, National Archives, Washington, D.C. (hereafter cited as Confederate Civilians File). Although the Georgia's casemate was apparently pierced for ten guns, she seems to have carried a maximum of nine heavy guns within and two light guns on top of the casemate. The heavy guns were later reduced to five in number. See Quarterly Ordnance Report, July 17, 1863, #108, Savannah Squadron Papers, Special Collections, Robert W. Woodruff Library, Emory University, Atlanta, Ga.; and Melton, The Confederate Ironclads, 178-79. The initial armament included 8-inch, 9-inch, and 32-pdr. smoothbores, and rifled and banded 32-pdrs. The two light guns were 6- and 24-pdr. smoothbores.

²⁴Northern illustrations of the Georgia include those in Harper's Weekly, February 14 and 21, 1863, and Leslie's Illustrated, March 14, 1863. Josiah Tattnall to G.B. Lamar, October 21, 1862, in G.B. Lamar File, Roll 563, Confederate Civilians File.

²⁵For details of recent underwater work on the Georgia, see Ervan G. Garrison, Robert M. Holcombe, and Lee L. Lowery, Archaeological and Engineering Study of the C.S.S. Georgia, 2 vols. (Savannah, Ga.: U.S. Army Corps of Engineers, 1980). No details of the Georgia's steam machinery have been found, but it is believed to have been secondhand.

²⁶Plans are in NASF-AD. Reference to contract is ORN, II, 2: 246. Descriptions of proposed use of Sanders' vessels is in Warren F. Spencer, The Confederate Navy in Europe (University, Ala.: University of Alabama Press, 1983), 89; and ORN, II, 2: 220-21. For potential problems in building the six vessels in Europe, see G.A. Trenholm to John E. Ward, July 22, 1862, ORN, II, 2: 226-27. In addition to the vessels' conflicting with neutrality laws, Trenholm believed their weight had been miscalculated and that they would be unable to carry any cargo.

²⁷All dimensions from NASF-AD plan "G.N. Sanders Contract," supplemented by

those taken from a redrawn plan by W.E. Geoghegan, Smithsonian Institution, 1962. Geoghegan's drawing has a reconstructed body plan. Thickness of armor to be carried by these vessels is not given.

²⁸Brooke, John M. Brooke, 267.; George M. Brooke to Robert Holcombe, March 18, 1863, in author's possession.

²⁹The first plan is NPF #81-12-2(C), and contains an inboard profile, a deck plan, and three sections. It is unclear from this plan whether pivot guns are intended for the casemate corners, or if a single gun is intended for each of the ten gunports. The second plan is NPF #81-12-2(O). It consists of an outboard profile, two sections, and what apparently is a drawing used to plot the shape of the propellers. The reason for the National Archives identifying these two drawings as Confederate is unknown.

³⁰Several Confederate ironclads, including the Atlanta, Tennessee, and Virginia II, had openings knocked in their casemates, but none actually had a projectile penetrate completely through and enter the vessel proper as did the Arkansas. See William R. Taylor, C.R.P. Rodgers, Robert Danby, and A.S. Mackenzie to S.F. Dupont, June 22, 1863, ORN, 14: 276; Thornton A. Jenkins, James Alden, William E. LeRoy, and Thom Williamson to D.G. Farragut, August 13, 1864, ibid., 21: 549; Report of Jno. W. Dunington, January 25, 1865, ibid., 11: 676; and Gift, "Story of the Arkansas," 118, 164. According to Gift, 11-inch spherical smoothbore projectiles seem to have done the most damage to the Arkansas.

CHAPTER IV

STANDARD HULL DESIGNS

In 1862 the Confederate navy ceased the construction of large seagoing ironclads and adopted two basic designs which became the standard models for the majority of the ironclads built thereafter. This change occurred as a result of a shift in naval strategy from one offensively inclined to one charged with defending the Confederacy's vulnerable coastline.

During the late summer and early fall of 1861 the South came under amphibious assaults by Federal army and naval forces. Two key points, Hatteras Inlet, North Carolina, and Port Royal, South Carolina, were lost, and by early 1862 other coastal areas were under threat. The clamor raised by these defeats caused the Confederate government to strengthen coast defenses, with the navy assuming a large share of the responsibility. The big ironclads then under construction were ill-suited for this new defensive scheme so smaller, lighter draft vessels were planned, and at least one was under construction by early March of 1862.¹

Despite the changes in progress, naval secretary Mallory still held some hope of using the larger vessels offensively. Just before the Virginia was taken into battle, Mallory wrote Franklin Buchanan, the vessel's commander, suggesting the untried armorclad be used to break the blockade of Hampton Roads, then dash northward to burn either Washington or New York.²

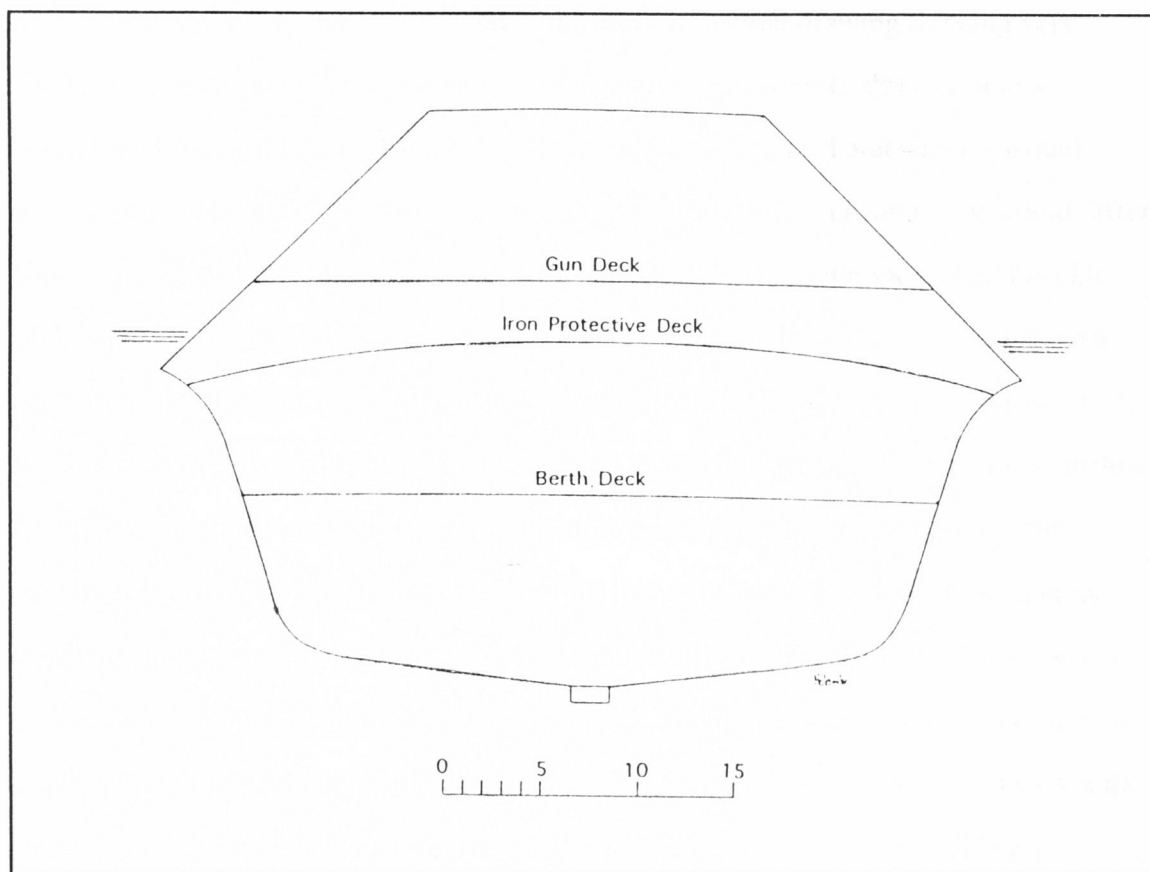
The Battle of Hampton Roads dashed those unrealistic dreams. Although the Virginia's clashes with the Cumberland, Congress, and Monitor on March 8 and 9 vindicated the low freeboard casemated model adopted by the department, it also demonstrated the inherent lack of seaworthiness in the design and the general unsuitability of the large ironclads for coastal and harbor defense work. The Virginia's deep draft and poor maneuverability considerably restricted her effectiveness in confined waters, and her

performance was likely indicative of what could be expected from other first generation ironclads under similar circumstances.

As a result of the lessons of Hampton Roads, Mallory commenced in earnest the building of harbor defense ironclads. In late March he requested that funding earlier earmarked for wooden gunboat construction be applied to the building of ironclads. Congress approved this appeal on May 1, and by late spring at least twelve of the smaller vessels had been commenced. Combining a lighter draft with greater maneuverability, and carrying from two to six guns, these new model ironclads were far better suited for operations in restricted waters.³

The first of two standardized ironclad designs adopted to meet the requirements of the new policy was for the Richmond class, a group of six or more vessels laid down in the spring of 1862. This design was apparently based on a plan conceived by constructor John L. Porter in 1846 while he was involved with the building of the U.S.S. Allegheny at Pittsburgh. An iron-plated, shot-proof vessel-of-war powered by the unusual Hunter horizontal submerged paddlewheel system, the ship was to be forty-five feet in beam with a nineteen-foot draft. Amidships Porter placed an angular shield with sides and ends sloped at forty-five degrees and plated with three inches of iron plate. Both the thickness and angle of the armor were deemed adequate defense against the most powerful ordnance of the period. Nevertheless, for added protection an armored deck was placed below the gun deck to prevent any shot which might penetrate the casemate from plunging through the ship's bottom.⁴

The lower hull was conventional in form, with a round bilge, keeled bottom with slight deadrise. Two feet below the waterline a built-on knuckle protruded from the hull to protect that vulnerable point and form the base of the casemate. Porter purportedly submitted these plans to the navy but no action was taken by the department other than to acknowledge their receipt.⁵

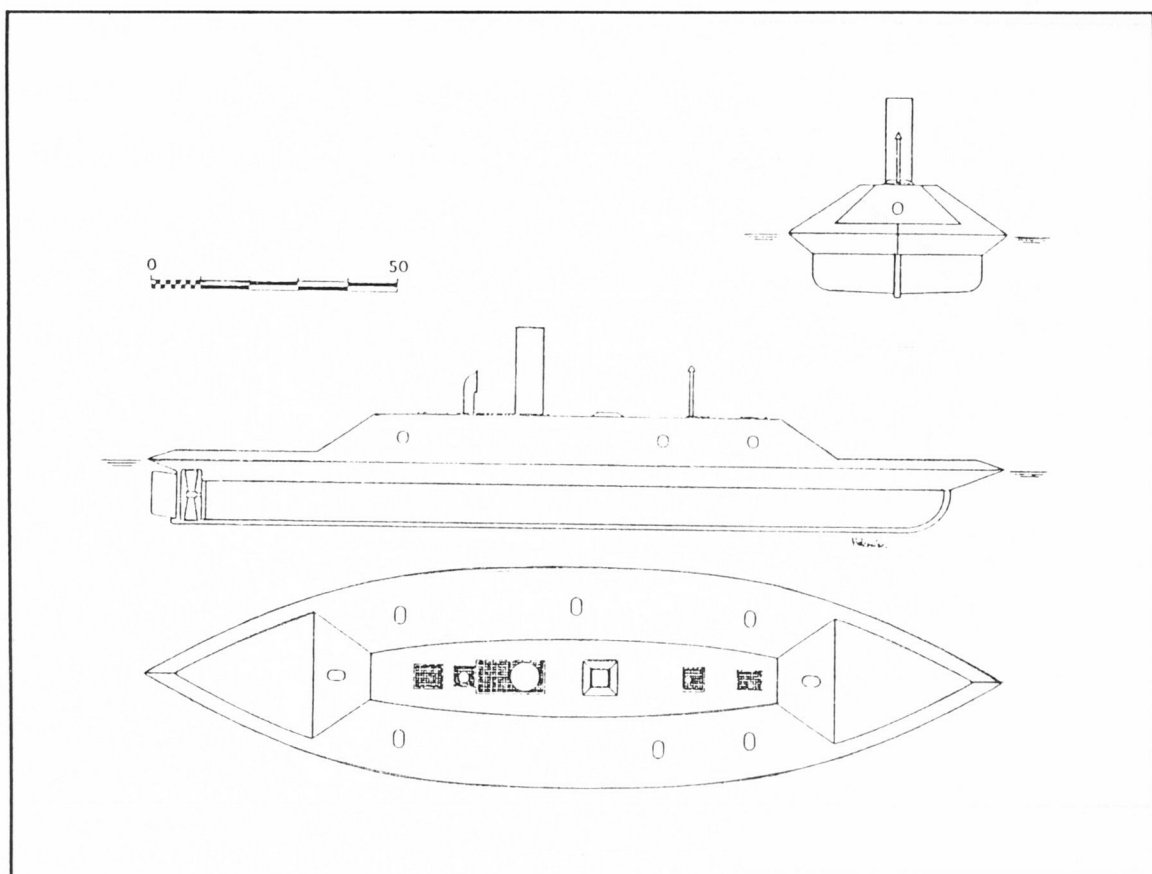


Plan 19. Porter's 1846 Ironclad, midsection.

When Porter adapted the Pittsburgh plans to the Confederacy's defensive requirements he retained many of its features, while other aspects of the design were upgraded to meet the demands imposed by the more powerful artillery of the early 1860s. Although only a simplified midship drawing of the 1846 ironclad is available for comparative purposes (Plan 19), fairly complete builder's drafts of one of the Richmond class, the Savannah, exist. These plans consist of sheer and half-breadth views, deck plans, and a constructional midship section. Neither a body plan nor written specifications, which must have been produced, have been found.⁶

The Savannah's hull is depicted in the midship section drawing as being very similar to that of the Pittsburgh ironclad, with about two degrees of deadrise and a comparatively sharp turn of the bilge. These deadrise and bilge characteristics would become characteristic of Porter's early and midwar designs, though later they would differ. The framework of the hull is laid solid, with no space. At the waterline a solid knuckle built of heavy timbers protrudes about five feet from either side of the hull. A 105-foot long armored casemate is shown constructed of timbers moulded 13 inches and sided 12, and covered with two layers of planking 3 and 4 inches thick each, for a total of 20 inches of wood. For added protection against the more powerful ordnance then in use, the Richmond class vessels were designed for four inches of iron rather than three, and the casemate angle was reduced from forty-five to thirty-five degrees. Two inches of armor covered the fore and aft flush decks, the spar deck, and the underside of the knuckle to a depth of about five feet below the waterline. Six inches of protection was produced at the waterline where the knuckle armor overlapped the casemate armor. This strongly constructed hull measured fourteen feet in depth of hold from the lower edge of the keel rabbet to the top of the main (gun) deck beam at the side of the hull. The moulded beam was thirty-four feet and the extreme beam over the armor plating at the knuckle forty-five feet. The intended draft is given as thirteen feet, which was a significant improvement over the Virginia's twenty-three feet, and even the Pittsburgh ironclad's nineteen feet. Nevertheless, it was little better than most of the 1861 models (Plans 20 & 21).

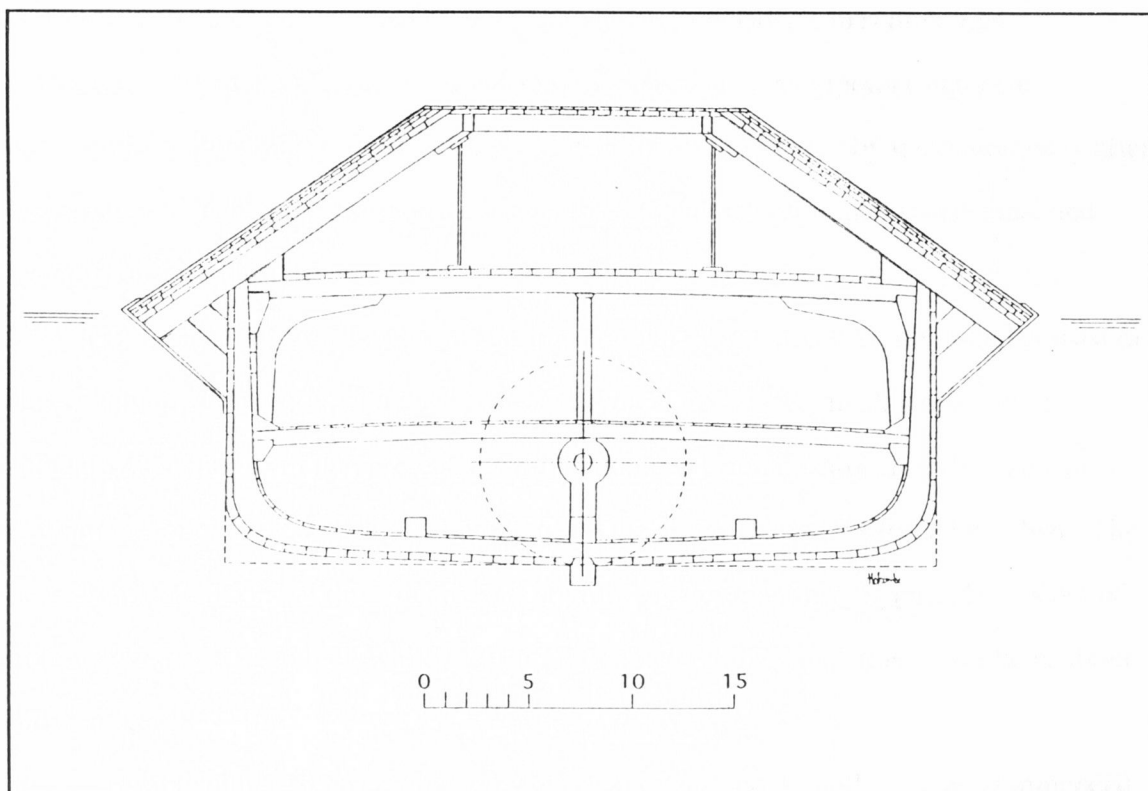
In plan view the ironclad was elliptical in shape, with both ends formed alike. Her overall length was 174 feet, while her length between stem and stern post was 150 feet. The rectangular casemate was centered on the hull with short, twenty-eight-foot long flush decks - extensions of the gun deck - protruding fore and aft a scant two feet above the waterline. The armored knuckle extended twelve feet over both the stem and stern post. Forward, this overhang formed a massive ram which, being an integral part of the vessel,



Plan 20. *Richmond*, three-view.

was not likely to be torn loose as was the Virginia's. Aft, the overhang protected the rudder and single, ten-foot diameter propeller. The Richmond class ironclads were arranged to carry four heavy guns behind their thick casemate walls. A single gun pivot-mounted at each end of the casemate could fire from one of three gunports positioned on the vessel's centerline and ninety degrees to port and starboard. One gun was carried on each broadside.⁷

Six of the class were constructed and commissioned into service: the Chicora, North Carolina, Palmetto State, Raleigh, Richmond, and Savannah. In addition, the navy proposed building an unknown number of this class in New Orleans, but apparently none



Plan 21. *Richmond*, midsection.

were commenced prior to the city's loss. According to the limited information available, the Richmonds generally conformed closely to the original design. The lone exception is the Palmetto State, which was built with an octagonal casemate.⁸

The built-on knuckle hull design borrowed from Porter's 1846 Pittsburgh plan and applied to the Richmond class ironclads became, numerically, the most important configuration used by the Confederate navy after early 1862. Of the approximately thirty-six ironclads commenced in the last three years of the war, eighteen are believed to have used this general hull form. For this reason, ironclads based on the hull shape are herein referred to as standard hull types.⁹

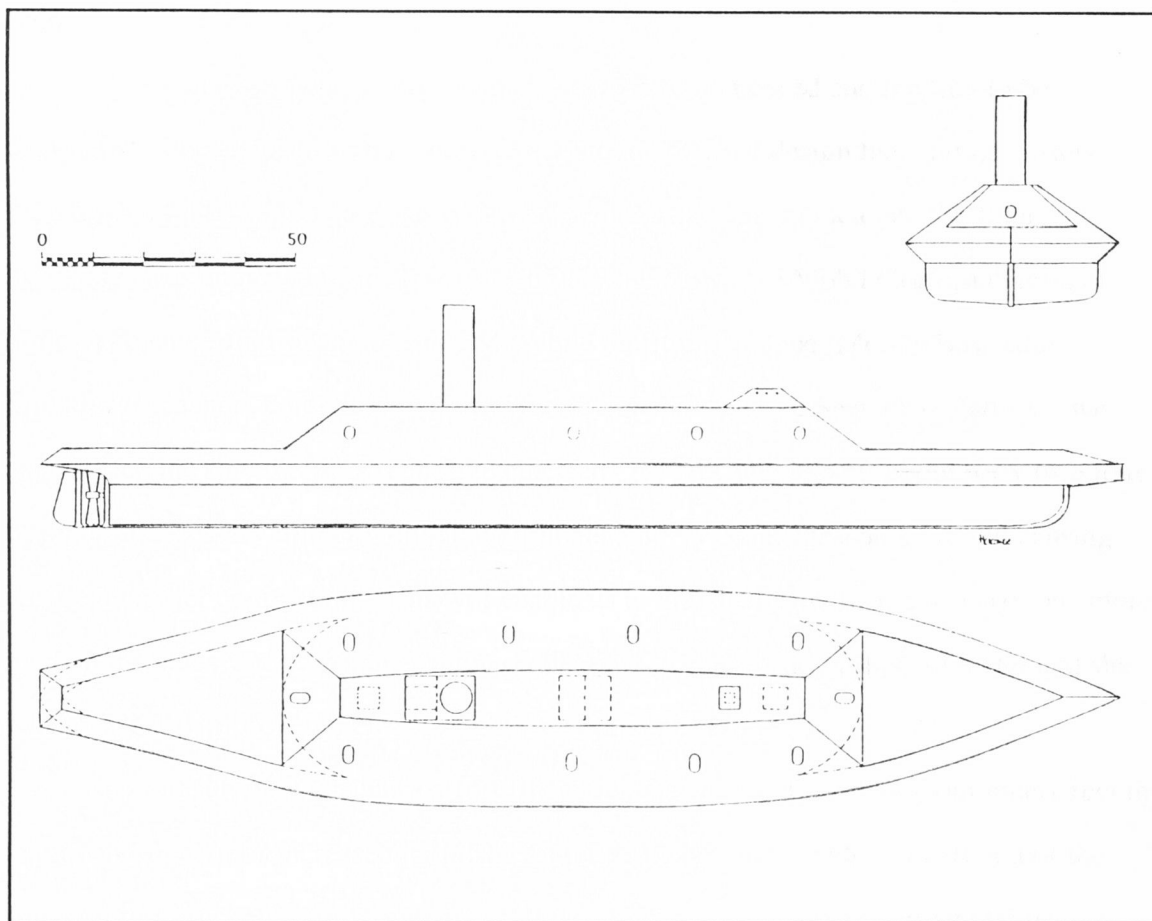
The first group of standard hull ironclads to follow the Richmond class was the Tennessee class. Consisting of the Tennessee (II), the Columbia, and the Texas, this class

is probably the best documented of any Confederate ironclads. Lines drawings, constructional and engineering sections, photographs, and contemporary and near-contemporary illustrations exist. Moreover, detailed surveys made by the Union navy after the capture of each vessel provide a considerable amount of additional dimensional and technical information.

Builder's drafts of the class as designed are in the National Archives and consist of sheer, half-breadth, body, and deck plans. A typical Porter-designed, single-screw, standard-type hull form is represented, with a moulded beam of thirty-four feet and an extreme beam over the knuckle, but underneath the armor-plating, of forty-three feet. The deadrise of the floors, at three degrees, is slightly greater than the Richmond's. Depth of hold is given as fifteen feet, while the draft, not noted on the plans, must have been about thirteen feet.¹⁰

Establishing a trend continued by every known standard hull ironclad commenced after the Richmond class, the Tennessees were larger, with a length between perpendiculars of 189 feet and an overall length (excluding armor) of 213 feet, 6 inches. A 114-foot long casemate was intended to carry 6 cannon; 2 pivot-mounted in the fore and aft ends, and 4 in broadside. The sides and ends of the casemate maintained the thirty-five degree incline common to most of Porter's early designs (Plan 22).

There is evidence to suggest that the Tennessee class plans were conceived by Porter as early as 1861. The casemate as originally depicted has rounded ends, like the Virginia and Porter's early-war harbor defense ironclad. It was later overdrawn with flattened ends, likely in an effort to simplify the structure's fabrication. The refinements incorporated in the initial design, if not based on experience with the earlier ironclads, certainly anticipated several of their shortcomings. The increased size of the Tennessees resulted in a number of improvements. First, it allowed the addition of two broadside guns which provided a fifty percent increase in the rate of fire without significantly increasing



Plan 22. *Tennessee* Class, original design, three-view.

draft. Second, the longer fore and aft flush decks provided more room for handling mooring gear and ground tackle, for the stowage of ships' boats, for ventilating cowls, and for sanitary facilities. The short flush decks of the Richmond class had little space for this necessary equipment.¹¹

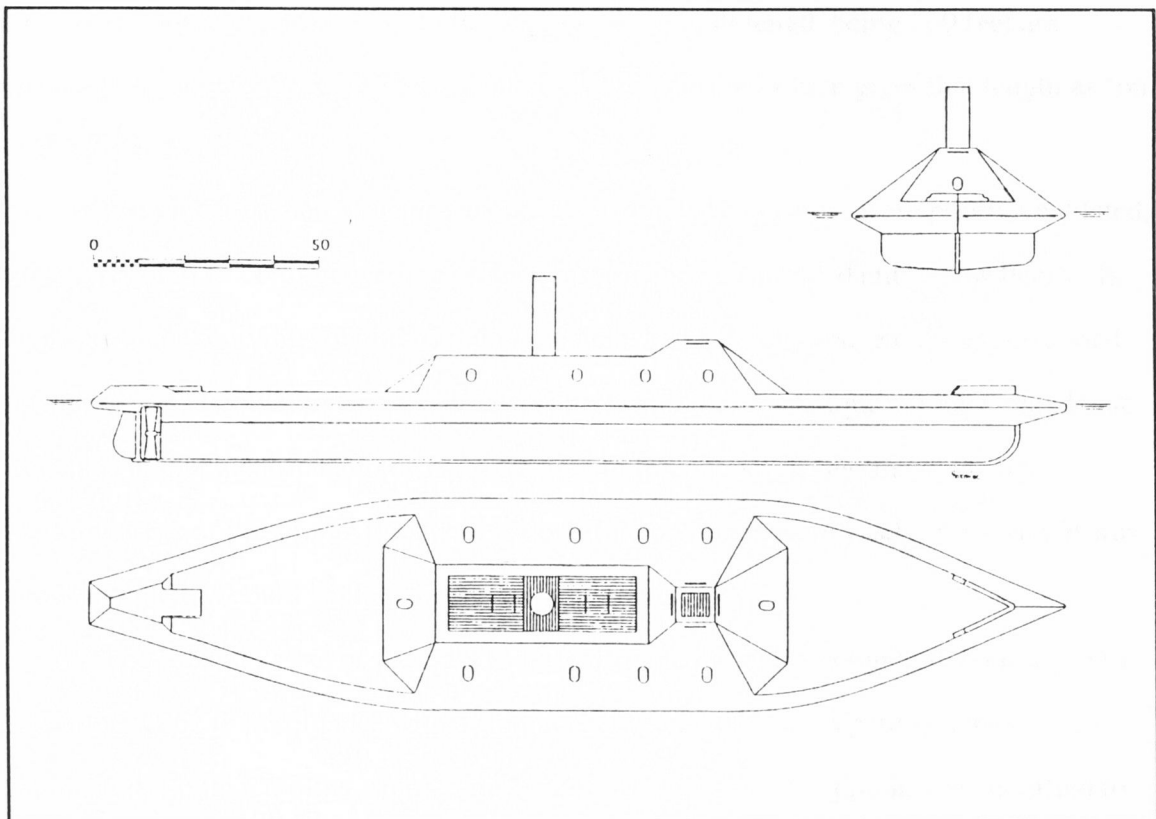
The initial design was ultimately to go through even more changes. All three vessels were altered during construction to a lesser or greater extent, though apparently each retained the basic 189-foot hull. The construction of the Tennessee, Columbia, and Texas were, in fact, spread over the final three years of the war in such a manner that operational and material influences can readily be determined from the final configuration of

each.

The Tennessee was the first of the class to be commenced and the first to be completed. She also conformed more closely to the original design than did her sisters. Laid down at the Confederate Navy Yard at Selma, Alabama, in October 1862, the Tennessee was launched the following February then towed to Mobile for installation of armor, ordnance, and steam machinery. While outfitting in upper Mobile Bay Adm. Franklin Buchanan, commander of the Mobile Squadron, wrote Secretary Mallory, "we can shorten the shield of the Tennessee nineteen (19) feet and take off about forty (40) tons of other unnecessary timber without altering her Battery or hatches, and without causing any delay in her completion. This will enable us to line the inside with oak, carry one more inch on the sides, and two inches more on the bow [forward end of the casemate] and she will be greatly improved thereby. We have commenced the work"12

As a result of Buchanan's efforts the casemate was shortened to about ninety feet in length and the armor increased in thickness to five inches on the sides and aft end of the shield and six inches on the forward end. Two concerns apparently prompted these alterations: the need for additional protection against the large 15-inch smoothbore cannon then being placed into service by the Federal navy, and the need to maintain a draft light enough for safe navigation in the shallow waters of Mobile Bay.

The power of the 15-inch guns had been conspicuously demonstrated against the Confederate ironclad Atlanta just five weeks previous to Buchanan's missive to Mallory. Sortieing out of Savannah on June 17, 1863, the Atlanta had run aground in nearby Wassaw Sound and was attacked by the monitors Nahant and Weehauken. The Atlanta was struck by four 11- and 15-inch projectiles, but was unable to return accurate fire due to the list caused by her grounding. While none of the shots penetrated the four-inch iron and eighteen-inch wood of her shield, considerable damage was done with armor and wood alike being shattered. As a result, the Atlanta, probably the most powerful Confederate



Plan 23. *Tennessee*, three-view.

ironclad then in commission, quickly surrendered. This devastating defeat, with its impressive display of Union firepower, likely served as the catalyst for additional armor being placed on the Tennessee and following standard hull ironclads.¹³

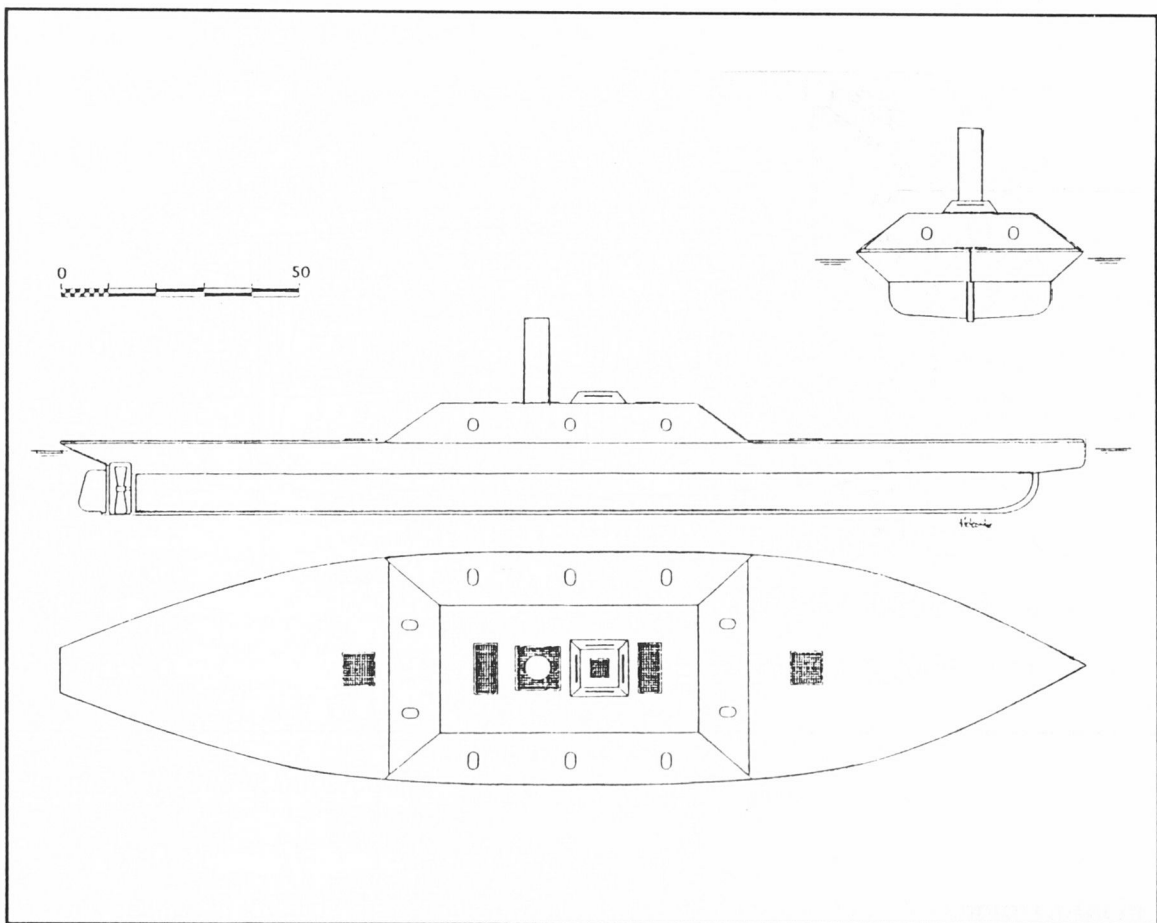
The reduction in the Tennessee's casemate length represented an attempt to prevent a significant increase in draft due to the application of additional armor. Consequently, the overall weight of material used in its construction was maintained at approximately the same level. The addition of a second layer of two-inch iron on the underside of the knuckle, however, negated these efforts and the Tennessee's draft increased by about a foot to fourteen feet. Other deviations from the original drafts include an increase in overall length and beam to 217 and 48 feet respectively, and an octagonal rather than rectangular

casemate. Numerous references to the Tennessee's overall length being 209 feet are erroneously based on a postcapture tabulation of dimensions which gives that length as "on deck" (Plan 23).¹⁴

With most of their structure underwater, ironclads by nature were poorly ventilated, excessively hot or cold (depending on the season), and constantly damp below decks. In an effort to make living conditions more tolerable, a variety of passive devices were used, including cowl ventilators and wind sails. The Tennessee was unique among Confederate ironclads in that mechanical blowers were used to force fresh air into the living and working areas of the ship. Although it is doubtful conditions were vastly improved, it was about as much as could be done in pre-air conditioning days.¹⁵

The second vessel of the class to be constructed was the Columbia. Laid down in December 1862 in accordance with a contract between the Navy Department and Charleston, South Carolina, shipwright Francis M. Jones, the Columbia was modified to an even greater extent during the course of her construction than was the Tennessee. These modifications, combined with the usual labor and material problems so customary in Southern warship construction, delayed her completion until just a few weeks prior to the fall of the city in early 1865.¹⁶

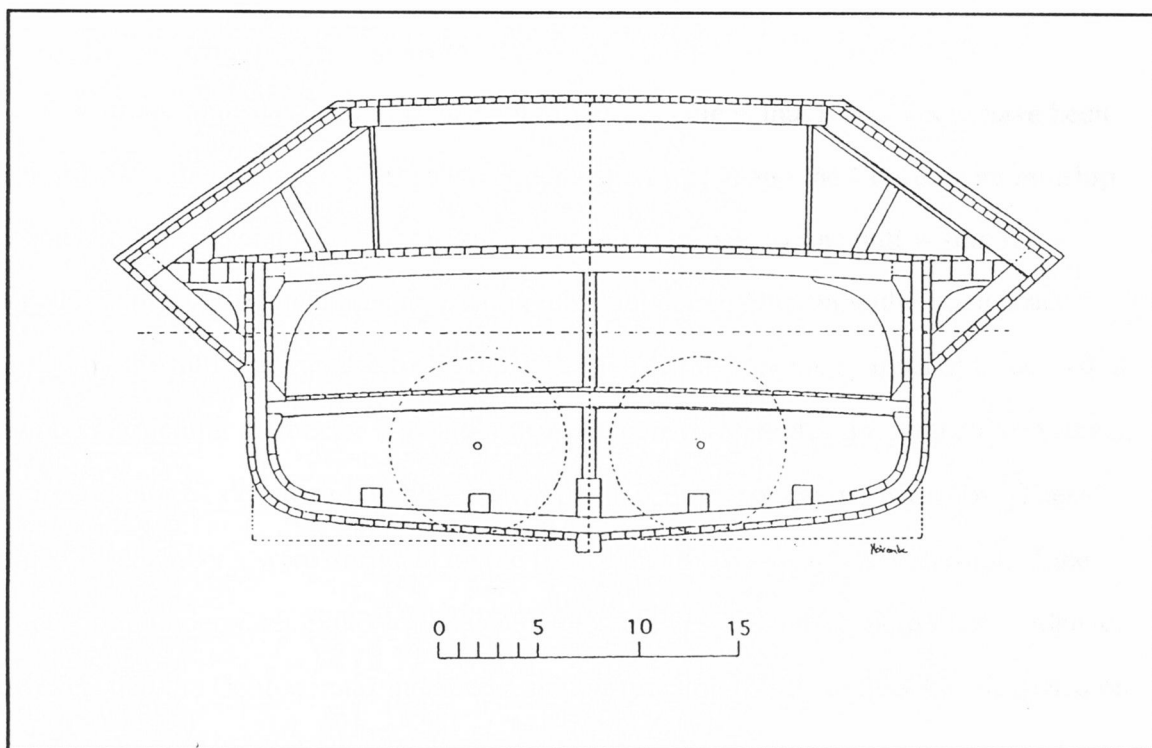
Fortunately, these alterations are well documented. Sometime between her February 1865 capture and her sale after the war, the U.S. Navy prepared drawings of the Columbia's outboard profile, deck plan, and midship section. Despite the inclusion of a bar scale, these views are more schematic than precise representations. They are made useful, however, by the inclusion of written dimensions of the ironclad's salient features. These indicate an overall length of 215.78 feet, an extreme beam of 48.5 feet, and a reduced casemate length of 77.08 feet. The casemate sides are inclined at about 36 degrees, the ends at about 33 degrees (Plan 24 & 25).¹⁷



Plan 24. *Columbia*, three-view.

The Columbia continued the Tennessee's example by carrying extra armor plate, with six inches on all four sides of her casemate. Despite the increase in armor, the shortened casemate resulted in a net savings in iron and wood, thus maintaining her draft at about thirteen feet, six inches.¹⁸

Along with the shortened casemate, the Columbia's most obvious deviation from the original plans is a refined knuckle configuration. This alteration is depicted on the builder's draft with the revised knuckle being drawn over the original body plan. As redrawn, the flaring line of the underside of the knuckle is continued outward past the original knuckle to the height of the main deck. Surviving records fail to explain the reason



Plan 25. *Columbia*, midsection.

for this change in knuckle shape, but several advantages are possible. An improvement in seaworthiness is one. The turnback at the knuckle line of the original design allowed even light seas to easily wash over the low flush decks, keeping them almost constantly wet. The extended flare of the underside of the revised knuckle should have retarded this effect and resulted in drier flush decks. Simplicity of construction by the deletion of the half-lap joint at the original knuckle line seems to be another benefit. Perhaps the primary reason for the improved knuckle, however, is the resulting increase in gun deck beam which allowed a more flexible disposition of the Columbia's six-gun battery. Rather than the two pivot guns and four broadside guns called for in the builder's plans and carried by the Tennessee, the Columbia mounted a pivot gun in each corner of the casemate and only one on each broadside. This arrangement doubled firepower fore and aft while slightly

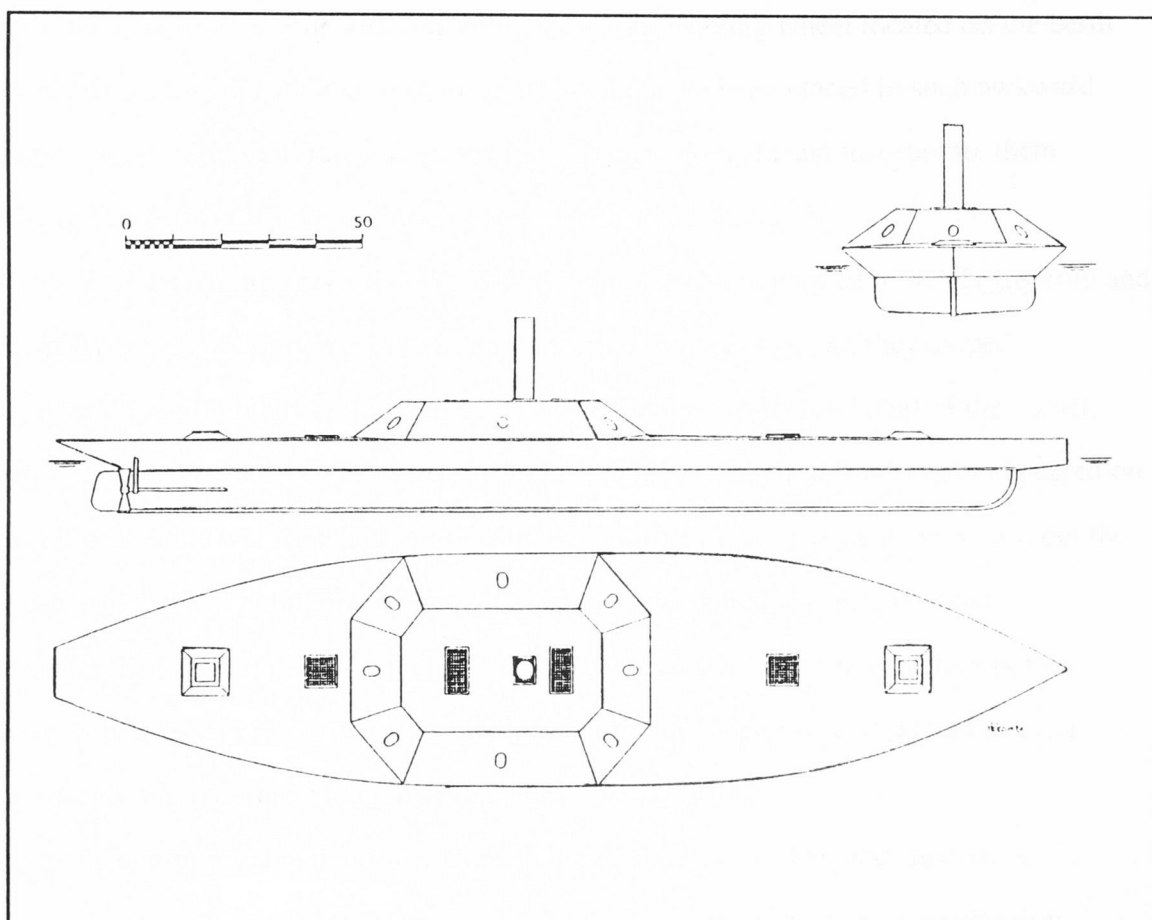
decreasing that from the broadsides.¹⁹

Another unusual feature of the Columbia's knuckle is that it appears to have been built hollow rather than solid. Both the Federal survey plan and the Confederate midship section show a conventional hanging knee attached to the side of the hull within the knuckle, with its horizontal arm supporting the main deck. The triangular open space formed by the hull, the gun deck, and the underside of the knuckle is apparently devoid of any other structural members. This hollow arrangement resembles the protective systems, or torpedo bulges, developed in the early twentieth century for capital warships. These bulges, or chambers, were designed on the theory that the open air space dissipated the effects of an underwater explosion thus protected the vessel's hull. There is no evidence, however, that the Confederates intended a similar function for the hollow knuckle used on the Columbia and several other ironclads. While it is possible the design was instead intended to offset the considerable topside weight of these vessels by increasing buoyancy and stability, its precise function is unknown.²⁰

Following her two sisters by nearly a year, the Texas' keel was laid at the Rocketts Navy Yard at Richmond in late summer of 1863. In likely consequence of both material shortages and combat lessons, her design was even more radically changed.²¹

Only four contemporary drawings of the Texas have been located: an engineering midship section showing her boilers and several steam fittings, and three ordnance drawings showing her pivot guns and a casemate section. None give considerable insight into the vessel's alterations. ²²

The only illustration located representing the Texas as constructed is an undated watercolor by John W.H. Porter, constructor Porter's son. This painting is considered a valid representation of the Texas as the signatures of both Porters appear, indicating the father's apparent supervision and approval. The Texas is shown with an extremely short,



Plan 26. *Texas*, three-view.

octagonal casemate carrying four guns. The fore and aft pivot guns fire only from centerline and quarter panel ports; only the broadside guns fire from broadside ports. The painting further indicates that the Texas was built with the revised knuckle form first used on the Columbia, while the original midship section shows the knuckle was built hollow.²³

The unusually short casemate was likely the product of a late war shortage of iron, with a reduction in weight a secondary but welcomed benefit. This structure was presumably so cramped that the pilot house, and probably the steering gear, could not be carried in their usual locations within the shield. Rather, several hatches with low, sloped combings appear on the long fore and aft flush decks. Some of these openings were

apparently used as viewing positions with at least one steering wheel located on the berth deck below. It seems unlikely this apparatus would have been placed in such awkward positions had there been iron enough to build a larger casemate and incorporate them therein (Plan 26).²⁴

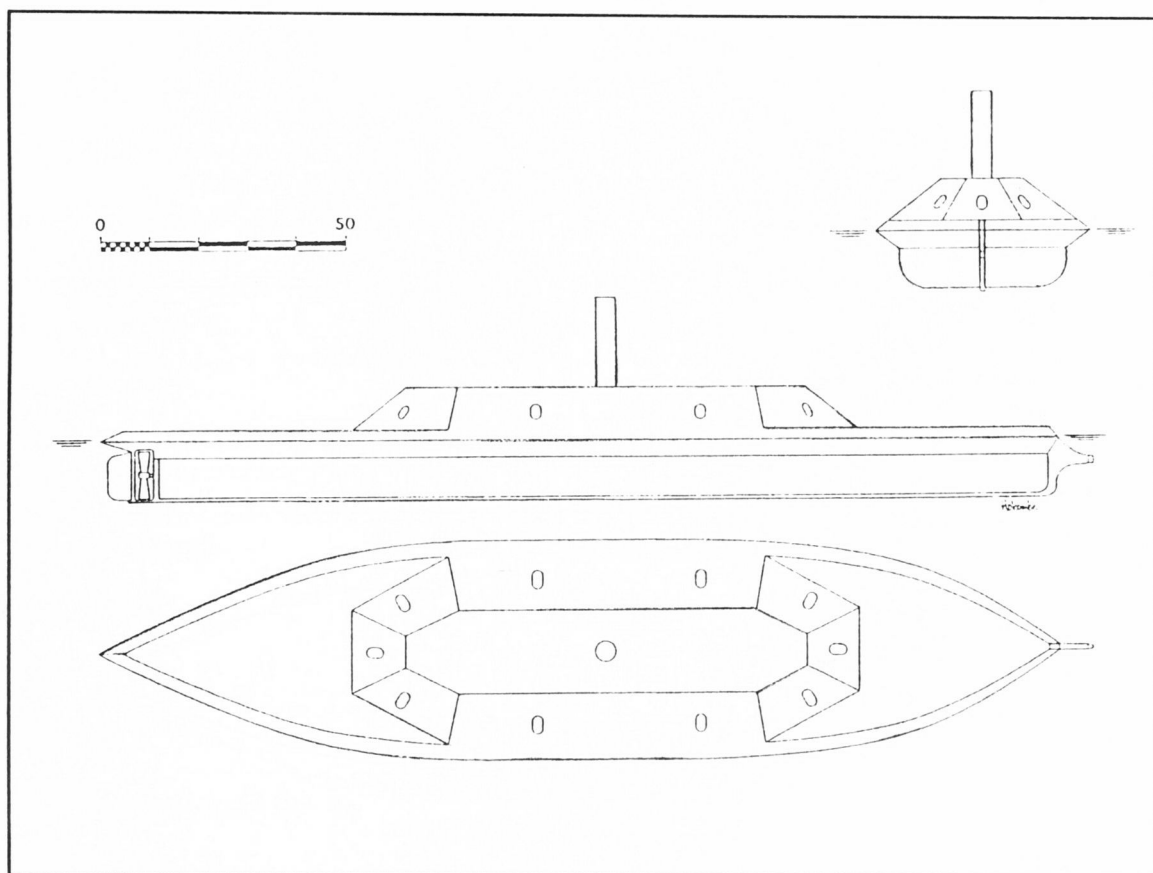
Porter's painting also depicts an unusual modification applied to the Texas' fore and aft flush decks. Not only were the decks cambered transversely, but they sloped downward longitudinally from the base of the casemate towards each end of the vessel, giving a "humpbacked," or reversed sheer appearance. Cambered flush decks appeared on several of the late war ironclads, apparently in an effort to improve seaworthiness, but the sloped effect is less common and known to have been applied to only one other Confederate ironclad, the Virginia II. This feature seems to have been an attempt to improve the vessel's resistive powers by increasing the number of curved and angular surfaces meant to deflect incoming projectiles.

In addition to the major revisions in her casemate, knuckle, and flush deck arrangements, the Texas differed significantly from her two sisters in her propulsion system. Whereas the Tennessee and Columbia used the single propeller called for in the original design, the Texas substituted two smaller screws. Although there is no indication why this change was made, it was possibly based on the type of steam machinery available at the time needed.²⁵

Beginning in the latter part of 1862 several ironclads designed by Acting Naval Constructor William A. Graves were either contracted for or placed under construction. Superficially similar to the Porter-designed standard hull models, Graves' vessels differed in several details which can be considered characteristic of nearly every one of his ironclad designs. Prominent among these unique features are flat floors with a comparatively soft turn of the bilge, and casemate sides and ends angled at thirty-eight degrees. The most unusual feature of Graves' ironclads, however, is the shape of their rams. Located about

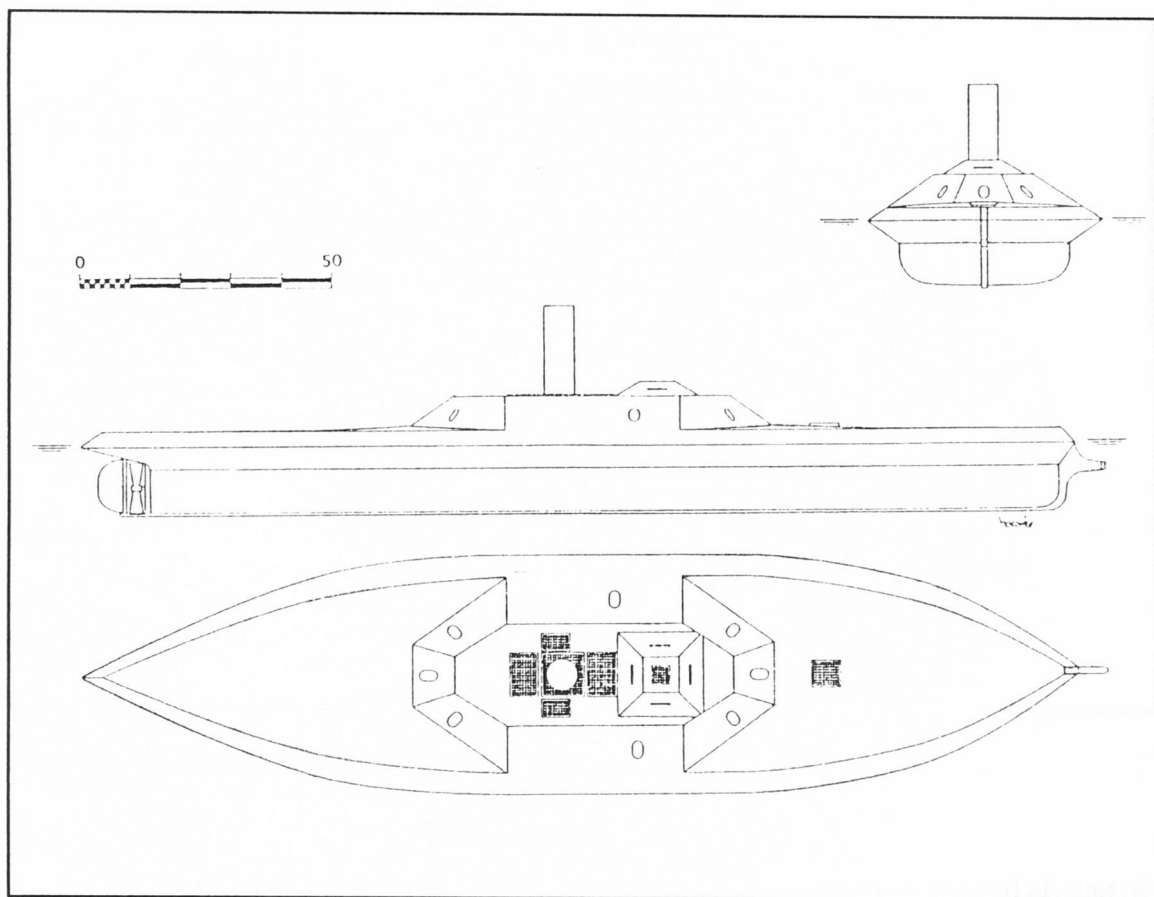
five feet below the waterline and extending outward some eight feet, the ram is formed as a narrow, horizontal, snout-like attachment to a plumb stem. Why this peculiarly shaped ram is so formed is not known. Possibly it was intended for use against monitor class ironclads, whose armored rafts protected their hulls much as the knuckles of Confederate ironclads protected theirs. The long extension and curved upper surface of the Graves ram might have been intended to slip under the raft and strike the unprotected hull of the monitors; or the ram's somewhat fragile shape, with a thickness of only twelve inches, could have been designed to break off after insertion. The Virginia's experience after ramming the Cumberland, when only the breaking of her ram prevented her from being dragged to the bottom, clearly demonstrated the dangers involved when the weapon could not quickly be withdrawn.

Two half-models and two builder's drafts attributed to Graves exist. The models are nearly identical, with the exception that one is designed for four guns (two pivot-mounted, two in broadside), and the other for six (two pivot-mounted, four in broadside). The former has been identified as the original design for the Virginia II, the latter for the Charleston. Dimensions taken from the models by the late W.E. Geoghegan of the Smithsonian Institution indicate both had lengths of 180 feet between perpendiculars and 201 feet overall. Moulded beam was measured as thirty-four feet, and extreme beam (probably under the armor plate) as forty-four feet for the four-gun model and forty-four feet, six inches for the other - a difference possibly caused by the wooden models drying and shrinking. Both ships had a depth of hold of fourteen feet, while the designed draft was estimated by Geoghegan as slightly over twelve feet. A minor difference was found between the two ironclads in the lengths of their octagonal casemates; the Virginia II's measured 108 feet, 8 inches, the Charleston's 101 feet, 9 inches (Plan 27).²⁶



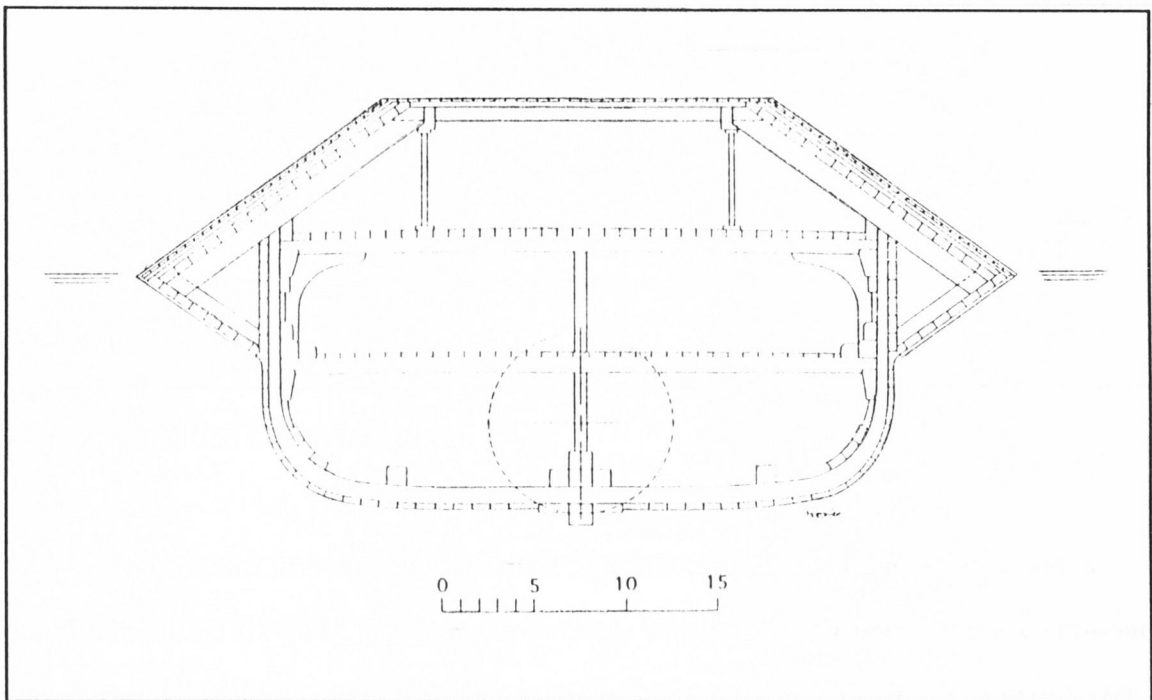
Plan 27. *Charleston* Class, original design, three-view.

The Charleston was the first of the 180-foot class to be constructed, being placed into service with the Charleston Squadron in late 1863. Several contemporary illustrations exist which depict her as completed. Other than the substitution of a rectangular casemate for the original octagonal, the addition of a pilot house abaft the stack, and the alteration of the upper bow for the attachment of a torpedo spar, she appears little changed from the half-model. The Charleston's construction was apparently so far advanced at the time of the Atlanta's capture that she could not be modified as a result of the lessons learned from that incident.²⁷



Plan 28. *Virginia II*, three-view.

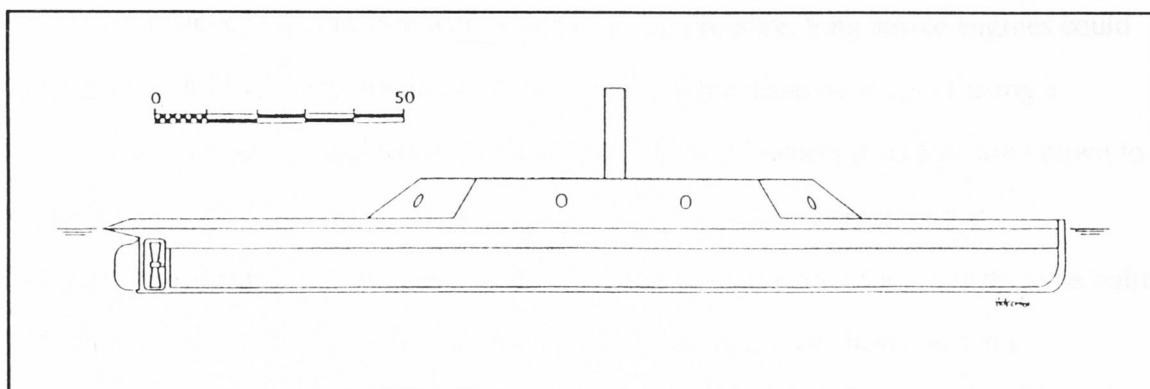
The Virginia II was built in Richmond at "the yard opposite Rocketts" under constructor Graves' immediate supervision. Original drafts of the Virginia II show that she received extensive modifications. Typically for a late war ironclad, the casemate was shortened (to a little less than seventy-four feet), though its octagonal shape and four-gun armament were retained. The original knuckle configuration was also kept - possibly because the vessel was already in the water - but the cambered and sloped flush decks seen on the Texas were installed. It cannot be conclusively determined from the plans if the knuckles were constructed hollow (Plans 28 & 29).²⁸



Plan 29. *Virginia II*, midsection.

The *Virginia II*'s armor plate was increased to six inches on the sides and aft end of the casemate and, according to several sources, eight inches on the three forward panels. Despite this considerable increase in protection, apparently enough weight was saved with the shortened casemate to allow the vessel to carry the unusually heavy armament of an 8-inch rifle forward, an 11-inch smoothbore aft, and two 7-inch rifles in broadside, all of the Brooke pattern. This combination of protection and firepower made the *Virginia II* the most powerful ironclad built in the Confederacy.²⁹

A third *Charleston* class ironclad was laid down at Oven Bluff, Alabama, on the Tombigbee River, in 1863. This vessel was built according to the four-gun plan but was never completed. Few details are known of her construction, or of any alterations applied to the initial design.³⁰



Plan 30. Modified *Charleston*, sheer.

The second surviving builder's draft of a Graves-designed ironclad illustrates a slightly modified six-gun Charleston class vessel. The most noticeable difference between this ship and the other Graves ironclads is her lack of a ram. Less obvious is a two-degree rise in the floors. One naval historian previously interpreted this plan as that for a downsized Charleston with a length between perpendiculars of 167 feet and a moulded beam of 32 feet, 2 inches. Measurements recently taken from the original drawings, however, confirm conclusively that her moulded dimensions are the same as the Charleston and Virginia II (Plan 30). Savannah shipwright H.F. Willink contracted on September 13, 1862, to build one of these altered Charlestons, though the vessel was never laid down due to Willink's previous naval commitments. Four days afterward a similar contract was signed with another Savannah firm, Krenson and Hawkes. The ironclad that resulted is known to have been designed by constructor Graves and is believed to have been of the same model. This vessel received extensive alterations to her shield and sponsons while still on the stocks, but details are not known. She was destroyed unlaunched just prior to the fall of Savannah in late 1864.³¹

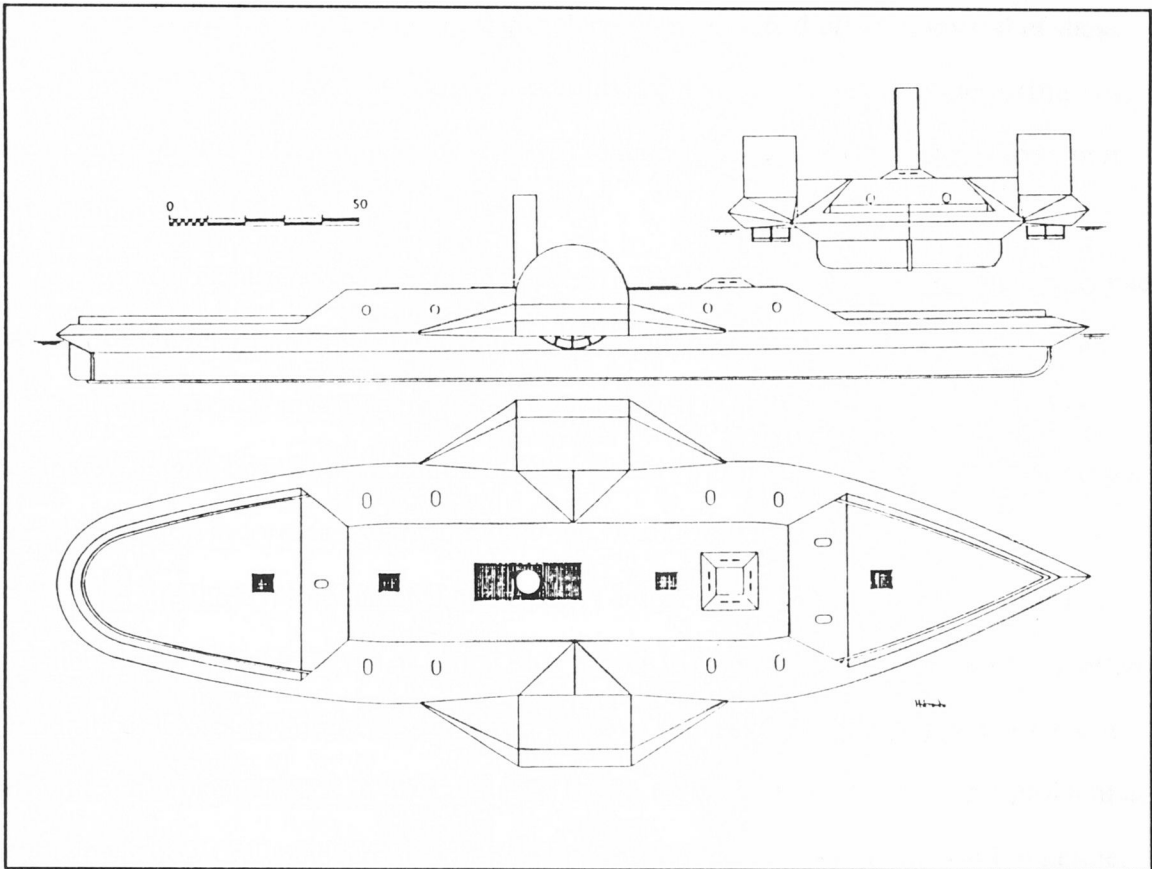
The availability of paddlewheel riverboat machinery, not easily adapted to screw propulsion, led to the design of a class of large sidewheel ironclads. Apparently the Navy

Department believed that the ease with which the high pressure, long stroke engines could be installed with few, if any, modifications outweighed the disadvantages of using a propulsion system so exposed to combat damage. Three sidewheel ironclads are known to have been contracted for and laid down: one at Yazoo City, Mississippi, one at Montgomery, Alabama, and another at Selma, Alabama. A contract for a fourth, to be built at Shreveport, Louisiana, was disapproved by the department. Of these, only the Montgomery ironclad, the Nashville, was completed and placed into service.³²

No builder's drafts of any of these unusual vessels have been located. Only a few contemporary sketches and a postwar examination exist to provide details of the Nashville's construction and above-water configuration. The survey dimensions indicate an exceptionally large ironclad, with an extreme length of 271 feet and a beam over the paddleboxes of 95 feet, 6 inches. Other pertinent statistics include a hull beam of sixty-two feet, a depth of hold of thirteen feet, and a draft of ten feet, nine inches. The casemate was 142 feet long and pierced for seven guns: three pivot-mounted (two forward, one aft) and four in broadside (Plan 31).³³

The Nashville's huge size ultimately proved to be her greatest weakness. Despite the use of hogging frames and cross chains, a reduced armament of three guns, and the deletion of all iron plate except that on the pilot house and fore and aft ends of the casemate (six and two inches respectively), the Nashville was reportedly hogged when surrendered at war's end.³⁴

Even less is known of the hull configurations of the Nashville and the three other sidewheel ironclads. Traditionally, all four have been grouped together as standard hull types but, lacking builder's plans and other documentation, there is no concrete evidence to support this assumption. The hull of the Selma boat was recently discovered in Mobile Bay where she was sunk as an obstruction in 1864. Future underwater archaeological investigations of the site may result in more information on these large, ungainly vessels



Plan 31. *Nashville*, three-view.

and permit their proper classification.³⁵

The adoption of the Richmond class design gave the Confederate navy a warship far better suited to the South's shallow, coastal waters. Added protection, especially at the waterline, and smaller dimensions, which resulted in improved maneuverability, rectified several of the deficiencies of the early-war designs. The reduction in armament resulting from the decreased size of the new model ironclads was in part remedied by the adoption of the powerful Confederate-made Brooke rifle as the standard shipboard gun.

The extension in overall length of the second generation standard hull vessels (the Tennessee and Charleston classes) improved several of the shortcomings of the Richmond

class, yet for the most part maintained their relatively moderate draft. On several of these vessels the extended length resulted in the addition of two broadside guns, increasing their rate of fire considerably. Another benefit was longer flush decks, which gave more room for essential equipment.

Combat experience caused an increase in armor thickness. As a result, the casemate was reduced in length in order to prevent a significant increase in weight and draft. On occasion a net savings in scarce iron plate was achieved in consequence of reducing the casemate's length, despite the addition of extra layers of armor. Other possible advantages were a reduction in topside weight and improved stability.

Despite these improvements, the greatest deficiency of the standard hull ironclads was their drafts of water. Even at a moderate twelve to fourteen feet their drafts were often a hindrance. Excessive draft was the direct cause of the loss of the Raleigh when she ran aground and broke her back in the Cape Fear River. In an attempt to rectify this problem at least two shallow draft standard hull ironclads were commenced late in the war but neither were completed. Their designs will be examined in Chapter VI.³⁶

Another shortcoming of the hull type was its basic form. The round bilge, keeled bottom was complex to build and required skilled shipwrights, of which there was a chronic shortage throughout the war. Although the standard hull shape was probably better suited to operations on coastal waters, perhaps more ironclads could have been completed if a simplified design had been adopted, as was done for the inland waters.

The sidewheel ironclads, as demonstrated by the Nashville, were failures. Their great dimensions, matching or exceeding many of the early-war vessels, stretched the basic design beyond its ability to carry the intended armor and ordnance. Even if the vessels had been strong enough, there was no practical way to adequately protect the two massive paddlewheels. Adapting riverboat machinery to more innovative paddlewheel designs, as was done with the inland rivers recessed paddlewheel ironclads, would have saved time

and effort, and made better use of scarce materials.

ENDNOTES

¹The best studies of Confederate naval strategy and its influence on ironclad design are William N. Still, Jr., "Confederate Naval Policy and the Ironclad," Civil War History 9 (June 1963): 145-56; and *idem*, "Confederate Naval Strategy: The Ironclad," Journal of Southern History 27 (August 1961): 330-43. Excellent accounts of the Union's early war inroads into the coastal South are Bern Anderson, By Sea and By River: The Naval History of the Civil War (New York: Knopf, 1962); James M. Merrill, The Rebel Shore: The Story of Union Sea Power in the Civil War (Boston: Little, Brown, 1957); and Rowena Reed, Combined Operations in the Civil War (Annapolis, Md.: Naval Institute, 1978).

²S.R. Mallory to Franklin Buchanan, February 24, 1862, ORN 6: 776-77.

³Mallory to Jefferson Davis, *ibid.*, II, 1: 751; Still, "Confederate Naval Policy," 153. Although Confederate shipbuilding switched to the smaller, defensive vessels, larger ironclads designed to cross the Atlantic and attack the blockade would continue to be built in Europe.

⁴Porter, A Record of Events in Norfolk County, 327-28; Porter, "A Short History of Myself," 3. Neither author gives the vessel's length.

⁵Porter, A Record of Events in Norfolk County, 327.

⁶The Savannah plans are in the H.F. Willink Collection, Special Collections, Robert W. Woodruff Library, Emory University, Atlanta, Ga.

⁷The ram Porter developed for the Richmond class, and used on the majority of his ironclad designs, reflected his misgivings about bolt-on rams of the type used on the Virginia. "I am of the opinion that projections of any kind beyond a ship bow will not stand as a ram, but that the bow should be used as a ram;" Porter, "A Short History of Myself," 5.

⁸The Chicora was built by James Eason, Charleston, S.C., and was operational by early October 1862. The North Carolina was built by Berry & Bros., Wilmington, N.C., and apparently became operational in the summer of 1863. The Palmetto State was constructed by James Marsh, Charleston, S.C. and went into service November 1862. The Raleigh was built by J.L. Cassidy and Sons, Wilmington, N.C., and placed into operation in late April 1864. The Richmond was laid down at Gosport Navy Yard, Va., by the C.S. Navy, completed at the Rocketts Navy Yard in Richmond, and entered service the latter part of 1862. H.F. Willink, Savannah, Ga., constructed the Savannah, which was commissioned in the summer of 1863. The best account of the construction of these vessels is Still, Iron Afloat.

A minor variation between vessels of this class is the placement of their pilot's hatches. Original drafts of the class locate the pilot's hatch just forward of the smoke stack, while the Savannah and Palmetto State are known to have had theirs positioned just abaft the stack. At least one, the Chicora, had a pilot house on each end of the spar deck.

Two engineering plans of the Savannah, in the James H. Warner Collection, Confederate Naval Museum, Columbus, Ga., suggest that vessel had slightly altered dimensions of a forty-four-foot extreme beam, a thirteen-foot, six-inch depth of hold, and a

twelve-foot, six-inch service draft; see Robert Holcombe, "The C.S.S. Savannah," Warship International vol. 20, no. 3 (1983): 309-14.

⁹Contemporary sources only rarely refer to Confederate ironclads as belonging to specific groups or types. One exception is John L. Porter's reference to several ironclads under construction in 1862 at Charleston and Wilmington as belonging to the same "class;" see Scharf, History of the Confederate States Navy, 671. Grouping these vessels based on certain characteristics therefore represents a modern classification system rather than reflecting one used by the Confederate navy. For a recent attempt to classify Confederate ironclads by hull configuration and size, see Robert Holcombe, Notes on the Classification of Confederate Ironclads (Savannah, Ga.: U.S. Army Corps of Engineers, 1978), and appendix "Confederate Ironclad Classes."

¹⁰Plans of the Tennessee class as designed are NPF, #41-5-9, berth deck and hold plans; and #41-5-10, sheer, half-breadth and gun deck, and body plans. Draft estimate is based on the distance from the bottom of the keel to the estimated location of the knuckle with armor attached, using body plan in NPF #41-5-10 as a guide. Usually the hull was immersed to the height of the knuckle or just over it.

¹¹A sketch of the Chicora drawn in October 1864 by Confederate soldier Frederick G. Smith shows a considerable amount of equipment carried on her exposed decks. Apparently Chicora's flush decks are so cramped that her boats are mounted on chocks carried on the casemate sides, with large masts and booms rigged on each end of the spar deck to raise and lower them. This drawing is held by The Confederate Museum, Charleston, S.C., and is reproduced in Still, Iron Afloat, 106. The lengthened hull of the Tennessee allowed her boats to be carried from davits on the aft flush deck.

¹²Franklin Buchanan to S.R. Mallory, July 27, 1863, Buchanan Letterbook, Southern Historical Collection, University of North Carolina, Chapel Hill, N.C.

¹³For an account of the Atlanta's capture and the damage she received, see John Rodgers to S.F. DuPont, June 17, 1863, ORN, 6: 265-66.

¹⁴Calculations made by the author, using formulas for determining cubic areas of rectangles and trapezoids, and standard weights for wood and wrought iron, suggest the amount of iron placed on the Tennessee's shortened casemate actually increased as a result of the thicker plate, but a reduction in the amount of wood used apparently offset this gain. Tennessee's draft in Thornton A. Jenkins, James Alden, William E. LeRoy, and Thom Williamson to D.G. Farragut, August 13, 1864, ORN, 21: 547; and ORN, II, 1: 268.

Reference to Tennessee's 209-foot length being "on deck" is Jenkins et al to Farragut, August 13, 1864, ORN, 21: 547. A deck plan with scale confirms this approximate length as on deck and not overall, see ibid., 582. For other dimensional data see ibid., 547-55.

¹⁵Jenkins et al to Farragut, ibid., 548.

¹⁶Contract between Jones and the Navy Department is dated October 16, 1862. The Columbia was launched March 10, 1864, and apparently commissioned in early 1865; see Report of Evidence, 462-63; Melton, The Confederate Ironclads, 167; and Ralph

Donnelly, History of the Confederate States Marine Corps (Washington, N.C.: the author, 1976), 21. The latter gives Columbia's launch date as January 12, 1865; this is an error and apparently refers to her approximate commissioning date.

¹⁷U.S. Navy drawings of Columbia are in NASF-AD.

¹⁸Calculations by the author comparing amounts of iron and wood used in the construction of original and revised casemates indicate that despite the reduction in length, the increase in iron from four to six inches in thickness resulted in approximately the same tonnage of plate being used. The principal savings in weight came from a considerable reduction in the amount of wood used. Reference to Columbia's draft is ORN, II, 1: 251.

¹⁹Revised knuckle is NPF #41-5-10. Although this plan shows the Columbia with twin screws, she, like the Tennessee, was built with only a single propeller.

²⁰Drawings showing Columbia's hollow knuckle are NASF-AD, U.S. Navy Plan; and NPF #41-5-8, midship section. The early twentieth century development of side protective systems is examined in Norman Friedman, Battleship: Design and Development, 1905-1945 (New York: Mayflower Books, 1978), 75-83. The Texas and possibly the Virginia II were also built with hollow knuckles.

²¹David D. Porter to W. Radford, April 12, 1865, ORN, 12: 115; John L. Porter to S.R. Mallory, November 1, 1864, ORN, II, 2: 750. The Texas was never completed. She was captured at the fall of Richmond, April 1865, launched but without armor, ordnance, or machinery installed.

²²NPF #81-12-2H, engineering midship section; NPF #81-12-22, ordnance plan; National Archives Record Group 74, Red Label File #115 A & B, ordnance plans. Record Group 74, Red Label File plans hereafter cited with prefix RLF and plan number.

²³The Texas painting is in a private collection but is reproduced in Still, Iron Afloat, 109.

²⁴Porter to Mallory, November 1, 1864, ORN, II, 2: 750, and NPF #81-12-22 indicate that Texas' casemate was angled at thirty-five degrees and was to be plated with six inches of armor. No reference to casemate length has been located. Texas apparently deviated little in overall dimensions from Tennessee and Columbia. Her beam is given as 48 feet, 6 inches, while her length is given as 216 feet in Confederate records, 217 feet in Federal records. See ORN, II, 1: 222; and Porter to Mallory, November 1, 1864, ORN, II, 2: 750.

²⁵A postwar survey of the machinery intended for the Texas suggests it had been taken from a wrecked blockade runner. Cmdr. William Radford, U.S.N., reported, "these [the Texas'] engines are exactly similar to those of the Don . . ." The Don was a twin-screw blockade runner built by J. & W. Dudgeon of London, England, captured and taken into U.S. service. Several of Don's sisters wrecked while attempting to run the blockade, and Texas' engines may have been removed from one of them. See report of William Radford, April 25, 1865, in NASF-PN. For information on Dudgeon-built blockade runners, see Stephen R. Wise, Lifeline of the Confederacy: Blockade Running During the

Civil War (Columbia, S.C.: University of South Carolina Press, 1988).

²⁶Dimensional data from take-off plans furnished the author by W.A. Geoghegan. The models are from the U.S. Naval Academy Collection at the Smithsonian Institution. They were purportedly captured in 1865 at Richmond.

William A. Graves (1830 - 1894), born in Norfolk, Virginia, learned the shipwright's trade as a youth, then established his own yard on Water Street. After the outbreak of the Civil War Graves received several contracts to build gunboats. On March 22, 1862, he was appointed to the rank of acting naval constructor and moved to Richmond. There he established a navy yard opposite the one at Rocketts and constructed warships for the remainder of the war. Graves returned to Norfolk after the war and reestablished his shipyard, which he operated until his retirement in 1890.

²⁷Wartime sketches of the Charleston include one drawn by Surgeon Charles Williamson, C.S.N., held by Historical Foundation of the Presbyterian and Reformed Churches, Montreat, N.C. The Charleston also appears in the same Frederick G. Smith sketch that portrays the Chicora; see fn. 10. The Charleston was plated with four inches of iron.

²⁸Original plans of the Virginia II as altered, consisting of half-breadth and deck plan, inboard profile, and two sections, are NPF #81-12-2E. These plans are dated July 6, 1863. Since the vessel was launched June 29, 1863, it is possible the modifications began after she was in the water; see Richmond Whig, July 1, 1863. Virginia II apparently deviated only slightly from the original design, being 203 feet long overall (a 2-foot increase), and 48 feet, 6 inches in beam.

²⁹Reduction in weight based on calculations by the author. The draft after these changes was nearly fourteen feet; see John K. Mitchell to S.R. Mallory, May 21, 1864, ORN, 10: 646; and Mitchell to John L. Porter, ibid., 647.

References to eight inches of iron on the Virginia II's forward casemate are: Porter, A Record of Events in Norfolk County, 317; J.T. Wood to C. ap R. Jones, February 26, 1864, ORN, 8: 801; and S.R. Mallory to J.K. Mitchell, May 24, 1864, ibid., 10: 652.

³⁰Contract, with Sidney D. Porter and J.M. Watson, August 13, 1862, is in Report of Evidence, 457-58. Reports on its construction are S.R. Mallory to Jefferson Davis, November 30, 1863, ORN, II, 2: 533; and Porter to Mallory, November 1, 1864, ibid., 753.

³¹These plans, dated May 2, 1863, are in the Willink Collection, Emory University, and consist of sheer, half-breadth, and deck plans, and a midship section. In 1966 W.E. Geoghegan prepared reconstruction drawings of the altered Charleston based on the originals. He concluded that its moulded dimensions were 167 feet long, 32 feet, 2 inches in moulded beam (42 feet overall, underneath armor), and 14 feet in depth of hold. Why he did so is puzzling since the plans are clearly labeled with dimensions of 180 feet long, 34 feet beam, and 14 feet deep. Allowing for age and condition, these latter dimensions were confirmed by measurements taken from the original plans by the author July 9, 1991.

Contracts from Report of Evidence, 458-59 (Willink); and "Contracts," RG365, (Krenson and Hawkes). Reference to modifications applied to Krenson and Hawkes vessel is in voucher to builders, May 23, 1864, NASF-AD.

³²S.R. Mallory to Samuel Barron, October 2, 1862, ORN, 23: 703-04. The Yazoo City ironclad, being built by Thomas Weldon and John McFarland, was destroyed before completion in May 1863. No contract for this vessel has been found; rather, Weldon and McFarland apparently were building the ironclad as agents of the Navy Department, a situation similar to the Tifts with the Mississippi and Atlanta; see S.R. Mallory to Weldon and McFarland, September 16, 1862, Area 5 File, and William N. Still, Jr., "Confederate Shipbuilding in Mississippi," Journal of Mississippi History 30 (November 1968): 297-98.

The Montgomery vessel (Nashville) was built by J.E. Montgomery and A. Anderson. Contract, dated September 16, 1862, in Report of Evidence, 460-61.

Contract (dated March 28, 1863) for the Selma vessel, built by John T. Shirley and David DeHaven, in "Contracts," RG365. This vessel was seriously damaged when launched. The hull was sold to Mobile interests, who named her Phoenix and planned to convert her to a blockade runner. C.S. Army authorities ultimately seized the ship and sank her as an obstruction in Mobile Bay. See Robert L. Gearhart, II, "The Phoenix: Mobile's Unknown Ironclad," A Paper Presented at the Seventeenth Annual Conference on Underwater Archaeology, Sacramento, Calif., 1986.

References to the vessel to have been built at Shreveport by John Smoker and Thomas Moore in Correspondence Book of Lieut. J.H. Carter, C.S.N., Record Group 45, National Archives, Washington, D.C.

³³Contemporary sketches of the Nashville include ORN, 21: 646; NPF #81-12-2C; and Caldwell Delaney, Confederate Mobile: A Pictorial History (Mobile, Ala.: Haunted Book Shop, 1971): 131. U.S. Navy survey of Nashville is H.K. Thatcher to Gideon Welles, June 30, 1865, ORN, 22, 225-26.

³⁴Thatcher to Welles, ibid., 226.

³⁵Federal reports of the Yazoo City ironclad being 310 feet long, 70 feet in beam, and powered by six engines turning four paddlewheels and two propellers are based on secondhand accounts and must be considered exaggerations; see David D. Porter to Gideon Welles, May 24, 1863, ORN, 25: 8.

³⁶For loss of the Raleigh see George N. Hollins to J.W.B. Greenhow, June 6, 1864, ORN, 10: 24-25.

CHAPTER V

DIAMOND HULL DESIGNS

The need for a shallow-draft ironclad of simplified form that could easily be constructed by inexperienced builders at secure, inland sites resulted in the adoption of a second standardized design in 1862. These ironclads are commonly referred to as diamond hull types because of their diamond-like configuration when viewed from end-on. Characterized by flat bottoms with chine bilges and straight, angular sides flaring outward to form the knuckle, most of this type had depths of hold of about ten feet and loaded drafts of around eight feet. All known were propelled by twin screws, with the exception of a single paddlewheel class.¹

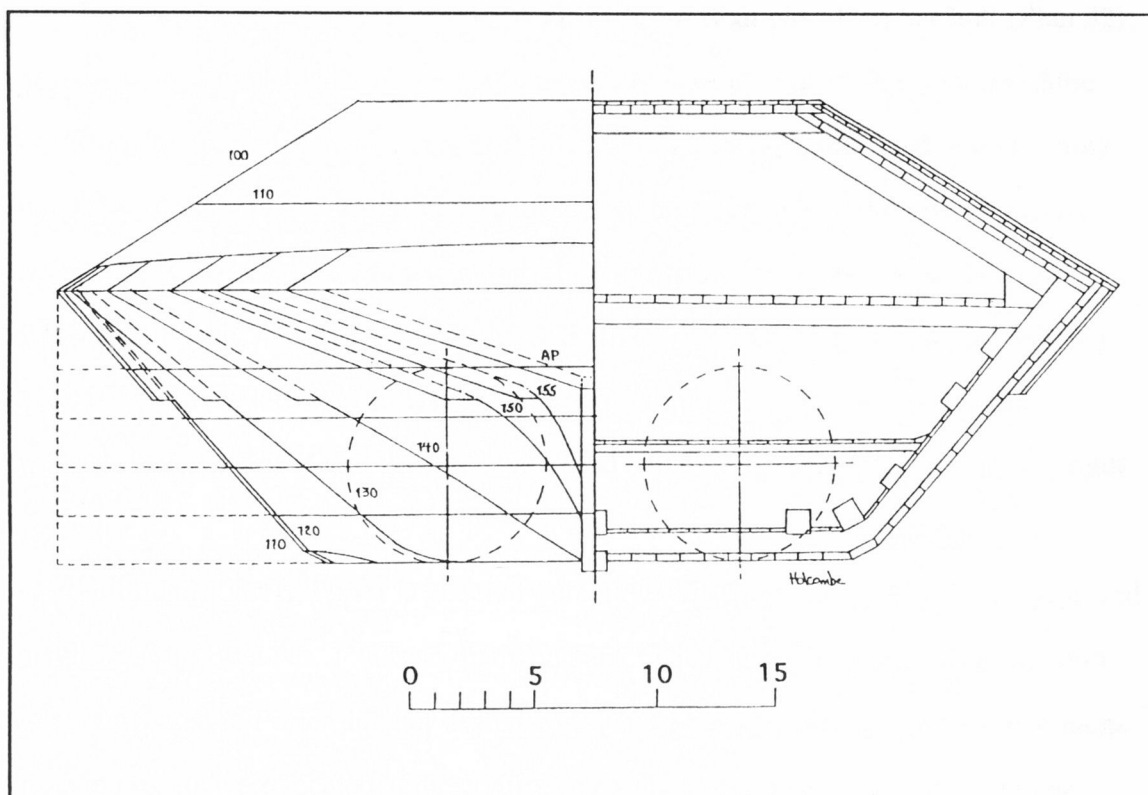
The diamond shaped hull form apparently evolved from John L. Porter's 1861 harbor defense ironclad plan (see Plan 4). Although differing in detail, the general configuration and structure of the vessel's hull corresponds closely to later ironclads of the same basic hull type. Possibly the first diamond hull ironclads to be placed under construction were laid down in the early spring of 1862 in the Norfolk area. In late March Secretary Mallory ordered the construction of from four to eight flat-bottomed, light-draft ironclads designed to pass through the easternmost edge of the Great Dismal Swamp to the North Carolina sounds by way of the Albemarle and Chesapeake Canal. These craft were to carry at least two guns and were to draw not over six feet of water. Their casemates were to be "like the Virginia but must not be weaker."² At least two such vessels are thought to have been commenced: one at Deep Creek, Virginia, by Gilbert Elliott, and another at Norfolk by Nathaniel Nash. One other is known to have been contracted for by the Norfolk partnership of Ambrose H. Lindsey and Willis W. Silvester, while R.L. Myers is believed to have been the recipient of a contract for another. There is no evidence that either was commenced. John L. Porter's son wrote in 1892 that three others, the

Escambia, Elizabeth, and Yadkin, were placed under construction at Gosport Navy Yard, but were destroyed along with Elliott's and Nash's upon the abandonment of the Hampton Roads area in early May 1862.³

No builder's drafts of the Dismal Swamp ironclads have been identified, nor are their dimensions known. A clue to their maximum possible size is the capacity of the canal's Great Bridge guard lock. That structure was 220 feet long, and 40 feet wide, and could accommodate vessels with a maximum 8-foot draft. It is doubtful, however, that these vessels were anywhere near that size, particularly in length. Most likely they resembled the later Albemarle class in both size and configuration.⁴

On May 1, 1862, the Navy Department contracted with Mobile shipwright Henry D. Bassett for the construction of two four-gun ironclad floating batteries. These were apparently the first diamond hull ironclads to enter service. Laid down at Selma, Alabama, as Gunboat No. 1 and Gunboat No. 2, these two vessels were formally named, respectively, Tuscaloosa and Huntsville prior to their completion. Although no plans or specifications have been positively identified, contemporary descriptions indicate they had diamond-shaped hulls. A crude sketch by a Confederate deserter shows just such a transverse configuration, while others describe the two as "flat-bottomed propellers between 150 and 175 feet in length, with drafts of 7 to 8 feet."⁵

A possible image of one of these boats is a contemporary draft labeled "Gun Boat No. 1 With Prattville Engines." Thought to depict the Tuscaloosa, the drawing consists of a plan view, an inboard profile, and several transverse sections. Only the aft half of the vessel is shown, with emphasis on her steam machinery layout. Measured dimensions are forty-three feet, six inches in beam and ten feet, six inches in depth of hold. Length between perpendiculars is estimated to be in the 160-foot range, with draft estimated at about 9 feet. Casemate sides and aft end are sloped at thirty-two degrees.⁶



Plan 32. *Tuscaloosa*, midsection & aft body plan.

Several features of "Gunboat No. 1" distinguish it from any other known Confederate ironclad. First, her gun deck is constructed fourteen inches lower than the aft flush deck (and presumably the fore flush deck), rather than being on the same level. As a result, the height of the casemate is reduced, and the vessel presents a lower profile thus smaller target. Second, the aft flush deck sweeps upward with about ten inches of sheer. While not depicted, the fore flush deck is presumed to have been similarly constructed. A desire to improve seaworthiness is the apparent reason for this feature. Third, the ironclad's machinery layout is unique in that each of her twin propellers are powered by two independent, single-cylinder engines. Based on existing data, one engine to each shaft is the common arrangement for all other twin-screw, diamond hull ironclads.

Finally, the most unusual characteristic of "Gun Boat No. 1" is her hull (Plan 32). Diamond-shaped in overall form, her flat bottom has a double rather than a single chine. About forty-five feet aft (and presumably forward) of amidships, this hard, double chine evolves into a round bilge. The rationale for the double chine is not known - especially since it complicated the hull's construction - but it possibly indicates a western rivers steamboat influence. The Bertrand, a Missouri River steamboat which sank in 1865 and was excavated in the late 1960s, has a similar double chine. The principal difference between the two vessels is that the Bertrand's hard chine was retained for the entire length of her hull.⁷

Although John L. Porter is generally credited with the design of the Tuscaloosa and Huntsville, "Gun Boat No. 1" has so many characteristics unlike any other diamond hull ironclad attributed to Porter that her designer may have been another. In 1983 the remains of the two vessels were located at the confluence of the Mobile and Spanish rivers just north of Mobile, where they had been scuttled by retreating Confederates at the close of the war. Several exploratory surveys have failed to add measurably to the meager information available on the vessels. If, however, future planned excavations confirm the ironclad depicted in the plan as the Tuscaloosa, then contemporary descriptions of the two sisters as being "singularly shaped," and their designs doing "no credit to the naval architecture of the Confederacy," will be better understood.⁸

Two ironclads closely associated with the Tuscaloosa and Huntsville were constructed at Oven Bluff, Alabama, on the Tombigbee River. Built in accordance with an August 12, 1862, contract with Sidney D. Porter and J.W. Watson, these two vessels were 160 feet long between perpendiculars, 41 feet in beam "at the knuckle," and 10 feet, 6 inches in depth of hold. They were to be propelled by high pressure engines geared to twin screws, and were to mount four guns. No builder's drafts or other contemporary illustrations of the two have been found. They are often placed in the same class as the

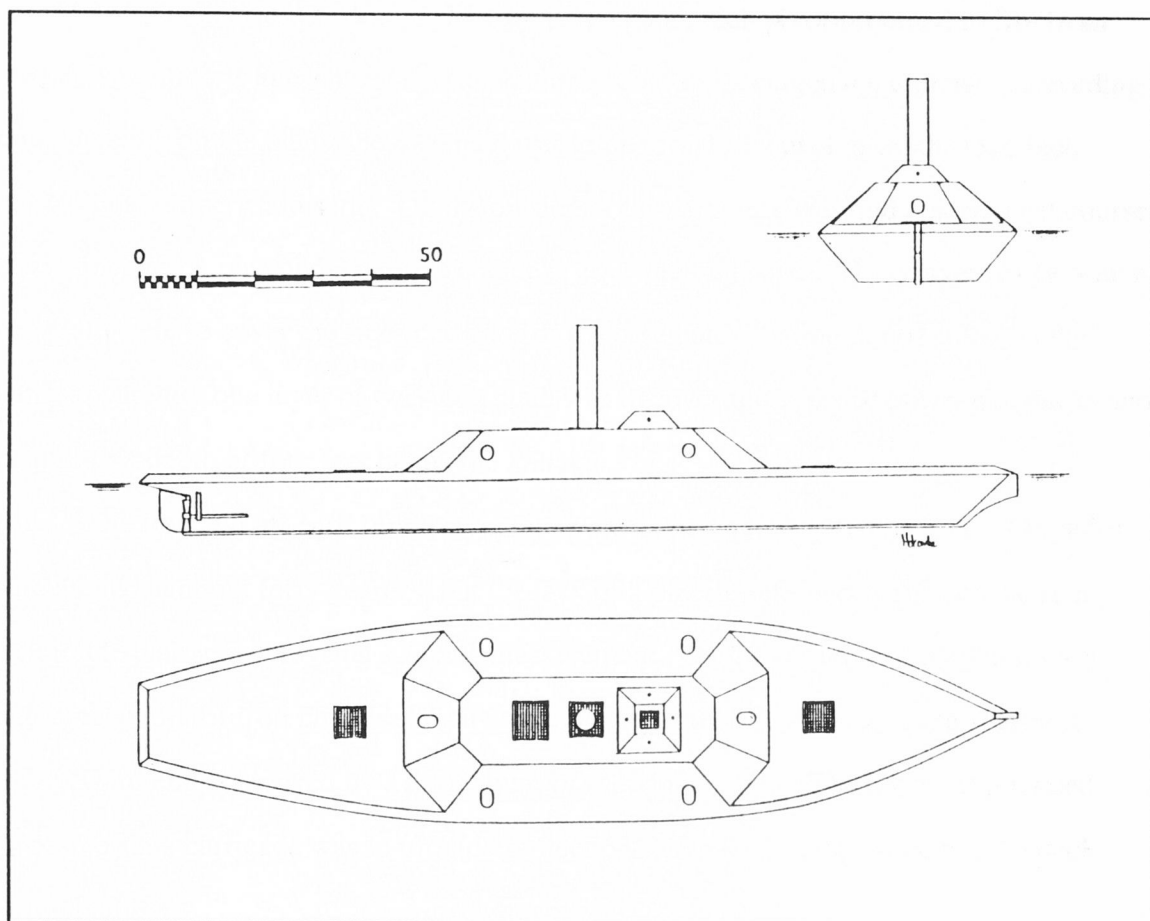
Tuscaloosa and Huntsville as a matter of convenience, but there is no conclusive evidence to support such a grouping.⁹

There is a possibility that the "Gun Boat No. 1" plan represents one of the Tombigbee boats rather than the Tuscaloosa. The measured beam and depth on the plan conform closely to the Porter and Watson contract dimensions, but the lack of a complete drawing of the hull precludes a precise determination of length. Even so, for the plan to illustrate one of the Tombigbee boats an error would be required in either the labeling of the plan, or in the numbering of the three ironclads under construction at Oven Bluff. "Battery No. 1" building at that yard was a 180-foot Charleston class ironclad contracted for on August 30, 1862. Being a standard hull ironclad, this vessel fails to conform in any manner to the size or hull shape of "Gun Boat No. 1." The two 160-foot boats, which closely match the dimensions of the vessel depicted in the plan, are referred to in official records as "No. 2" and "No. 3." The confusion surrounding these four ironclads will not likely be unraveled until the remains of the two Selma boats are thoroughly investigated.¹⁰

In the latter part of 1862 contracts were let for a trio of small ironclads designed by constructor Porter. This class has come to be considered the quintessential example of the diamond hull type. The first was laid down at Tarboro, North Carolina, the product of a September 17 contract between the Navy Department and the shipbuilding partnership of J.G. Martin and Gilbert Elliott. The following July 20 a Federal raiding force destroyed the unnamed ironclad while she was still on the building ways.¹¹

On October 10, 1861, Martin and Elliott received authorization from Mallory to construct an additional ironclad according to the terms of the September contract. Commenced after the first of the year at Edwards Ferry, North Carolina, on the Roanoke River, the vessel was completed as the Albemarle about fifteen months later.¹²

Considerable documentation on the Albemarle's design and construction survives. Photographs, builder's plans, and other contemporary illustrations of the vessel exist, as



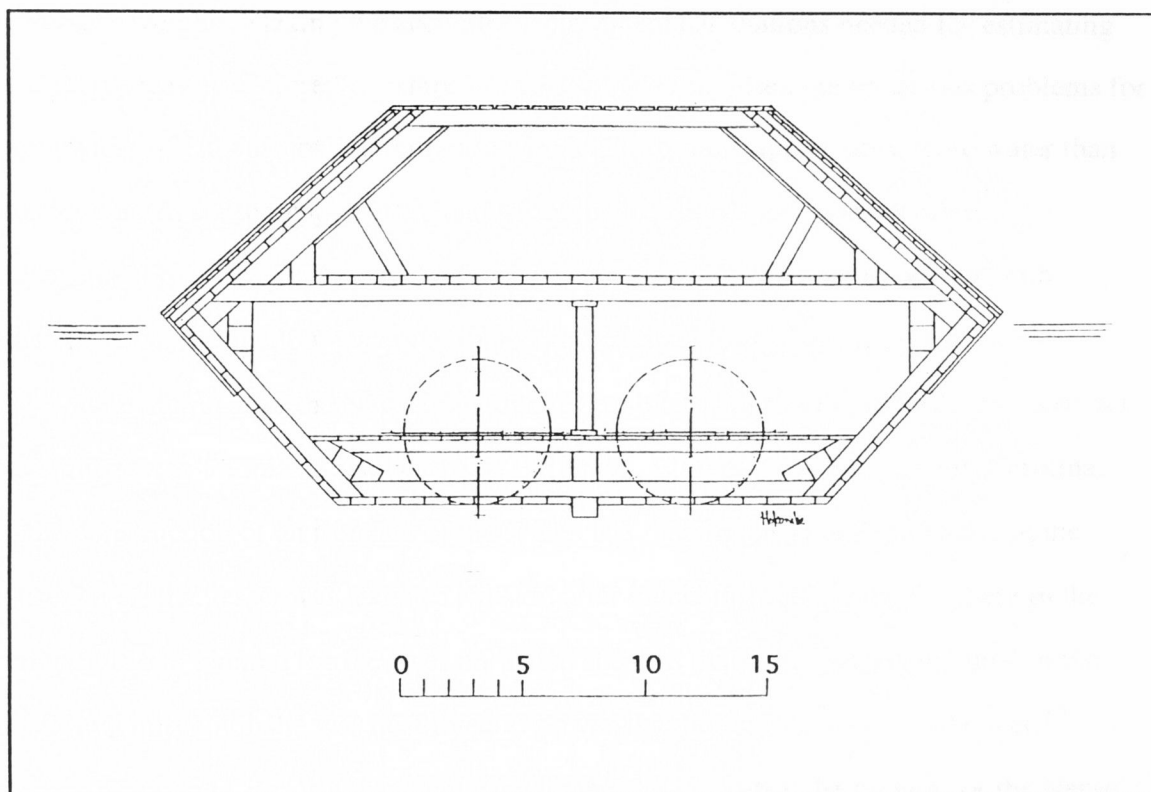
Plan 33. *Albemarle*, three-view.

do several accounts of her construction by participants. The original plan in the National Archives consists of two views: an inboard profile, and a plan view with decks and interior arrangements superimposed. A small, casemated ironclad measuring 139 feet between perpendiculars and approximately 155 feet overall is delineated. Beam - probably without armor plate - is nearly thirty-four feet, while depth of hold is nine feet. Intended loaded draft is noted as six and one-half feet. On the forward end of the hull a ram is formed by a six-foot wooden extension of the stem at the waterline. This ram design is characteristic of all known diamond hull ironclads planned by Porter.¹³

The Albemarle was designed to carry two guns, each pivot-mounted to fire from one of five gunports at each end of a sixty-three-foot long, octagonal casemate. According to the labeling on the plans, the casemate was to be formed by twelve-by-thirteen-inch vertical pine timbers laid solid. On the outside of this structure was laid a horizontal course of five-inch thick pine and a vertical course of four-inch thick oak. Two layers of two-inch iron plate were to cover the sides and ends of the casemate. Although not noted on the plans, apparently one layer of two-inch plate was to cover the exposed horizontal decks and the hull to a depth of four feet below the knuckle.¹⁴

The fore and aft ends of the casemate were angled at thirty-five degree. The sides were angled at about forty degrees, but the lack of a precise reference point for the spar deck in the plan view prevents accurate measurement. On the casemate top a three-foot high breastwork of iron plate is shown enclosing the sides and aft end of the spar deck. The forward end is blocked by a pilot house of the same height. The apparent intended purpose of this barricade was to provide protection for sharpshooters manning the deck during battle.

The absence of a body plan and a midship section prevents a detailed examination of the hull form and structure. Nevertheless, some general conclusions can be reached based on the two views shown in the original plan, and Gilbert Elliott's postwar account of the Albemarle. According to these sources, the vessel was flat-bottomed with a shallow, four-inch keel. Her bottom was twenty feet in breadth at its maximum point amidships, with a hard chine formed by the attachment of side frames. The sides angle outward at fifty degrees, rising to a height of eight feet above the chine where they join the casemate frames and form the knuckle. By Elliott's account the Albemarle's floor and futtock frames were comprised of eight-by-ten-inch yellow pine laid solid and covered on the outside by a layer of four-inch planking.¹⁴



Plan 34. *Albemarle*, midsection.

As built, the Albemarle differed only slightly from the initial design. The most obvious variance is the deletion of the quarter panel gunports, leaving only the centerline and broadside ports. On the inside of the casemate a thin layer of finely dressed wood was added as protection against splinters. Evidence suggests that the length of the vessel was decreased slightly. An apparently contemporary schematic sketch, probably made by the U.S. Navy at the end of the war, gives her length as 153 feet. Most modern sources cite 152 feet, based apparently on the original plans published in revised form in 1887, or in Elliott's article of the following year. There is no indication that iron bulwarks were ever fitted to the spar deck (Plans 33 & 34).¹⁵

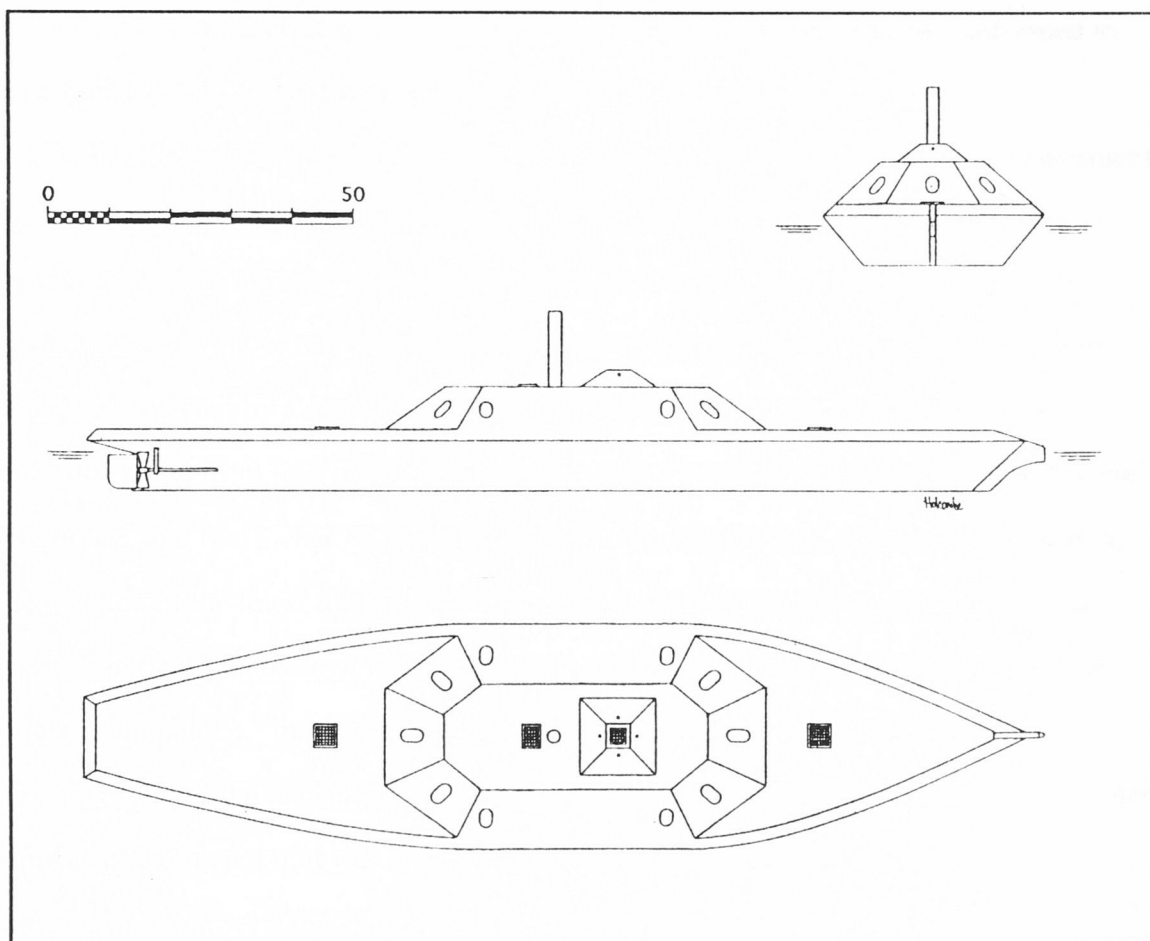
Additionally, the Albemarle's intended draft of six feet, six inches was exceeded by one and one-half feet. The probable cause of this increase was an imprecise computation of

the vessel's weight. Making the accurate displacement calculations needed for estimating the draft of heavily armored warships of the Civil War era often posed serious problems for both navies, and it was not uncommon for ironclads to draw appreciably more water than intended. Even so, the Albemarle's eight-foot loaded draft was a considerable improvement over that of the standard hull ironclads and allowed her to operate with relative ease in the shallow waters of inland and coastal North Carolina.¹⁶

One month after the Navy Department's contract with Martin and Elliott, a contract was signed with Thomas S. Howard and Ellijah W. Ellis of New Bern, North Carolina, for the construction of an ironclad of the same class. Commenced at Whitehall, on the Neuse River, the vessel was taken to Kinston after launching and completed there in the spring of 1864. Named for the river on which she was built, the Neuse remained in the Kinston vicinity until she was destroyed to prevent capture near the end of the war.¹⁷

During the Civil War centennial celebration of the 1960s the remains of the Neuse were recovered. A 136-foot long section of the hull, intact in places up to the knuckle, was retrieved and moved to a site in Kinston for public display. The vessel's flush deck and forward casemate base were initially found intact and attached to the hull but were lost during the course of the salvage effort. Despite this unfortunate loss, however, the surviving hull segment has provided considerable information on the Neuse's construction that would otherwise be unavailable.¹⁸

In overall form and size the Neuse's hull closely conforms to that shown in the builder's drafts of the Albemarle. Externally, the most noticeable difference is the Neuse's lack of a keel; a twelve-by-fourteen-inch gum keelson serves instead as the vessel's main longitudinal component. Internally, her hull members differ somewhat from those described postwar by Gilbert Elliott for the Albemarle. The Neuse's solid framework is made of eight-inch moulded by twelve-inch sided pine floor frames, half-lap joined to futtock (or side) frames of the same size and species of wood. On the interior of the chine



Plan 35. *Neuse*, three-view.

three longitudinal stringers, sided twelve and moulded an average of five inches, stretch the entire length of the hull and serve to strengthen the floor and futtock frame joints. The exterior of the hull is covered on the bottom and to a level sixty-seven inches above the chine with four-inch pine planking. Above that level oak is used (Plan 35).¹⁹

Prior to its loss, enough remained of the Neuse's casemate base to reveal that its construction was similar to the Albemarle's: a solid, vertical framework of twelve-by-thirteen-inch pine covered on the exterior with a five-inch horizontal layer of pine and a four-inch vertical course of oak. The surviving portions of the gun deck, along with a

contemporary sketch of the Neuse by one of her officers, indicates that she conformed to the original design by having gunports in the casemate's quarter panels.²⁰

The Neuse deviated considerably from normal Confederate practice in the placement of her armor plate. As indicated by the now lost portions of her upper structure, seen in photographs taken during the vessel's recovery, the flush decks and undersides of the knuckle were devoid of any evidence that armor had been attached. Normally these areas would be protected by a single two-inch layer of iron. Apparently the Neuse's only protection came from four inches of iron on the casemate sides and ends, and probably the pilot house, and two inches on the upper angle of the knuckle fore and aft of the casemate. The deletion of the lower knuckle and flush deck armor likely was prompted by concern over a significant increase in the Neuse's draft. Prior to the ship's completion one of her officers complained, "the vessel will draw nearly eight feet of water when complete" ²¹ The extent of the reduction in draft that resulted from the elimination of a portion of her armor is not known, but it was insufficient. Throughout her career the Neuse was hindered in her movements by the shallow depth of the Neuse River, and she never ventured far from her Kinston base. On at least one occasion she was prevented from taking part in a planned operation by running fast aground.²²

Operational use of the Albemarle revealed other problems relative to the basic design of the class. On May 5, 1864, the Albemarle battled to a draw a superior force of seven Union warships in Albemarle Sound. James W. Cooke, the ironclad's captain, afterwards wrote the Navy Department outlining what he perceived to be the Albemarle's main flaws. Principal among these were a lack of firepower and the inability to quickly train the two pivot guns on moving targets. "I find," he wrote, "[that] shifting the guns in action [is] a very great disadvantage; while the gun is being shifted the enemy has time to change position." Cooke believed that with two additional guns, one to each broadside, the Albemarle would have won a complete victory. He recommended that any future ironclads

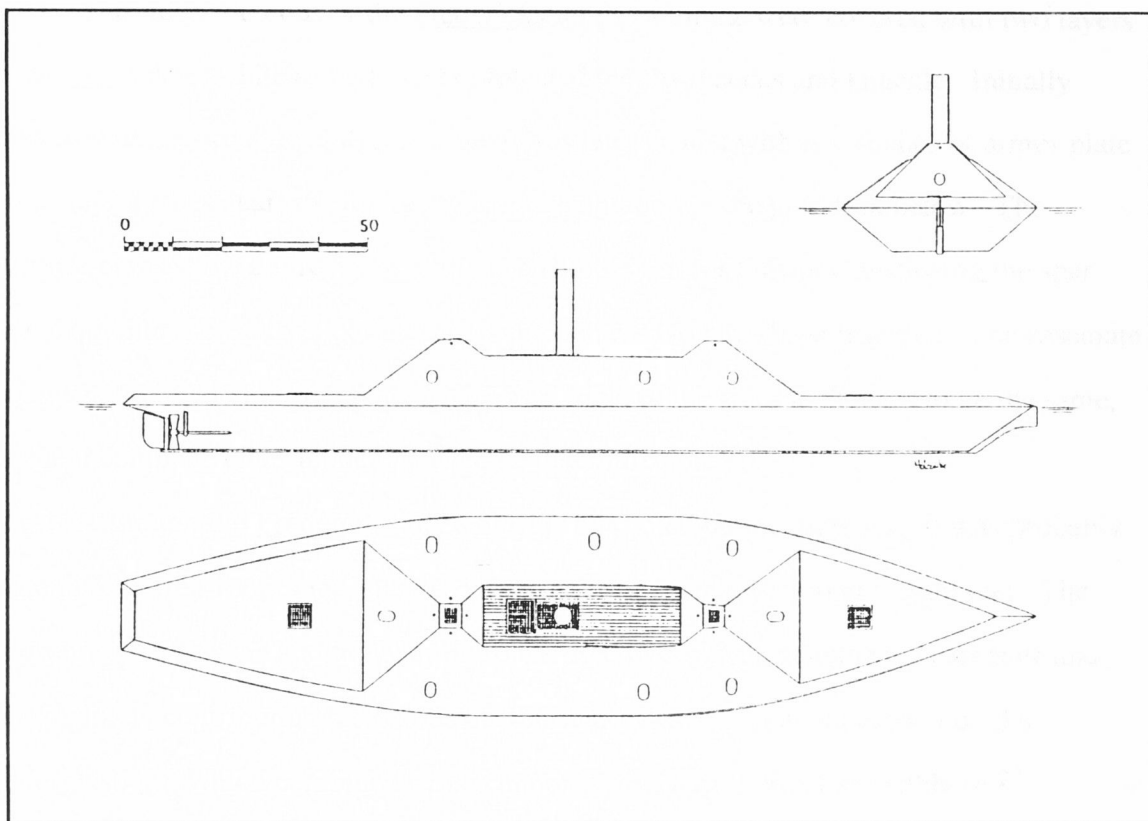
built for the North Carolina sounds should carry four guns.²³

Cooke's other complaints primarily concerned the Albemarle's resistive powers, speed, and draft. These were common complaints directed at Confederate ironclads in general, often received by Mallory but not easily rectified. Management of these and other design components was a delicate balancing act whereby the improvement of one was often detrimental to one or more of the others. It was probably with not a little irritation that the Secretary replied, "The three requisites which are demanded for a vessel of war in the waters of North Carolina are of different combination, and I will be glad to hear from you on the problems of uniting invulnerability, good speed, and light draft in the best manner." There is no evidence that Cooke ever responded to Mallory's terse rejoinder.²⁴

The need for an enlarged Albemarle type with greater firepower was apparently anticipated by constructor Porter. At nearly the same time as the three two-gun ironclads were being contracted for in North Carolina, a larger four-gun version was being laid down at the Rocketts yard in Richmond. Eventually named the Fredericksburg, this vessel was completed in the spring of 1864 and became an operating element of the James River Squadron.

Two original plans of the Fredericksburg exist in National Archives files: a builder's draft consisting of an inboard profile and a half-breadth plan with superimposed deck plans, and a gun deck plan. The latter drawing was prepared for the Ordnance Bureau to assist in setting up the ship's guns. Both plans bear Porter's signature as designer.²⁵

The Fredericksburg was similar in appearance to the Albemarle, but larger. The most noticeable external differences were a lengthened, rectangular casemate and two pilot houses - one on each end of the Fredericksburg's spar deck. To accommodate two additional guns the casemate was increased in length to about eighty-nine feet underneath its armor plate. Accordingly, the hull was lengthened to 170 feet between perpendiculars



Plan 36. *Fredericksburg*, three-view.

and 188 feet overall, and the beam expanded to about 40 feet beneath the armor. The depth of hold was also increased, to about ten feet, ten inches. In other respects the Fredericksburg had the same twin-screw propulsion, transom stern, and stem-extended ram as her smaller sister (Plan 36).

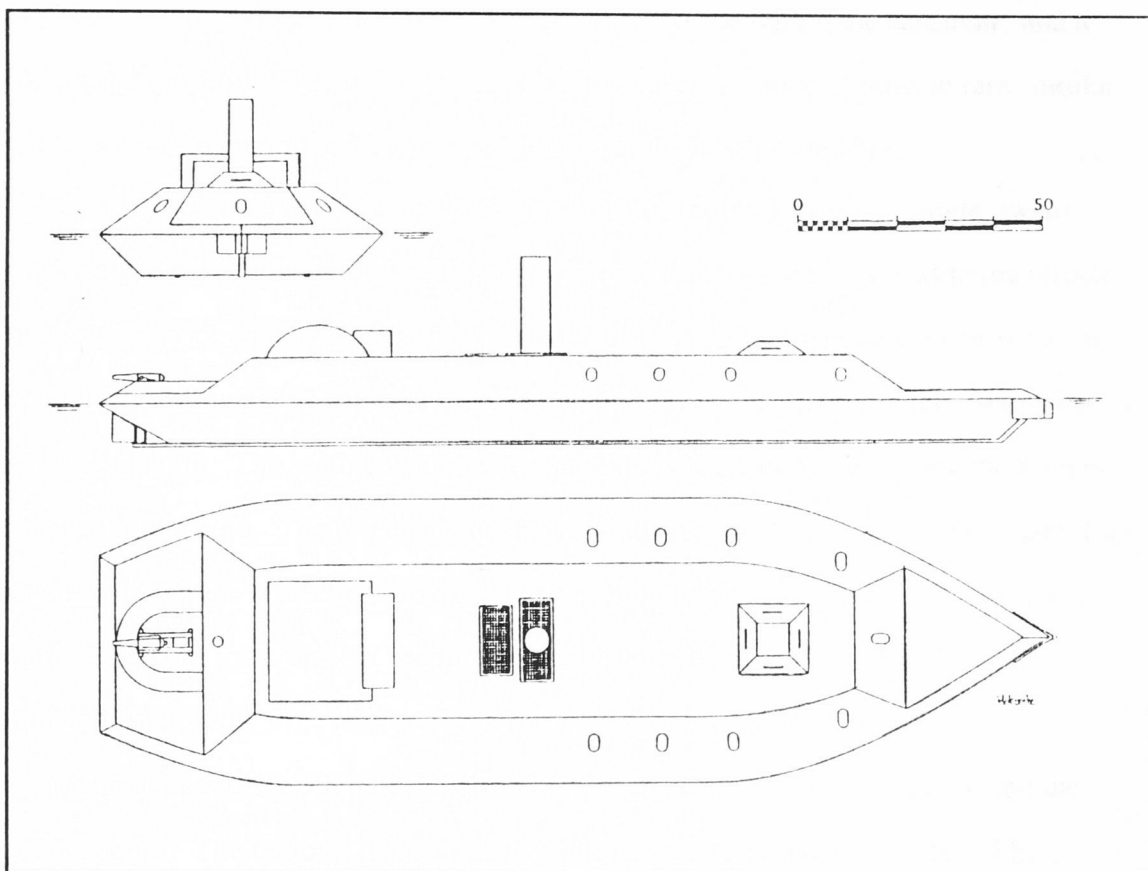
The hulls of the two were also superficially similar, with shallow keels and chine to chine breadths of twenty feet. The Fredericksburg differed, however, in that her futtocks angled outward at forty-two degrees rather than the Albemarle's fifty. This change, combined with the increase in depth of hold, accounts for the Fredericksburg's wider beam.

The sides and ends of the Fredericksburg's casemate were covered with two layers of two-inch plate, while a single layer protected the flush decks and knuckle. Initially covered with wood, the vessel's spar deck was later coated with two inches of armor plate laid several inches apart to provide light and ventilation to the gun deck below. The builder's plans show a three-foot high, iron rifle screen (or bulwark) enclosing the spar deck from pilot house to pilot house; it is not believed to have been installed. The casemate ends were inclined at thirty-six degrees. The angle of the sides is thought to be the same, but the incomplete plans hinder an accurate determination.²⁶

Although the Fredericksburg's draft is not noted on the drawings, it was probably in the nine- to ten-foot range, superseding even the Albemarle's inflated eight feet. The apparent cause was the additional armor plate used to cover the lengthened casemate and hull. A likely contributing factor was the unusually heavy armament carried by the Fredericksburg, which combined rifled cannon with a large caliber smoothbore.²⁷

While the majority of the diamond hull ironclads were propelled by twin screws, one class was designed to be powered by a center, or recessed, paddlewheel. Like the standard hull Nashville class, the centerwheel design was probably meant to take advantage of existing high pressure riverboat machinery which was better suited for driving paddlewheels than turning propellers. Two of this type were constructed: the Missouri at Shreveport, Louisiana, and the Jackson at Columbus, Georgia. A third was apparently intended for construction at New Orleans but was likely not commenced before the city's capture. Plans and specifications for yet a fourth of this class were submitted by the Navy Department to the Ladies Defense Committee of Mississippi for construction on the Alabama or Tombigbee Rivers, but there is no evidence that construction ever began on this vessel.²⁸

In the mid-1980s builder's drafts of a centerwheel ironclad prepared by constructor Porter were discovered in the collections of the Museum of the Confederacy. These



Plan 37. Centerwheel Ironclad, three-view.

drawings presumably served for both the Missouri and the Jackson. Consisting of an inboard profile, a half-breadth view with superimposed deck plans, and a half-midsection plan, they represent the most complete plans of any diamond hull ironclad. The vessel illustrated is 190 feet long between perpendiculars, 56 feet in moulded beam, and approximately 9 feet, 9 inches in depth of hold. Her designed loaded draft is 6 feet. Overall dimensions are about 193 feet in length and 58 feet in beam.²⁹

The rectangular casemate measures 140 feet in length, not including armor. The sides of the casemate are inclined at thirty-five degrees; the fore and aft ends at about thirty-seven and thirty-five and one-half degrees respectively. Eight guns were intended as the

vessel's armament: a pivot gun forward and six in broadside within the casemate, and a pivot gun mounted in the open on the short aft flush deck. A stem-extension ram, similar to those on the Albemarle and Fredericksburg, is on the bow (Plan 37).

The most novel feature of the design is its propulsion system. A single, twenty-two-foot diameter paddlewheel is mounted forty-four feet forward of the aft perpendicular. A twenty-five-foot wide wheelwell, or raceway, allowed an unimpeded flow of water in the paddlewheel's wake by forming a catamaran hull for the aft fifty-five feet, six inches of the vessel's length. The inclined engines are mounted on the gun deck, while the boilers are placed in the hold. The principal advantage of the recessed system over the Nashville's sidewheels lay in the protection provided the wheel by its placement within the armored casemate. Except for a six-foot section protruding above the spar deck, the wheel is completely enclosed.

The diamond-shaped hull is a greatly enlarged version of the Albemarle and the Fredericksburg. The bottom, from chine to chine, is forty-one feet in breadth. The futtocks angle upward from the chine at forty-five degrees. Eight feet above the bottom the casemate frames join the futtocks and form the knuckle. Three keels, one on the centerline and the others spaced seven and one-half feet from each chine, protrude a scant three inches from the floor planks.

During the fall of 1861 the Federal navy constructed a class of seven centerwheel ironclads that bear a striking resemblance to the Confederate design. Known as the "City class," these gunboats were 175 feet long on deck, 51 feet, 2 inches in breadth, and 6 feet in depth of hold. They carried thirteen guns on a six-foot draft, but were only partially plated with two and one-half inches of iron. Their hulls were diamond-shaped with three shallow keels. Although the Union model lacked the heavier protection and sharper lines of its Southern counterpart, both are comparable in their basic plan. Considering their similarities, it is quite possible that reports of the Union ironclads influenced Porter when

he developed his design the following year. Likewise, it is equally possible Porter developed his plan independently as a logical method of protecting the vulnerable propulsion system. Regrettably, no evidence has been found to support either thesis.³⁰

The construction of the two Confederate ironclads built on the centerwheel arrangement followed widely divergent courses once laid down. The Missouri, begun in December 1862 and completed ten months later, was quickly and efficiently built. Taking into consideration the extreme inadequacy of facilities, materials, and labor that existed in the isolated trans-Mississippi region of the Confederacy, this was an incredible feat rarely matched anywhere in the South.³¹

A Union survey of the Missouri conducted after her surrender at the end of the war indicates that the original design was somewhat altered. While certain of these changes no doubt resulted from shortages of materials and equipment, others seem to have been made in an effort to improve the operating efficiency of the vessel.³²

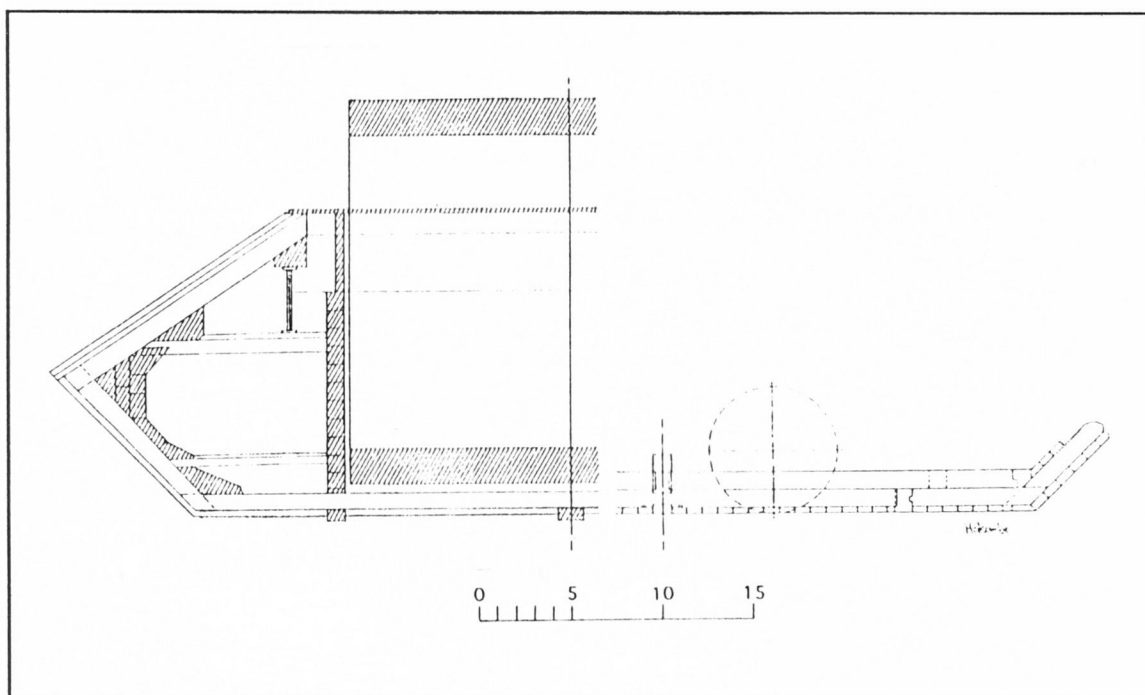
As a result of these modifications, the Missouri was built shorter and narrower: 183 feet in length and 53 feet, 8 inches in beam. Conversely, her depth of hold was increased slightly to ten feet, three inches. Typically, her loaded draft increased to eight and one-half feet - two and one-half feet more than intended. The survey report fails to mention the existence of a ram, which might account for some (but not all) of the ironclad's shorter length. The Missouri's casemate was 130 feet, 6 inches long, a full 10 feet shorter than designed. This alteration was apparently made in order to provide a more flexible arrangement of her armament. By cutting back the casemate face to a wider portion of the hull, two pivot guns rather than one could be mounted forward in each corner of the casemate. Perhaps in consequence of the shorter casemate the number of broadside gunports was reduced from six to four (two per side). Gunports were also provided in the aft end of the casemate abreast the wheel box, but these had apparently been closed by war's end; they are not mentioned by Union surveyors. The lack of heavy ordnance in the

western theater forced yet another change. When only three guns could be provided, one was mounted on a pivot carriage placed between the aftermost broadside ports, allowing it to fire to either port or starboard. The remaining guns were placed in the two forward pivot positions.³³

Since it was impossible to obtain the preferred rolled iron plate for armor, four and one-half-inch railroad "T" rail was used instead. On the casemate sides the rails were laid diagonally, apparently to save time and effort in cutting them to length; on the casemate ends they were placed vertically. The spar deck was left unplated, but the survey is unclear concerning the flush decks. Apparently the sides and ends of the Missouri's casemate were also modified. Measurements based on superficial dimensional data indicate that the ends were angled at about thirty-three degrees, the sides at about forty degrees.³⁴

If quickly and efficiently building the Missouri on the edge of the frontier was something the Navy Department could point to with pride, then the problems entailed in building the Jackson must have been a bitter disappointment. Laid down a few weeks after the Missouri at Columbus, Georgia, one of the major industrial centers of the South, the Jackson was plagued by constructional problems. When finally launched two years later she had the dubious distinction of being the most altered ironclad built in the Confederacy.³⁵

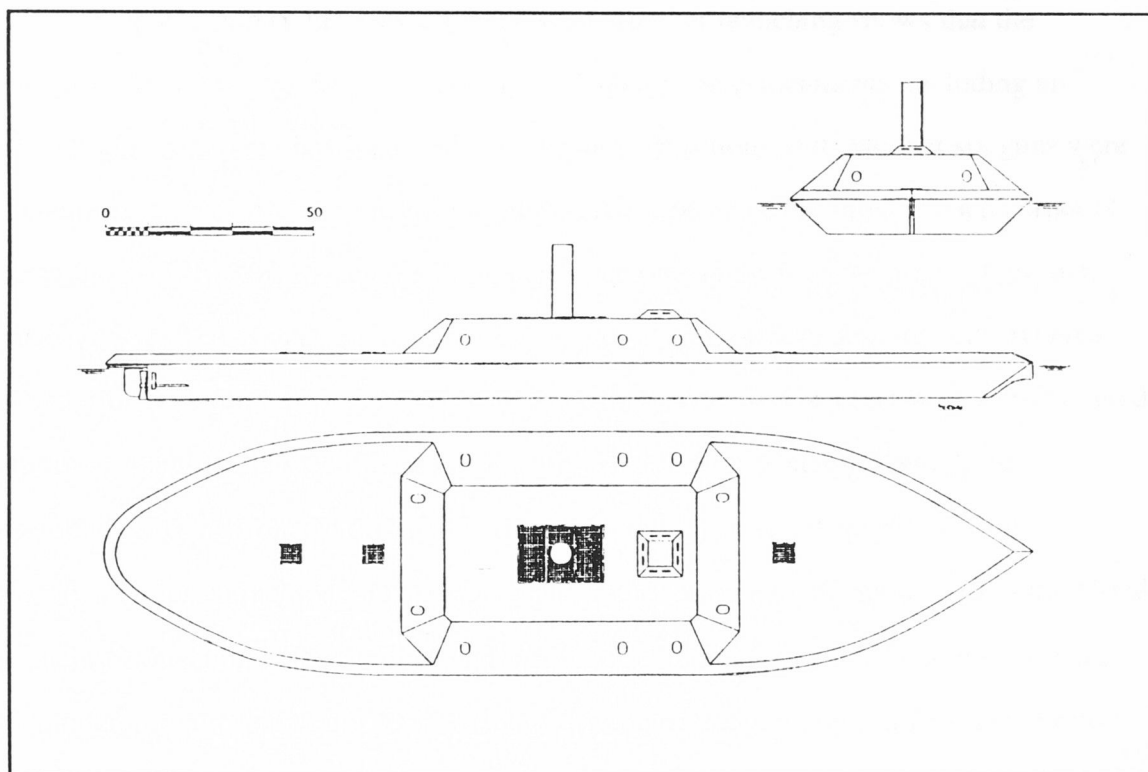
After a failed launch attempt in early 1864 the Jackson was deemed too heavy for successful navigation in the shallow Chattahoochee River. As a result, Porter ordered the vessel modified in an attempt to decrease weight and increase buoyancy. Accordingly, the recessed wheel was removed and the wheelwell enclosed, the hull was lengthened twenty-seven feet and tapered to a center stern post, and a twin-screw propulsion system was installed with machinery in the hold. The long casemate was also shortened by fifty-four feet, considerably decreasing the weight of armor carried. These alterations consumed the remainder of the year and the Jackson was not launched until late December 1864. The



Plan 38. Centerwheel Ironclad - *Jackson*, midsections.

ironclad was still unfinished when captured and burned by Federal troops in April 1865. Little was known of the Jackson's transformation from centerwheel to twin-screw until 180 feet of her hull was recovered in the early 1960s. Although burned to the waterline, then badly damaged by river dredging in the early twentieth century, the remains have provided considerable insight into the ironclad's original structure and the modifications applied to it.³⁶

A preliminary survey places the Jackson's altered overall length at approximately 225 feet, and her extreme beam at 59 feet. With the exception of the new stern section and the filled-in wheelwell, the floor and futtock frames are foot-square yellow pine laid solid. The construction is lighter in the wheelwell and stern section, with the floor frames being laid with room and space. Futtocks in the extreme stern are laid solid but, while retaining the twelve-inch thickness of the other frames, are sided only six inches. The bottom of the



Plan 39. *Jackson*, three-view.

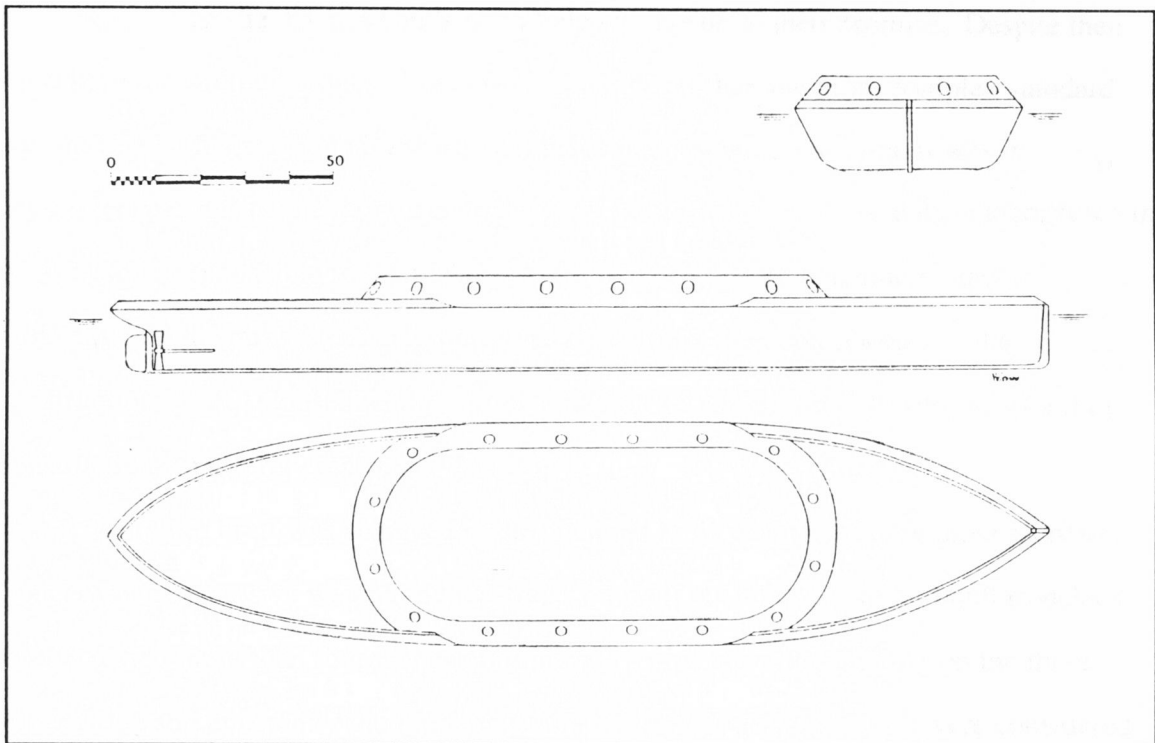
hull is covered with four-inch thick planking and the sides with six-inch planking from the chine up. The height of the existing hull indicates that the Jackson was drawing about six and one-half feet of water at the time of her destruction. Her operational draft is estimated at seven to eight feet.³⁷

Externally, the Jackson's hull closely resembles that depicted in the builder's drafts. The bottom is forty-one feet in breadth, and the futtocks flare outward from the chine at forty-five degrees. The most obvious difference between the two is the Jackson's lack of keels. In lieu of these members, a six-inch thick, thirteen-inch wide king plank, jogged two inches into the floor frames, is flush on the exterior of the hull. Inside the hull a keelson and rider keelson provide longitudinal strength (Plan 38).³⁸

A photograph of the Jackson taken soon after her launching shows that the shortened casemate was octagonal in shape. Contemporary documents, including an original gun deck plan that was used to plot gunport positions, indicate that six guns were to comprise the vessel's armament; four guns were to be pivot-mounted in each corner of the casemate to fire from one of two gunports, and one gun was to be mounted on each broadside. The casemate was to carry four inches of iron on its sides and ends, whereas the exterior decks and the underside of the knuckle to a depth of six feet were to be covered with two. As ultimately configured and nearly completed, the Jackson bore little resemblance to the ironclad originally designed and laid down (Plan 39).³⁹

An unusual diamond hull design exists in the form of a half-hull model in the Naval Academy Collection at the Smithsonian Institution. Representing a twin-screw ironclad, the model measures, in scale, 202 feet long between perpendiculars and 213 feet overall. Extreme beam is fifty-one feet, six inches, while the estimated draft is twelve feet, nine inches. The 110-foot long casemate mounts four pivot and eight broadside guns. The ends of the casemate are rounded and are inclined at fifty degrees; the sides are sloped at fifty-two degrees. Forward, the stem is vertical and without a ram. This vessel's hull differs from most other diamond hull types in that she has round rather than chine bilges. The floors remain flat for sixteen feet on either side of the keel before the bilges turn sharply upward. Above the bilges the sides of the hull angle outward at sixty-five degrees, joining the casemate frames and forming the knuckles about fourteen feet above the floors (Plan 40).⁴⁰

Virtually nothing is known of the origins of this model. Although the hull bears the date "1864," the inclination of the casemate and its rounded ends suggest it was conceived much earlier in the war. A clue to its designer might lie in its reported capture in Richmond at the same time as the two Charleston class half-models. If, in fact, the models do share a common provenance, then they might also share the same designer, Acting Naval



Plan 40. 202-foot Ironclad, three-view.

Constructor William A. Graves. Although many differences exist between the 202-foot ironclad and Graves' known designs, all have similar vertical stems. Nevertheless, evidence in support of Graves as their mutual creator is inconclusive.

Designed to fill a specific need, the diamond hull types offered several theoretical advantages over other Confederate ironclad classes. Their hull was simplified in form and construction, and should have been quicker and easier to build, even when using inexperienced labor. Their designed drafts were shallow enough for them to be constructed and operated on inland waterways. And their twin screws (excluding the paddlewheel Missouri class) could provide greater maneuverability in narrow tributaries, if operated independently.

In reality, the diamond hulls often failed to live up to their promise. Despite their simplified design few, if any, were constructed quicker than the more complex standard hull models. This was not necessarily a fault of the design. Most often it was in consequence of insufficient raw materials (especially pig iron), an inadequate labor force in the industries responsible for furnishing armor plate and steam machinery, and a breakdown in the rail system that transported these important components to the construction yards. Consequently, the advantages of a simplified hull form in speeding construction were rarely realized.⁴¹

A lighter draft was achieved in the diamond hull design but not without sacrifice. Concern over excessive weight and its effects on draft meant that diamond hull ironclads rarely carried more than four inches of armor. For probably the same reason the three Albemarles and apparently the Fredericksburg had lighter scantlings and were considered inferior to other types in resistive strength. The very form of the hull was another source of weakness. The flaring knuckle of the diamond-shaped hull, an integral part of the hull, failed to provide adequate protection against ramming and waterline hits. In this respect the massive built-on knuckle of the standard hull types was far superior.⁴²

Firepower was also compromised. Weight concerns, as well as the smaller dimensions of the diamond hull ironclads, resulted in fewer guns being carried. With only two guns, the Albemarles lacked an adequate rate of fire. The larger Fredericksburg was an improvement with two additional guns but suffered a significant increase in draft. The centerwheel design over-compensated by increasing firepower to eight guns, more than any of these ships could carry. The overweight Jackson could not even be launched and had to be drastically altered while on the building stocks. Even the modified centerwheel Missouri drew eight and one-half feet of water - two and one-half feet over her planned draft - with only three guns mounted. In spite of all efforts to control weight and deliver a respectable rate of fire, apparently none of the completed diamond hulls achieved their

intended drafts. Even so, they still drew less water than the standard hulls and were capable of navigating on the inland waters for which they were designed.⁴³

The twin-propeller arrangement potentially offered considerable advantages in maneuverability. The turning radius of a vessel could be markedly improved by working each screw independently of the other, an important asset when operating in narrow rivers. There is some doubt, however, that this was the primary reason for adopting the system to the majority of the diamond hull ironclads. Fittings within the hull of the Neuse indicate that her two propellers were geared to a single shaft turned by both engines, thereby preventing their independent use. The principal reason for adopting the twin-screw arrangement, then, might have resulted from the diamond hulls' light draft rather than a desire to enhance maneuverability. With a hull of shallow depth, a single large screw of required size would be partially exposed above water, resulting in diminished efficiency. Two smaller screws, completely immersed and with a combined blade surface equivalent to a larger single screw, performed more effectively. Unfortunately, the lack of machinery data on most of these ironclads makes it impossible to determine conclusively the fundamental reason for the use of the twin-screw propulsion system.⁴⁴

The centerwheel design was an improvement over the sidewheel Nashville class. The recessed wheel was far better protected, and the shorter hull resulted in a stronger structure that was not as prone to hogging as were the large sidewheelers. The centerwheel design suffered from an excessive draft, but this probably could have been remedied by cutting back the length of the armored casemate and decreasing the number of guns carried, thus reducing weight. Considering the availability of riverboat machinery and the ease with which it could be converted to centerwheel use, it is unfortunate for the Confederacy that a modified version of the design was not put to greater use.

The diamond hull design was an innovative response to specific needs and capabilities. In many ways it made better use of the Confederacy's limited resources than

did any other ironclad design. And despite the compromises made to achieve a simplified form and light draft, the diamond hulls were superior to most any warship they might oppose on inland waters until the latter stages of the war. Had the South's industrial and transportation systems been more capable and allowed more of the class to be completed, the Confederate navy could have met its foe on more equal terms and with a greater chance of success.

ENDNOTES

¹For characteristics of diamond hull ironclads, see Still, Iron Afloat, 96; and DANFS, II: 490.

²S.S. Lee to John L. Porter, March 27, 1862, Order Book Gosport Navy Yard, Forrest Family Papers, Southern Historical Collection, University of North Carolina, Chapel Hill, N.C.

³For Mallory's instructions concerning the construction of these ironclads, see S.R. Mallory to S.S. Lee, March 30, 1862, Correspondence of the Secretary of the Navy, Record Group 59, National Archives, Washington, D.C.; and Lee to Porter, March 27, 1862, Order Book Gosport Navy Yard, Forrest Family Papers.

Contracts with Gilbert Elliott, April 16, 1862, and Lindsey and Silvester, April 23, 1862, are in Report of Evidence, 452-54. Although no contract between the Navy Department and Nathaniel Nash has been found, references to his constructing such a vessel are Lee to Porter, March 27, 1862 (two letters, same date), Order Book Gosport Navy Yard, Forrest Family Papers; and a payment voucher for work done, May 15, 1862, NASF-AC. Reference to R.L. Myers apparently building one of these ironclads is in S.R. Mallory to George W. Harrison, April 3, 1862, NASF-AC.

References to Escambia, Elizabeth, and Yadkin being Dismal Swamp ironclads are Porter, A History of Norfolk County, 29, 32. Since these references are likely based on the recollections of the author's elderly father, John L. Porter, it is quite possible the three ironclads have been confused with several small, wooden gunboats under construction concurrently at Gosport, or the ironclads being built (or to be built) by Elliott, Nash, Myers, and Lindsey and Silvester. Constructor Porter in his testimony before a congressional investigating committee stated that the Secretary had "five or six light draft ironclads being built outside of the navy yard by persons from Norfolk," but failed to mention any under construction at the yard itself; see the testimony of John L. Porter at the investigation of the Navy Department, March 3, 1863, ORN, II, 1: 803.

⁴Alexander C. Brown. Juniper Waterway: A History of the Albemarle and Chesapeake Canal (Charlottesville, Va.: University Press of Virginia, 1981), 1981. While some modern sources claim these ironclads were also to use the nearby Dismal Swamp Canal, Mallory's instructions refer only to the Albemarle and Chesapeake Canal. See Mallory to Lee, March 30, 1862, Correspondence of the Secretary of the Navy, Record Group 59.

⁵The term floating battery, as used by the Confederates, usually implies a warship that is minimally powered, but capable of moving from one anchorage to another while being used as a mobile floating fort.

Contract for Huntsville and Tuscaloosa in Report of Evidence, 454-56. References to them as Gunboats No. 1 and No. 2 in NASF-AC. Contemporary sketches of the two appear in NASF-AD; and attached to D.G. Farragut to Gideon Welles, September 26, 1864, ORN, 21: 663. These images are of dubious accuracy. The former was drawn by a Mobile citizen who deserted to the Federals, the latter by Adm. Farragut. The transverse sketch is "Abstract of statement of J.W. Porter," September 29, 1862, ibid., 19: 200. Reference to flat bottom in "Report of Capt. J.B. Marchand, U.S. Navy," February 18, 1864, ibid., 21: 106. Reference to length in "Memorandum forwarded by Col. A.J. Myer,

U.S. Army," July 7, 1864, ibid., 363. Reference to draft in "Report of Capt. S.M. Eaton, U.S. Army," March 3, 1865, ibid., 22: 60.

⁶Identification of drawing is based on its known preparation by the C.S. Naval Iron Works, Columbus, Ga., fabricators of Tuscaloosa's machinery, and by the process of elimination - it matches no other known Confederate ironclad. "Gun Boat No. 1 with Prattville Engines" is in the James H. Warner Collection, Confederate Naval Museum. Prattville engines apparently refers to William Penny and Co., Prattville, Alabama, which operated as a branch of the C.S. Naval Iron Works. The precise nature of the work being done by Penny and Co. for the Naval Iron Works is not known.

⁷For the hull construction of the Bertrand, see Jerome E. Petsche, The Steamboat Bertrand: History, Excavation and Architecture (Washington, D.C.: National Park Service, 1974), 74-76.

⁸For underwater work on Tuscaloosa and Huntsville, see Allen R. Saltus and Sidney H. Schell, The CSS Huntsville and CSS Tuscaloosa Project, Mobile River, Alabama (Mobile, Ala.: U.S. Army Corps of Engineers, 1985). Negative descriptions are "Memorandum forwarded by Col. A.J. Myer;" C.J. McRae to S.R. Mallory, July 13, 1862, ORN, II, 2: 217-18; and McRae to Mallory, ibid., 230-32.

⁹Contracts in Report of Evidence, 456-57.

¹⁰Ibid. References to Tombigbee boats being referred to as No. 1, No. 2, and No. 3 are NASF-AC. Although all three boats were launched, none were completed.

¹¹Martin and Elliott contract in Report of Evidence, 461-62. Reference to the destruction of the Tarboro boat is "Statement of Michael Cohen," August 18, 1863, ORN, 9: 164.

¹²Reference to addendum to the Martin and Elliott contract is S.R. Mallory to James W. Cooke, October 10, 1862, Martin Papers, Southern Historical Collection, University of North Carolina, Chapel Hill, North Carolina. Payment vouchers in NASF-AC indicate that advance payment for construction of Albemarle was not made until January 1863.

¹³Builder's plan of the Albemarle is NPF #3-5-27.

¹⁴Ibid.; Gilbert Elliott, "The Ram Albemarle: Her Construction and Service," in Walter Clark, Histories of the North Carolina Troops (Goldsboro, N.C.: Nash Brothers, 1901), 5: 317.

Two contemporary accounts provide contradictory information on the armor ultimately provided the Albemarle. An officer assigned to the ironclad wrote "you must not expect much of the 'Albemarle' for she is the poorest iron clad in the confederacy [sic]. her [sic] sides are plated with four inches of iron, her spar deck is not covered at all & a portion of her flush deck forward, is covered with one inch of iron[,] the other portion is not covered with anything. Her after flush deck is partially covered with one inch iron, the rest of it with 1/4 inch sheet iron." See James C. Long to Hubbard T. Minor, Jr., June 28, 1864, in James C. Long, "Poorest Ironclad in the Confederacy," CWTI 13 (January 1975): 25. A Federal survey of the Albemarle at the end of the war stated that "The vessel

was plated two feet below the knuckle and to the deck above with two thicknesses of one inch [plating]. Forward and aft of the casemate the deck was covered with one inch plating and the casemate with two thicknesses of two inch iron." H.N.T. Arnold, J. Hanscom, and John H. Long to J.M. Brown, May 18, 1865, Records of the District of Columbia Courts, Case 146, Record Group 21, National Archives, Washington, D.C.

¹⁵The post-war schematic sketch with dimensional data is NASF-AD. In addition to the 153-foot length, beam is given as 36 feet. This dimension is likewise at variance with some sources which give beam as thirty-four to thirty-five feet. Another postwar Union survey of the Albemarle gives her dimensions as: extreme length 158 feet; extreme beam 35 ft., 3 in.; breadth of beam on deck 32 ft.; depth of hold from top of beam to top of floor 8 ft., 2 in.; loaded draft 9 feet. See Arnold et al to Brown, May 18, 1865, Records of the District of Columbia Courts. The altered drawing appears in Battle and Leaders, 4: 626.

¹⁶One extreme example of inaccurate calculations affecting draft is the Casco class Union monitors. These vessels were designed to draw only slightly more than six feet of water, but when the first of the class was launched - without turret, guns, and other fittings - she would barely float; see William E. Sloan, III, Benjamin Franklin Isherwood: Naval Engineer (Annapolis, Md.: United States Naval Institute, 1965), 68 -73.

¹⁷Howard and Ellis contract, dated October 17, 1861, is in Report of Evidence, 463-64. The best accounts of the Neuse are William N. Still, Jr., "The Career of the Confederate Ironclad Neuse," North Carolina Historical Review 43 (January 1966): 1-13; and Leslie S. Bright, William H. Rowland, and James C. Bardon, C.S.S. Neuse: A Question of Iron and Time (Raleigh, N.C.: North Carolina Division of Archives and History, 1981).

¹⁸Details of Neuse's salvage from Bright, C.S.S. Neuse, 19-28. The Neuse, along with many artifacts recovered with the hull, is on display at the Caswell - Neuse Historic Site in Kinston, N. C.

¹⁹Details of Neuse's construction from ibid., 29-35; and reconstruction drawings of the Neuse by W.E. Geoghegan.

²⁰The contemporary sketch is by Lt. R.H. Bacot, and appears in Bright, C.S.S. Neuse, 159.

²¹Photographs of salvage in ibid., 14. Quote concerning Neuse's draft is B.P. Loyall to R.D. Minor, April 16, 1864, Minor Family Papers, Virginia Historical Society, Richmond, Va., quoted in Bright, C.S.S. Neuse, 14.

²²On April 27, 1864, the Neuse steamed from Kinston to take part in an assault on New Bern, N.C. After proceeding for only about a mile and one-half, she ran aground and remained firmly fixed for nearly a month; Still, "Career of the Neuse," 10-11.

²³James W. Cooke to Stephen R. Mallory, May 8, 1864, ORN, 10: 627.

²⁴Mallory to Cooke, May 26, 1864, ibid., 659.

²⁵Builder's plans of the Fredericksburg are NPF #41-5-7; the gun deck plan is Drawing #492, Record Group 24, Records of the Bureau of Naval Personnel, National Archives, Washington, D.C. All dimensions of the Fredericksburg are taken from these plans.

²⁶The builder's drawings do not include body, midsection, or spar deck plans. W.E. Geoghegan reconstructed plans of the Fredericksburg in 1958 and estimated the inclination of the sides to also be thirty-six degrees. References to wooden spar deck and it ultimately being covered by iron are J.K. Mitchell to S.R. Mallory, October 22, 1864, ORN 10: 586; T.R. Rootes to J.K. Mitchell, October 22, 1864, ibid., 588-89; Mallory to Mitchell, September 28, 1864, ibid., 752; and Mitchell to Rootes, October 24, 1864, ibid., 798.

²⁷Fredericksburg was initially armed with a 7-inch Brooke rifle forward, a 10-inch Brooke smoothbore aft, and two 6.4-inch Brooke rifles in broadside. During the fall of 1864 the fore and aft guns were replaced with an 8-inch Brooke rifle and an 11-inch Brooke smoothbore, respectively; see J.K. Mitchell to S.R. Mallory, October 9, 1864, ORN, 10: 777. In consequence of the ordnance changes alone, weight increased by approximately four and one-half tons. Estimate of draft is based on the height of the knuckle above the bottom of the keel.

²⁸Missouri was built pursuant to a November 1, 1862, Navy Department contract with Thomas S. Moore and John Smoker, in Report of Evidence, 465-66. The Jackson was built by the Confederate navy at a yard established at Columbus, Ga.; Still, Iron Afloat, 91. Reference to a similar centerwheel ironclad at New Orleans is Navy Department contract with John Armstrong, New Orleans, April 10, 1862, for the construction of engines for a centerwheel gunboat, NASF-EE. Reference to proposed construction of centerwheel ironclad by ladies of Mississippi is W.P. Williamson and J.L. Porter to S.R. Mallory, October 20, 1862, in Ladies Defense Association Correspondence, Louisiana Room Papers, Carton V6-1-2, Eleanor S. Brockenbrough Library, Museum of the Confederacy, Richmond, Va.

²⁹Plan No. 240, Museum of the Confederacy, Richmond, Va. Because of the poor condition of these drawings, dimensions should be considered approximate only, particularly measurements of angles.

³⁰Details of the "City class" come from W.E. Geoghegan, "Study for a Scale Model of U.S.S. Carondelet," Nautical Research Journal 17 (1970): 147-63, 231-40; and Tom McGrath and Doug Ashley, U.S.S. Cairo: Historic Structure Report (Denver, Colo.: Department of the Interior, National Park Service, 1981): 30-40.

³¹Best accounts of the Missouri are William N. Still, Jr., "The Confederate Ironclad Missouri" Louisiana Studies 4 (Summer 1965): 101-110; and Katherine Brash Jeter, "Against all Odds: Lt. Jonathan H. Carter, CSN, and His Ironclad," Louisiana History 28 (Summer 1987): 263-88.

³²For survey see Edward P. Lull, Robert Tate, and Jno. Swaney to James P. Foster, June 14, 1865, ORN, 27: 241-42. All dimensions taken from this report unless

otherwise noted.

³³Ibid.; Still, "Confederate Ironclad Missouri," 110, fn. 10.

³⁴Lull, Tate, and Swaney to Foster, ORN, 27: 241-42.

³⁵The best account of the Jackson's construction is Maxine Turner, Navy Gray: The Story of the Confederate Navy on the Apalachicola and Chattahoochee Rivers (Tuscaloosa, Ala.: University of Alabama Press, 1988).

³⁶For alterations to Jackson, see Augustus McLaughlin to S.R. Mallory, February 26, 1864, Augustus McLaughlin Letterbook, Confederate Naval Museum, Columbus, Ga. The hull of the Jackson is on display at the Confederate Naval Museum, Columbus, Ga.

³⁷Details of Jackson's construction from "Field Notes on the Hull of the C.S.S. Jackson," unpublished manuscript containing measurements and drawings from an ongoing survey of the ironclad's remains, at Confederate Naval Museum, Columbus, Ga. Estimated draft based on the need to immerse completely the Jackson's two seven-foot diameter propellers.

³⁸One other external difference between the Jackson and Plan No. 240 is in the chine clamps (or stringers). The later shows a massive piece, about four feet by one foot, reinforcing the floor and futtock joint; the Jackson has only a single twelve-inch square stringer serving the same purpose.

³⁹Photograph of the Jackson in the W.W. Hunter Collection, Special Collections, Howard-Tilton Memorial Library, Tulane University, New Orleans, La. The original gun deck plan is in the James H. Warner Collection, Confederate Naval Museum. The Jackson's armament consisted of four pivot-mounted 7-inch rifles, and two 6.4-inch rifles in broadside, all double-banded Brookes.

⁴⁰Dimensions of the 202-foot ironclad from take-off plans by W.E. Geoghegan, 1962.

⁴¹For the effect of industrial and transportation problems on naval construction, see Charles B. Dew, Ironmaker to the Confederacy: Joseph R. Anderson and the Tredegar Iron Works (New Haven, Conn.: Yale University Press, 1966), 176-77, 248, 287.

⁴²The only diamond hull ironclad known to have carried more than four inches of armor was the Missouri, which was plated with four and one-half inches of inferior railroad "T" iron. References to diamond hull ironclads being weaker are Loyall to Minor, April 16, 1864, Minor Family Papers, quoted in Bright, C.S.S. Neuse, 14; and Scharf, History of the Confederate States Navy, 737.

⁴³The smaller dimensions of the diamond hulls also meant a decrease in storage and berthing spaces. Usually this was not a serious inconvenience since most of the vessels operated in inland areas, near supply bases and onshore housing.

⁴⁴Details of the Neuse's propulsion system from a reconstruction plan by W.E.

Geoghegan, 1966. The Albemarle's machinery was apparently set up in a similar fashion, see Elliott, "The Ram Albemarle," 317; and ORN, II, 1: 31. For advantages of independently operated screws, see Gordon Watts et al, CSS Chattahoochee: An Investigation of the Remains of a Confederate Gunboat (Greenville, N.C.: East Carolina University Program in Maritime History and Underwater Research, 1990), 42; and Edgar C. Smith, A Short History of Naval and Marine Engineering (Cambridge: University Press, 1937), 166.

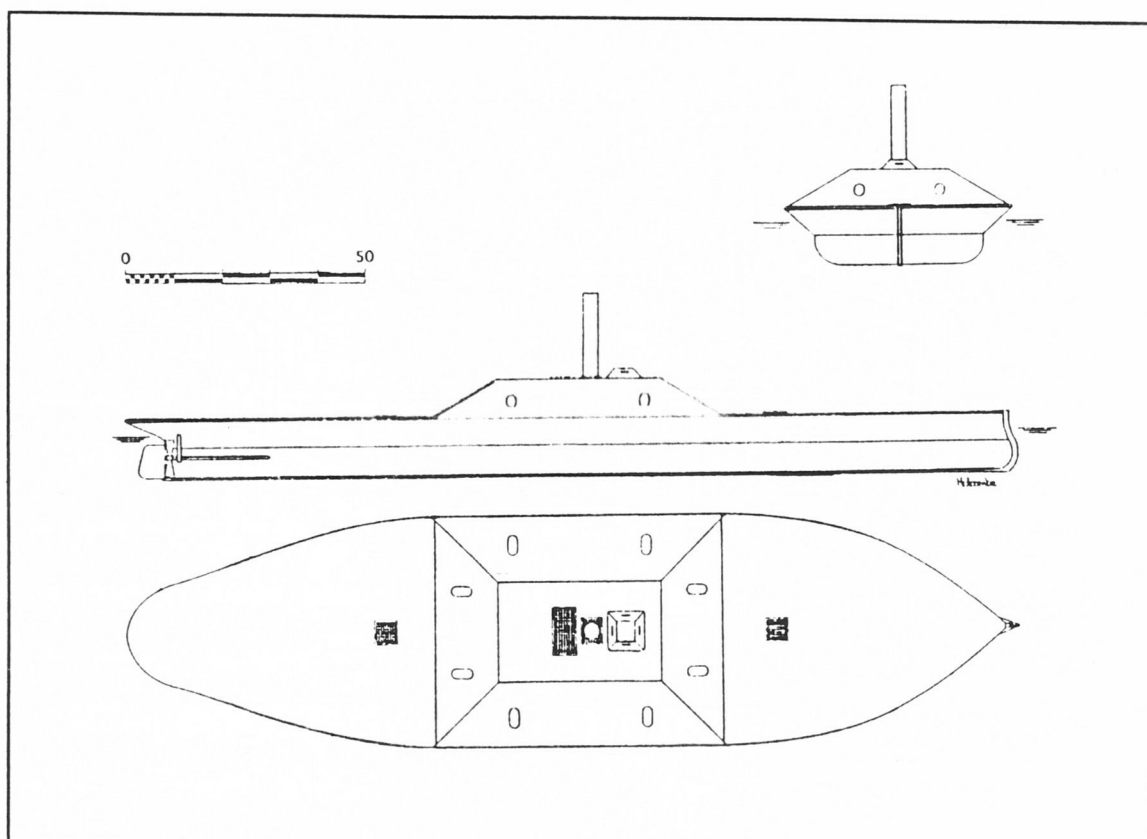
CHAPTER VI

LATE-WAR TRENDS

Experience gained from the construction and operations of ironclads during the first half of the war demonstrated a number of deficiencies in their designs. Chief among these were excessive draft, insufficient firepower, inadequate protection, lack of seaworthiness, inferior speed, and poor maneuverability. Consequently, a number of designs conceived during the final years of the war attempted to redress these shortcomings.

In order to develop the most appropriate plan possible Secretary Mallory detailed a board of six naval officers in early 1864 "to report upon the best form of construction, shield, battery, etc., for ironclads."¹ Apparently the board was also charged with examining vessels already under construction for on February 20 five members reported on the ironclad Texas, then being built at Rocketts. They suggested alterations in the construction of the vessel's hollow knuckle and in the lining of its "rafters," and that an additional layer of iron be placed on the underside of the knuckle. The following November the board (or perhaps a new board formed for the purpose) reported on another ironclad building in Richmond and made pertinent recommendations concerning its design. Only these few tantalizing details survive of the activities of the board (or boards), thus its potentially significant impact on late-war ironclad design remains a subject for conjecture.²

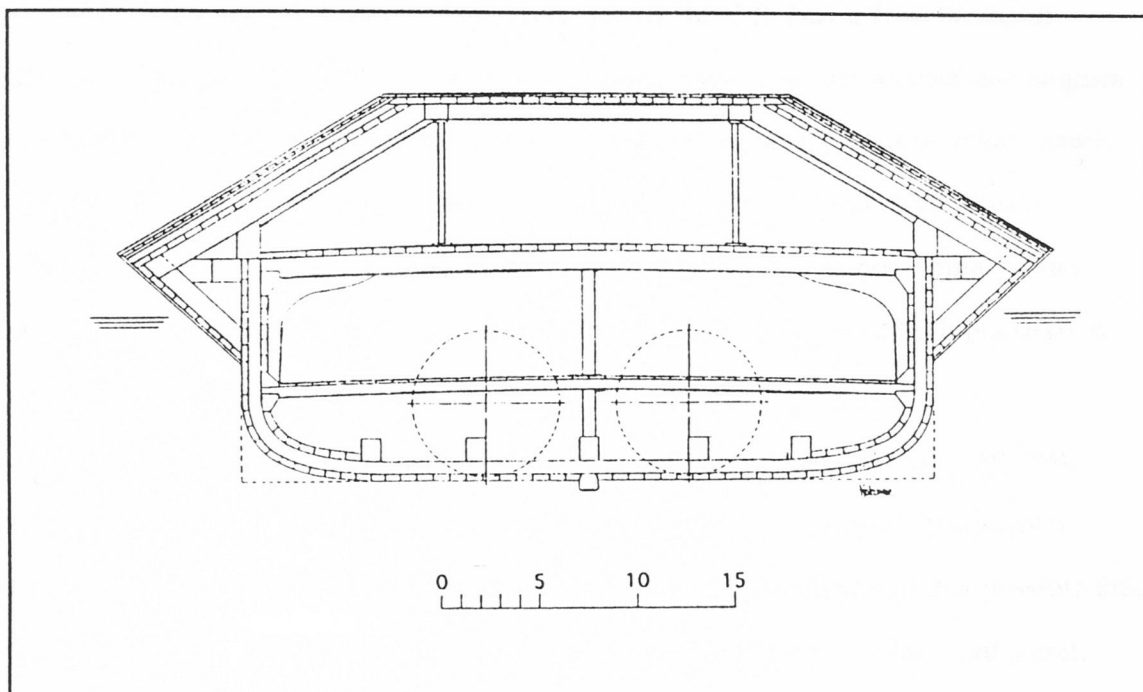
The Milledgeville was apparently the first ironclad that incorporated from the beginning improvements based on previous practice. The second of two ironclads contracted for with Savannah shipwright H.F. Willink on March 31, 1862, the Milledgeville's keel-laying was delayed until the following February because of the builder's difficulties in completing the first, the Savannah. Not until Willink turned the Savannah over to the navy in mid-1863 was he able to devote full attention to the second vessel. Finally launched in the early fall of 1864, the Milledgeville was destroyed before



Plan 41. *Milledgeville*, three-view.

completion when Savannah was evacuated the following December.³

About a year after being placed under construction, the *Milledgeville's* shield was modified at a cost of \$7500. Although the precise nature of these alterations cannot be determined, the amount charged by Willink suggests they were relatively minor. Extant plans of the *Milledgeville*, undated but bearing constructor Porter's signature, are believed to show her after modifications were applied. A twin-screw, standard hull ironclad is illustrated, with principal dimensions of 185 feet overall length, 175 feet between perpendiculars, 35 feet, 2 inches in moulded beam, and 48 feet, 6 inches in extreme beam. The body and section plans show a fairly conventional Porter-designed standard hull form, though the flat floors and soft bilge turns deviate from the constructor's earlier practice.



Plan 42. *Milledgeville*, mid-section.

Improvements in protection, seaworthiness, and draft are embodied in the design.

Protection was increased by inclining the sides and ends of the compact, sixty-two-foot long casemate at thirty-two and one-half degrees, and covering it with six inches of armor backed with twenty-four inches of wood. Seaworthiness was improved by incorporating into the design the revised knuckle form first used on the Columbia (Plans 41 & 42).⁴

The Milledgeville's most significant advance over the earlier standard hulls was a shallower draft. By decreasing the depth of hold to twelve feet, draft was reduced to nine feet, a considerable improvement over the twelve- to fourteen-foot drafts of the previous classes. The short casemate also contributed to the lighter draft by having its armored surface reduced, thus helping to control weight. Although the smaller structure resulted in a cramped gun deck within, increased space was gained on the exterior flush decks.⁵

The Milledgeville's power plant, furnished by the C.S. Naval Iron Works at Columbus, Georgia, should also have been an improvement over the secondhand engines used in earlier ironclads. After initially altering existing machinery for armorclad vessels, by 1864 the Naval Iron Works was manufacturing more powerful and more reliable engines specifically for use in those vessels. Naval Iron Works engines similar, if not identical, to the Milledgeville's were used in the Columbia and received high praise from Union Admiral John A. Dahlgren.⁶

The Milledgeville's rectangular casemate was efficiently designed to carry four guns, each mounted in a corner of the casemate and pivoted to fire from either of two gunports. No mention has been found of the type ordnance intended, but it is possible that at least some of the guns would have been large caliber smoothbores. The Confederate navy adopted the rifled cannon early in the war in an effort to outrange the predominantly smoothbore-armed U.S. Navy, as previously noted. But experience demonstrated that most of the sea battles being fought were at virtually point-blank range, negating the rifle's advantages in distance and accuracy. As a result, many naval officers believed that large caliber smoothbores, by battering, or "racking," had a better chance of smashing and ultimately penetrating armor at close range than did heavy wrought iron bolts fired by rifled cannon. Smoothbores were also considered more destructive against wooden ships than were rifles because of the greater explosive power of the shell. By the latter stages of the war some Confederate ironclads, like the Virginia II and Fredericksburg, were being armed with a combination of rifles and 10- or 11-inch smoothbores, all of the Brooke pattern, and it is likely that the Milledgeville would have been so equipped.⁷

An unusual and distinctive feature of the Milledgeville is the shape of her bow. The stem is nearly vertical, raking slightly aft from waterline to flush deck. At the waterline the stem curves outward for a distance of about three feet, then curves back to join the keel. In doing so, it forms nearly a half-circle, or parabola, in profile. While similar in shape to

the ram bows that characterize the steel battleships and armored cruisers of the turn of the century, the Milledgeville's prow seems to lack the requisite reinforcement necessary to function as a ram. In lieu of adequate documentation, however, its function (if any) is problematical.

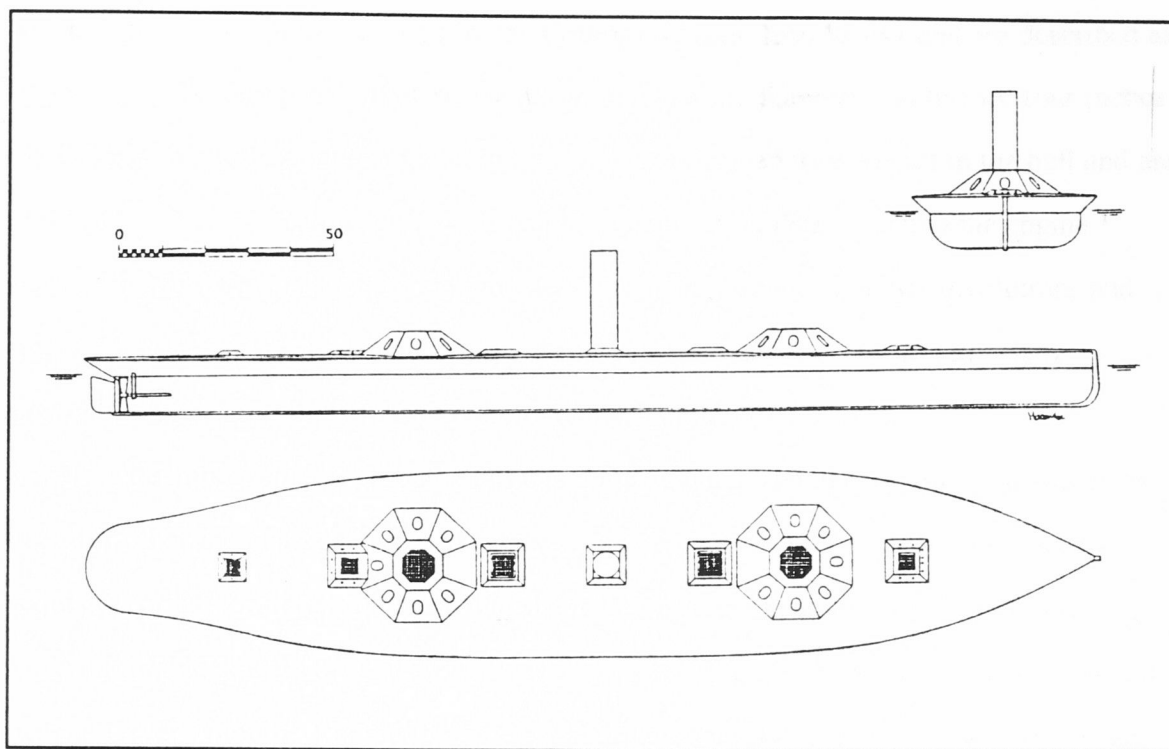
In late May of 1864 constructor Porter was ordered to Wilmington, North Carolina, "to build and equip an iron clad steamer in the shortest possible time."⁸ The completion of this vessel was considered important for two reasons: its pressing need to assist in the defense of Wilmington, the Confederacy's most important blockade running port; and the utter failure of the two previous ironclads constructed for the same purpose. The North Carolina, the first built, apparently suffered from the start with structural problems and underpowered machinery. Used as a floating battery in the Cape Fear River, she finally sank due to a worm-eaten bottom in September 1864. The second, the Raleigh, fared little better. Completed in the spring of 1864, she sortied from the Cape Fear on May 7 of that year and attacked the Federal blockading fleet offshore. Due to inadequate speed she failed to close with the enemy, but did succeed in driving off several of his ships with long-range cannon fire. As the Raleigh was returning to her anchorage after this inconclusive skirmish, she ran aground and broke her back, ultimately becoming a total loss. The dismal failure of the North Carolina and the Raleigh to aid materially in the defense of the South's most vital seaport doubtlessly caused Mallory considerable embarrassment and resulted in his precipitate order to Porter.⁹

Design of the replacement ironclad - popularly referred to as the Wilmington but apparently never officially named - seems to reflect lessons derived from the Raleigh's sally from the Cape Fear. The Raleigh's primary failings were insufficient speed, which prevented her from closing with the blockaders, and excessive draft, which restricted her movements in the treacherous waters around Cape Fear and ultimately caused her loss. Two original plans of the Wilmington indicate a potential improvement in the first

shortcoming and a definite improvement in the second. Porter's plans consist of an inboard profile, a combination half-breadth and deck plan, a midship section, and a body plan. These views depict an ironclad with unusually fine lines, indicative of an attempt to gain greater speed. With a length between perpendiculars of 224 feet, and a moulded beam of 34 feet, the Wilmington had the greatest length-to-beam ratio of any ironclad known to have been constructed in the Confederacy. Other pertinent dimensions include an overall length of about 233 feet, 4 inches, an extreme beam of 41 feet (not including armor), and a depth of hold of 12 feet. Her designed draft of nine and one-half feet bettered the Raleigh's by two and one-half feet. The body and midsection plans illustrate a rather conventional, Porter-designed standard hull form with a slight rise in the floors. Like the Milledgeville, however, the turn of the bilges is comparatively slack. The stem is vertical and lacks a ram, while a counter stern, similar to the Virginia's, protects the rudder and twin propellers (Plan 43).¹⁰

The Wilmington's most novel features are two short, octagonal, turret-like casemates. These structures, with twenty-four-inch thick walls angled at thirty-seven degrees, each measure only twenty-one feet, six inches in length (not including armor). Both are designed to hold one cannon of unknown caliber, pivot-mounted to fire from one of seven ports. The gun deck within each shield is countersunk below the level of the exterior deck, thus reducing the visible height of the structure and lowering the ship's overall profile. Additional features include a cambered flush deck and an improved Columbia-style knuckle.¹¹

The inclusion of twin shields in this design has usually been attributed to the need to conserve armor plate in an iron-starved country, but this may not be the principal reason the Wilmington was so configured. An officer assigned to the decrepit, rotting North Carolina wrote in the summer of 1864 that iron was to be taken from his vessel and placed on the new ironclad then building at Wilmington. Since the North Carolina was covered



Plan 43. *Wilmington*, three-view.

with far more iron than needed for the Wilmington, it is possible that the greatest concern in designing the latter ironclad was the need to conserve weight and preserve her intended light draft. The reported need of 150 tons of one-inch plate to complete the Wilmington adds credence to this hypothesis. If this iron was meant for the ship's sizeable flush deck as believed, the savings in weight over the more commonly used two-inch plate would be considerable. Although no mention has been discovered of the intended thickness of armor to be applied to the casemates, a minimum of six inches would be in keeping with practice elsewhere at this stage of the war. Regardless of the rationale for using the double casemate arrangement, the Wilmington presented a low, rakish appearance not achieved by any other Confederate ironclad save, perhaps, the Manassas.¹²

A second original drawing of the Wilmington shows only her engine arrangement.

These engines were manufactured by the Columbus Naval Iron Works and are described as high pressure types, with cylinders twenty-eight inches in diameter and twenty-four inches in stroke. According to the drawing, the cylinders are placed fore and aft in the hull and are geared to the two propeller shafts. Although more complex than attaching the engine connecting rod directly to the crank, the gearing system produced higher revolutions and potentially greater speed. Interestingly, the engines are connected by an idler shaft, preventing their independent use to improve maneuverability.¹³

The improvements embodied in this design suggest that the Wilmington was to be used for other than harbor defense purposes. The emphasis on speed - not necessarily a requisite for harbor defense - infers that she may well have been intended for hit-and-run raids on the blockaders off Cape Fear, or to protect defenseless blockade runners stranded near the river's mouth. Regrettably, the capabilities of the Wilmington were never tested, for she was destroyed on the stocks when her namesake city was evacuated in late February 1865.

On August 29, 1864, the Navy Department contracted with Peter E. Smith, W.H. Smith, and Gilbert Elliott for the construction of a second ironclad at Edwards Ferry, North Carolina. First intended to support the Albemarle in the defense of Albemarle Sound and the Roanoke River, the ironclad's construction became imperative with the destruction of her predecessor by Federal raiders the following October. Detailed specifications supplementing the contract give the unnamed vessel's dimensions as 170 feet between perpendiculars, 30 feet in moulded beam, and 9 feet in depth of hold. The design likely incorporated as many as possible of the improvements recommended in Commander Cooke's critique of the Albemarle's performance in combat the previous spring, although few specifics can be ascertained due to the lack of builder's drafts. The Edwards Ferry ironclad improved on the Albemarle's lack of firepower with an armament of four guns, but her nine-foot depth of hold infers that her draft would have been little, if any, better.

Similarly, her intended protection of four inches of iron backed with twenty-two inches of wood on a shield angled all around at thirty-five degrees was no significant advance. An allusion in the specifications to sponsons suggests that the Edwards Ferry vessel had built-on knuckles and was a standard hull ironclad. This same reference states that the sponsons were to be hollow, probably similar to the hollow knuckles found on the Columbia and other late war ironclads.¹⁴

Despite the acquisition of steam machinery and iron, construction of the vessel lagged. On April 7, 1865, while only seven-twelfths complete, the Edwards Ferry ironclad was burned to prevent capture.¹⁵

Concern over restricted maneuverability in narrow waterways resulted in one of the most peculiar ironclad designs of the Civil War. Conceived by constructor Graves, the craft was to be double-ended and capable of steaming in either direction without having to turn around. On each end were to be two propellers, a rudder, and a ram. Four engines, two to each set of propellers, were to furnish motive power. Machinery enough for two such vessels was ordered from Britain. On a hull stretching 220 feet in length, 27 feet in beam, and 11 feet, 6 inches in depth, was mounted a single, short casemate containing one gun. It is not evident from the available information whether the size of the casemate was limited by a shortage of iron, by constraints imposed on the design by the unorthodox propulsion system, or for other reasons. The lack of builder's drawings and other data, including references to armor and ordnance, prevent a more detailed description of Graves' "double ram."¹⁶

At least two examples of the class were contemplated. One was started by early November 1864 at Graves' yard in Richmond but was not completed before the evacuation of the city. A second was recommended for construction at Charleston, but there is no evidence it was commenced before the city's fall.¹⁷

Concerns similar to those that led to the construction of Graves' double ram were

responsible for yet another unusual late-war design. In early 1865 a serious attempt was made to construct a Confederate ironclad with a rotating gun turret. Although the use of turreted ironclads (or monitors) during the Civil War is exclusively associated with the United States Navy, there were several proposals to build similar vessels in the Confederacy. The earliest known occurred in New Orleans where an unknown citizen of the Crescent City designed and built a model of a double-turreted ironclad which he presented to Capt. Lawrence Rousseau, C.S.N., for his consideration. Rousseau, in turn, referred the matter to Lieut. Joseph Fry, who recognized its advantages and recommended its construction. Rousseau then ordered Fry to build five or six of the vessels, pending approval from Mallory. The plan was apparently not approved and none were constructed. As late as 1875 the original model of this vessel was still in New Orleans, but its current whereabouts is unknown.¹⁸

Yet another proposal for turreted ironclads was submitted to Lieut. R.D. Minor of the navy's ordnance bureau. A plan dated April 25, 1863, depicts several vessels carrying from six to sixty guns in turrets up to one hundred feet in diameter. These fantastic contrivances were apparently conceived by an individual with absolutely no understanding of the realities of Confederate industrial capabilities. Men struggling even to supply the navy's ordnance needs, as Minor and his associates were, probably paid scant attention to this wild scheme and quickly filed it away.¹⁹

In 1865, Chief Engineer James H. Warner, commander of the Naval Iron Works in Columbus, Georgia, made the final and most earnest effort at producing a monitor class warship in the Confederacy. Concerned by the rapidly deteriorating military situation in the South, Warner wrote navy chief Mallory on February 3, 1865. In this letter Warner proposed the construction of a type of vessel that he believed to be better suited to the defense of the shallow inlets and rivers to which the country was then restricted, and which

could be built with the limited supply of iron available:²⁰

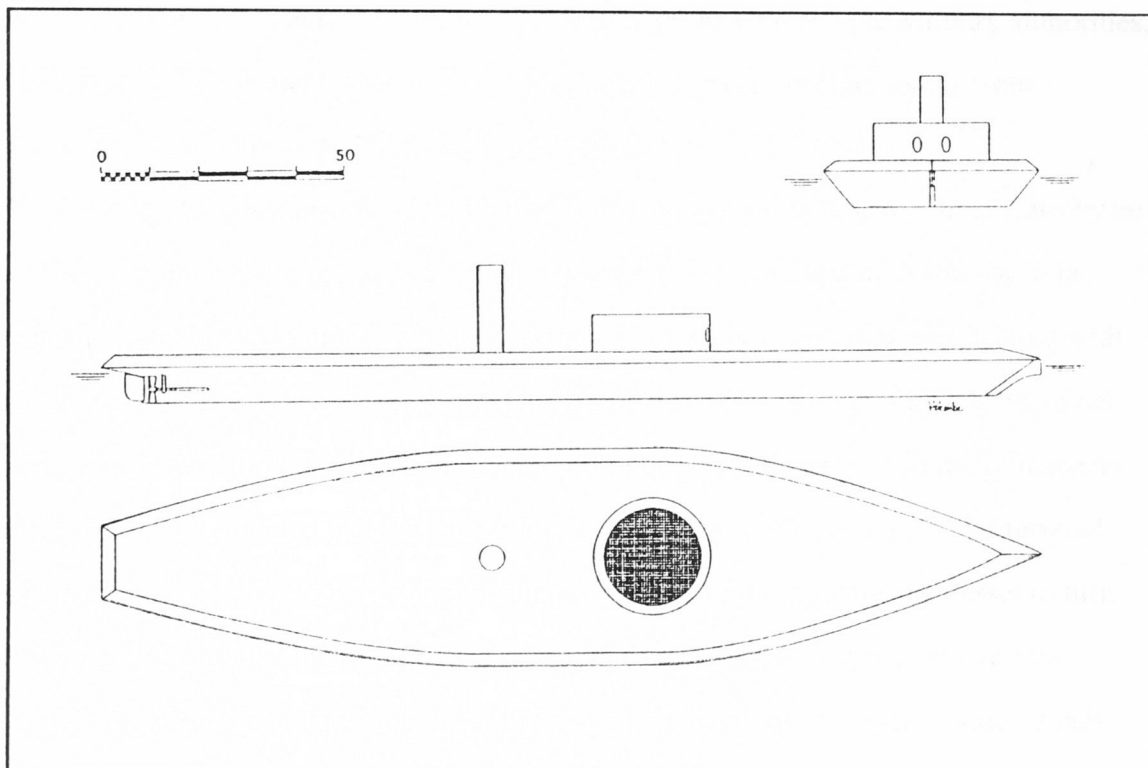
I am satisfied [he wrote] . . . that for harbor and river defense very light draft vessels furnished with a revolving Cupola containing heavy guns and having a range nearly 360 [degrees] arc are the most efficient. These vessels are superior for defensive operations, although when attacking heavy fortifications [and] subjected to plunging fire they may not be so effective[,] but for our purposes I consider them superior.

They require less iron, are far more invulnerable, carry heavier metal and can seldom be placed in a position where their guns cannot be used effectively.²¹

Warner further maintained that a turreted ironclad could be built with the same expenditure of materials used to construct a casemated ironclad. The iron, he promised, could be secured from the large amount of railroad iron rendered unfit for its intended purpose by Union raiders.²²

Warner provided the secretary with a detailed description of the ironclad and its workings. The proposed vessel would be 175 feet long between perpendiculars, 45 feet in beam, 9 feet in depth, with a 6-foot maximum draft. It was to be powered by twin screws, each independently operated. The turret, or revolving tower as Warner called it, was to be twenty or twenty-one feet in diameter on the inside, extend eight feet above the spar deck, and carry two 11-inch Brooke smoothbore cannon. The guns would be run in and out by machinery. The turret could be rotated either by steam or by hand power, "four or five men being sufficient ." Its structure was to be of composite construction, with fourteen inches of wood backing eleven and one-half to twelve inches of iron. A strong grating would cover the turret's roof.²³

For the ship's hull Warner wanted to apply the design used by the ironclad Jackson. "The method of construction adopted in the Jackson . . . ," he submitted, "although not in accordance with the best practice of naval architecture is nevertheless a very strong form, and well adapted for this purpose. The advantages of using straight timbers would contribute to a speedy completion, for that reason I would prefer it." The



Plan 44. James H. Warner's Turreted Ironclad.

Jackson, then nearing completion at the adjacent navy yard, was one of about ten Confederate ironclads built with an angular, diamond-type hull configuration.²⁴

With his letter Warner included several drawings: a midship section with three different knuckle configurations, and three sketches of different methods of forming the turret. These plans unfortunately have not been found (if, indeed, they still exist), but a reasonably accurate representation of the vessel can be reconstructed from the surviving specifications in the engineer's correspondence (Plan 44).

Warner wished to build the monitor in Columbus. The Naval Iron Works possessed the capabilities of producing all of the vessel's component parts except its guns, and those could be obtained relatively close by at the naval ordnance works in Selma, Alabama. If given permission to construct the ship, Warner promised the department that

"provided we are not interfered with by the Yankees or the Confederate Military authorities, I will complete the vessel . . . by the next fall rise of the river - or ten months from commencement of the work."²⁵

Just prior to writing Mallory, Warner communicated with fellow officer Catesby ap R. Jones, commander of the Selma ordnance works. Jones, as captain of the Virginia when she fought the Monitor two years previous, had practical experience in dealing with that type of warship, and Warner wanted his friend's opinion of the design. "The vessel you propose to build," Jones replied, "would be a very formidable one, in many respects more so than any ironclad that we have built."²⁶ Furthermore, he reasoned that turreted ironclads could be used to particular advantage in rivers too narrow for the vessel to turn. He warned Warner that the first Federal monitors were subject to having their turrets jammed and presumed that the engineer had remedied that deficiency. In closing, Jones hoped that permission would be given to construct the vessel.²⁷

Evidently the Navy Department approved construction of the ironclad, but Warner apparently never received notification of the fact. Gen. William T. Sherman's depredations in Georgia and South Carolina disrupted communications between Columbus and Richmond, and made it impossible for Warner to obtain the go-ahead he desired. On April 16, 1865, Gen. James H. Wilson's Union cavalry force effectively ended Warner's attempt to construct a turreted warship when it captured Columbus and systematically demolished all of the city's manufacturing establishments, including the Naval Iron Works.²⁸

The ironclad designs developed during the last half of the war responded to the shortcomings of the previous models in a variety of ways and with mixed results. The most serious of the demonstrated deficiencies - especially with the standard hull types - was excessive draft. As a result, each of the five ironclads examined in this chapter incorporated a shallow draft ranging from six to nine and one-half feet. The need to increase protection caused at least two of the five, the Milledgeville and Warner's turreted

model, to be designed to carry from six to twelve inches of armor. The unusually short casemates carried by the majority of the five probably reflected an effort to minimize (if not reduce) weight gains caused by the application of thicker armor so that the intended light drafts could be maintained. Only the Edwards Ferry ironclad, designed for service in the shallow North Carolina sounds, is known to have retained the earlier standard of four-inch plating.

Graves' and Warner's ironclads each approached the problems inherent in operating in confined waters in a novel manner. Graves designed his vessel to move in either direction without the need to turn around; Warner equipped his with independently operating screws to increase maneuverability, and a rotating gun turret that allowed its guns to fire in nearly any direction.

In a fundamentally unstable design that combined a low freeboard with a high center of gravity, seaworthiness was of paramount concern even in sheltered waters. The Milledgeville and Wilmington attempted to deal with at least a portion of this problem by incorporating a new knuckle design first applied to the Columbia that should have resulted in drier flush decks.

Speed was never a pressing requirement for harbor defense, thus few Confederate ironclad designs emphasized that quality. Apparently responding to specialized local requirements, the Wilmington broke with the norm. Her fine lines and purpose-built geared engines suggest a high priority on speed. Had she been completed, she probably would have been among the fastest ironclads built, North or South. The purpose-built machinery used in many of the late war ironclads, including the Wilmington and the Milledgeville, should have resulted in greater reliability, if not speed, in comparison to the earlier vessels, which relied upon inferior, secondhand engines.

In order for these ironclads to achieve their sought-for improvements, sacrifices were made in other areas. To maintain a shallow draft yet carry extra armor, weight had to

be controlled. Graves, Porter, and Warner accomplished this by reducing casemate lengths or, in Warner's case, by substituting a small but heavily plated turret. The drawbacks were reduced firepower and cramped gun decks. The latter shortcoming was especially pronounced in the small one-gun shields of the Wilmington and Graves' double ram. These small citadels probably contained barely enough room to work the guns.

Since none of the five ironclads became operational, performance evaluations cannot be made. Nevertheless, some assumptions can be deduced from information available on their known characteristics. The double ram represents a singular approach to its operational requirements. The quadruple machinery system, with screws on both ends, probably would have been complex, inefficient, and subject to damage if the ship was used as a ram as intended. Furthermore, with only one gun, the vessel would have been woefully lacking in firepower. Any gain in maneuverability would not have warranted the sacrifice made in ordnance.

By late 1864 the Confederate navy certainly had the manufacturing capabilities to produce a turreted ironclad. It is questionable, however, if the type offered any significant advantages over the more conventional casemated ironclad. The monitors' ordnance arrangement was more flexible, and the design was capable of carrying heavier armor, but these qualities were offset by a complex turret-rotating mechanism subject to breakdowns, and an unusually slow rate of fire. And despite Warner's promise otherwise, it is doubtful whether a turreted ironclad could have been produced any quicker than a casemated ship.

The Wilmington represents a novel approach to apparently local requirements that required a sacrifice in firepower in order to gain speed and light draft. If designed, as believed, for occasional forays outside the Cape Fear River, she should have given good service.

The Edwards Ferry ironclad apparently incorporated improvements based on the Albemarle's combat experiences. With draft the critical factor for operating in the North

Carolina sounds, this vessel approximately maintained the Albemarle's draft (at least on paper) and four-inch armor, while boosting her armament to four guns. This increase in firepower answered Cooke's chief complaint regarding his command and should have made her successor a superior warship.

Porter's design for the Milledgeville combines light draft with improved seaworthiness, increased armor protection, and a flexible battery of four pivot guns. Furthermore, the use of specially-built machinery should have enhanced the vessel's speed and reliability. Based on surviving data, the Milledgeville seems to have been the best balanced of the five late-war ironclad designs.

ENDNOTES

¹J.T. Wood to C. ap R. Jones, February 26, 1864, ORN, 9: 801. The six officers were Capt. J.R. Mitchell, Cmdr. J.M. Brooke, Chief Constructor J.L. Porter, Engineer-in-Chief W.P. Williamson, Cmdr. R.B. Pegram, and Cmdr. J.T. Wood.

²John M. Brooke's Richmond Journal, entry of February 20, 1864, in John M. Brooke Papers, Private Collection of George M. Brooke, Jr., Lexington, Virginia. J.M. Brooke, W.P. Williamson, and W.A. Graves to S.R. Mallory, November 7, 1864, "Miscellaneous Letters Sent," Office of Ordnance and Hydrography, Record Group 109, National Archives, Washington, D.C.

³Milledgeville's contract is in Report of Evidence, 451. The Savannah was launched February 4, 1863; on February 27, Willink received his first payment for the construction of the Milledgeville, signifying that her keel, stem, and sternpost were laid. Savannah's launch date is in William L Graves, A Confederate Marine: A Sketch of Henry Lea Graves with Excerpts from the Graves Family Correspondence, 1861-1865, edited by Richard Harwell (Tuscaloosa, Ala.: Confederate Publishing Co., 1963), 98. Payment vouchers to Willink for construction of the Milledgeville are in NASF-AC. Milledgeville's approximate launch date is indicated in James H. Warner to Catesby ap R. Jones, December 15, 1864, Area 6 File; and Josiah Tattnall to W.W. Hunter, October 19, 1864, W.W. Hunter Papers, Perkins Library, Duke University, Durham, N.C.

⁴Milledgeville plans are in Willink Collection. Payment voucher to Willink for alterations to Milledgeville, February 29, 1864, NASF-AC. The original contract price for the Milledgeville was \$140,000.

⁵Milledgeville plans, Willink Collection.

⁶References to Naval Iron Works furnishing Milledgeville's machinery include Warner to Jones, December 15, 1864, Area 6 File; and Porter to Mallory, November 1, 1864, ORN, II, 2: 752. The Naval Iron Works initially manufactured several sets of engines and boilers specifically for use in wooden gunboats, but the first power plants for ironclads were refurbished secondhand units. For a detailed study of the Naval Iron Works' efforts to produce steam machinery for Confederate warships, see Turner, Navy Gray.

⁷Thomas B. Dickey, "The Armor Punchers," Civil War Times Illustrated 28 (August 1979): 24-25, 29-31. John Taylor Wood to Catesby ap R. Jones, March 24, 1863, ORN, 7: 862-63. Catesby ap R. Jones to George W. Gift, February 25, 1864, NASF-PI.

⁸S.R. Mallory to J.L. Porter, May 23, 1864, Area 8 File.

⁹Few details exist on the construction and operations of the North Carolina and Raleigh. The best accounts are in Still, Iron Afloat. The extremely brief official report on the loss of the Raleigh in the Cape Fear River is George N. Hollins to J.W.B. Greenhow, June 6, 1864, ORN, 10: 24-25.

¹⁰Builder's drafts are NPF #41-5-11; second drawing is "Engine No. 15," Warner Collection, Confederate Naval Museum.

¹¹Height of twin casemates above exterior deck is about five feet, nine inches; measurement taken from NPF #41-5-11.

¹²Reference to armor taken from North Carolina intended for Wilmington, Charles Smith Peek to "Brother," July 8, 1864, Charles Smith Peek Papers, private collection of Charles V. Peery, Charleston, S.C.; Porter to Mallory, November 1, 1864, ORN, II, 2: 752.

¹³"Engine No. 15," Warner Collection, Confederate Naval Museum; James H. Warner to J.H. Alexander, June 17, 1865, Captured and Abandoned Property, Case File #825, Record Group 56, National Archives, Washington, D.C.

¹⁴Contract with annexed specifications bearing John L. Porter's signature in NASF-AD; J.W. Cooke to S.R. Mallory, May 8, 1864, ORN, II, 2: 627. Plating elsewhere on the vessel included two inches on the underside of the knuckle, one inch on the exposed decks, and four inches on the pilot house. Sponson, in the naval terminology of the period, meant a projection from a vessel's side. Confederate naval personnel used the terms sponson and knuckle interchangeably; see W.A. McEwen and A.H. Lewis, Encyclopedia of Nautical Knowledge (Cambridge, Md.: Cornell Maritime Press, 1953), 524.

¹⁵Statement of William Waggner, Acting Naval Constructor, April 8, 1865, NASF-AD.

¹⁶Descriptions of vessel, along with machinery order, include: S.R. Mallory to James D. Bulloch, September 5, 1864, ORN, II, 2: 718-19; and Porter to Mallory, November 1, 1864, ibid., 751. The only contemporary plans found of any part of this vessel are two drawings of her boilers in the Hart Nautical Museum, Massachusetts Institute of Technology, Cambridge, Mass. These plans refer to the vessel as "Graves Double-Ram." The boilers were apparently being built by the C.S. Naval Works, Richmond, Va.

¹⁷Brooke, Williamson, and Graves to Mallory, November 7, 1864, "Miscellaneous Letters Sent," Record Group 109. This report indicates that an unusual submerged sliding torpedo arrangement was proposed for this class of ironclads but was rejected because of its complexity and shortages of materials and labor.

¹⁸Jeanie Mort Walker, Life of Capt. Joseph Fry (Hartford, Conn., J.B. Burr Publishing Co., 1875), 138.

¹⁹Drawing dated April 25, 1863, Minor Family Papers.

²⁰J.H. Warner to S.R. Mallory, February 3, 1865, NASF-AD.

²¹Ibid.

²²Ibid.

²³Ibid.

²⁴Ibid.

²⁵Ibid. Although the Naval Iron Works did not have the ability to roll armor of the thickness need at the time Warner wrote, a rolling mill of sufficient capacity to produce such iron was nearing completion. Warner apparently was in anticipation of that fact.

²⁶ J.H. Warner to C. ap R. Jones, January 28, 1865, Area 6 File.

²⁷ Jones to Warner, February 2, 1865, Ibid.

²⁸ Still, Iron Afloat, 99; S.R. Mallory to A.G. Brown, February 18, 1865, NASF-VN, cited in Baxter, Introduction of the Ironclad, 310-11.

CHAPTER VII

SUMMARY AND CONCLUSIONS

Mallory's June 1861 decision to construct an ironclad warship in the Confederacy launched a war-long effort by the Confederate navy to produce efficient armored vessels that would satisfy the country's strategical needs and conform to its industrial capabilities. Initially, existing ships were hurriedly converted to ironclads in order to counter a numerically superior but technologically inferior United States Navy, while those built from the keel up were planned in accordance with an ill-defined offensive strategy that emphasized ocean-going qualities and a desire to break the Federal blockade of Southern ports. Consequently, these vessels were often large, heavily armed, and deeply laden, and therefore totally unsuited for operations in the South's shallow, coastal waters. The converted Virginia characterized these early-war endeavors in many respects, though her armored casemate form, rifled cannon, and bow-mounted ram became standards for most of the ironclads built thereafter.

In the spring of 1862 a more realistic naval policy was adopted. This strategy shifted the navy's responsibilities from the offensive to the defensive, and charged it with guarding important harbors and coastal areas against Federal inroads. Two standardized classes of home-built ironclads were adopted to meet the new defensive requirements. Both types were smaller, more maneuverable, less heavily armed, and usually drew less water than their predecessors. Their designs were established on the limited capabilities of Southern labor and industry, and were generally well-suited for the restricted waters on which they were intended to operate. Large seagoing ironclads, already under construction in Europe, would cross the Atlantic when completed and break the Union stranglehold on the Confederacy.

Based on an 1840s plan by John L. Porter and typified by the Richmond, the first standardized design adopted was equipped with a conventional hull form requiring experienced shipwrights in its construction. Called standard hull types, vessels built in conformance to this plan were of moderate draft (about thirteen feet), and were intended for construction and operations in coastal areas. The second design, characterized by the Albemarle, is usually referred to as the diamond hull type because of its characteristic flat bottom and angular hull shape. Of shoal draft (less than ten feet) and simplified form, these ironclads were meant to be built on shallow, inland waterways where experienced labor was limited.

As the war progressed, influences came to bear that caused changes in these two basic designs. These influences were generated largely by operational and combat experience, and to a limited extent by industrial deficiencies. Operational use of the first generation standardized ironclads (Richmond and Albemarle classes) demonstrated several inadequacies: inferior speed; poor seakeeping qualities; virtually unbearable living conditions; and insufficient room on the exposed flush decks for ground tackle and other necessary equipment.

Powered initially by secondhand machinery designed for smaller and lighter vessels, perhaps no characteristic of Confederate ironclads was more vilified than their universal lack of speed and power plant reliability. This was not strictly a Southern problem. Even the industrially superior North was initially incapable of producing adequate power plants for its heavy monitors, as few of the early turreted classes reached their intended service speeds.¹ Despite its obvious requirement for closing with the enemy and when attempting to ram, John L. Porter and many others, North and South, believed that speed was unnecessary for harbor defense and coastal operations. Nevertheless, efforts were made to improve both the power and dependability of steam engines used in Southern ironclads. By 1864, reliable, purpose-built machinery was being manufactured

for these warships. The impressive performance of engines produced by the Columbus Naval Iron Works for the Columbia, for example, provoked a rare compliment from one high-ranking Union naval officer.

The characteristic combination of a low freeboard and a high center of gravity in the casemated design resulted in vessels with marginal stability, even in sheltered waters. In an effort to improve seaworthiness, a refined knuckle form was developed and applied to the Columbia and other late-war vessels. None of the vessels so equipped reached an operational status, so the success of the design cannot be determined. The installation of hollow knuckles in several of these same ironclads may have resulted from a desire to improve stability by increasing buoyancy. The primary intention of this feature, however, must remain an intriguing mystery in lieu of adequate documentation.

Life on board Confederate ironclads was miserable at best. Poor ventilation, excessive heat and cold, and constant dampness were inherent characteristics of the low freeboard, casemated design. Cowl ventilators and wind sails served as passive air circulators, but did little good. At least one ironclad was equipped with mechanically powered ventilation blowers, but most were not, and the only alternative was for crews to live ashore or on tenders, especially during the hot, summer months. All iron plated ships of the period suffered accordingly and little could be done; indeed, the habitability aboard metal warships was not markedly improved until after the Civil War.²

The need for more deck space was alleviated in many of the following classes by an extension in hull length combined with a reduction in casemate length. While these changes were not accomplished solely to rectify the need for larger flush decks (the major cause was a desire to improve combat efficiency), the extra space was a secondary but welcomed result.

Combat experience identified several deficiencies in the early designs. Prominent among these flaws were inadequate protection, insufficient firepower, and excessive draft.

If the Virginia's combat at Hampton Roads vindicated the basic casemate configuration, then the Atlanta's battle with two monitors near Savannah fifteen months later revealed a serious flaw in the structure's ability to resist blows from the enemy's big 15-inch smoothbores. Alterations were instituted almost immediately in the Tennessee to enable her to carry more armor, and other ironclads already under construction, or about to be built, were similarly modified. Without exception the primary modification consisted of shortening the casemate. By so doing an extra thickness of iron plate could be carried without significantly increasing weight, and the vessel's designed draft could be approximately maintained. Contrary to many recent studies of Confederate naval construction, which insist the primary reason for shortening the casemates of late-war ironclads was due to a shortage of iron for armor plate, calculations clearly show that nearly the same amount of iron was used on the smaller casemates when an extra course of armor was added. Although at least one ironclad probably had her casemate shortened because of a deficiency of iron, the majority seem to have reduced casemate length in order to carry extra protection yet maintain their designed drafts. Extra space on expanded flush decks was an added benefit.

The Confederate navy early adopted the rifled cannon to help offset the Federal navy's numerical superiority. This decision resulted in the development of the excellent Brooke rifle used in various calibers on many Southern ironclads. Battle experience established that, despite the use of fore and aft pivot guns to provide a more flexible armament, the rate fire of the four-gun Richmond class and two-gun Albemarle class was inadequate. Consequently, the second generation standardized classes (Tennessee and Fredericksburg) had lengthened casemates and hulls to accommodate two additional broadside guns. The shorter but heavier clad late-war shields sacrificed firepower for protection, thus reversed the trend towards longer casemates and more guns. Most contained only two to four cannon that were usually pivot-mounted in order to maintain as

much flexibility as possible in their use. Combat also demonstrated that battles were rarely fought at the long ranges most advantageous to the rifle's range, accuracy, and penetrating power. This revelation, combined with a belief among some officers that smoothbore cannon were more destructive than rifled cannon when used against wooden ships, resulted in several late-war ironclads being equipped with large-caliber smoothbores of the Brooke banded pattern in combination with rifles. Beginning in mid-1863 with the Atlanta, many ironclads were equipped with spar torpedoes as an added offensive threat. Although the slow speeds of most ironclads prevented the spar torpedo from being an effective weapon, the device was much feared by the Federals and served usefully as a psychological threat.

The shallow tributaries and harbors in which the home-water Confederate navy operated and fought were a continuous source of concern for the commanders of its vessels. Two ironclads were lost as a direct result of grounding: the Atlanta was captured when she ran aground in close proximity to the enemy, and the Raleigh became a total loss when she broke her back after grounding in the Cape Fear River. Constant efforts were made to control or reduce draft, yet maintain adequate strength and firepower. This was a precarious balancing act at best, but the first standard hull and diamond hull ironclads reduced draft to about thirteen and eight feet respectively, while carrying four inches of armor and two to six cannon. Several late-war standard hull ironclads, particularly the Milledgeville, reduced draft to approximately nine feet, and carried an additional two inches of armor but could mount only two to four guns.

Industrial inadequacies, particularly materials and labor, had less effect on Confederate ironclad design than is generally thought. The decision to adopt the simplified casemate form in 1861 addressed the country's shortfalls in raw materials, manufacturing capabilities, and skilled labor. Once the fundamental model was chosen and these issues dealt with, strategic changes and operational and combat experience were the primary influences on the evolutionary modifications applied to ironclad design. One possible

exception is the Texas, whose cramped casemate and detached pilot hatches suggest that a shortage of armor plate had the greatest impact on her alterations.

Whatever the influences, a close examination of original builder's plans and specifications, along with other pertinent documents relating to Confederate ironclad design and construction, establishes conclusively that the Navy Department made conscious efforts throughout the war to improve the basic ironclad model established by the Virginia. Furthermore, these same sources indicate that those ironclads commenced late in the war were far superior to those built earlier because of these efforts.

ENDNOTES

¹For designed speed versus service speed of U.S. monitors, see United States Navy Department, Monitors of the U.S. Navy: 1861-1937 (Washington, D.C.: Government Printing Office, 1969).

²The best contemporary source on life aboard a Confederate ironclad is the journal of Dabney Scales, Southern Historical Collection, University of North Carolina, Chapel Hill, N.C. Scales was a young midshipman on the Atlanta and extremely critical of conditions on that vessel. A perspective from the enlisted ranks is contained in the diary of Robert Watson, Cornell University Library, Ithaca, N.Y. Watson was a seaman on the ironclad Savannah.

Sources on living conditions on warships of other nations include Andrew Lambert, Warrior: The World's First Ironclad (Annapolis, Md.: Naval Institute Press, 1987); William F. Keeler, Aboard the U.S.S. Monitor, 1862, ed. Robert W. Daly (Annapolis, Md.: Naval Institute Press, 1964); and Alvah F. Hunter, A Year on a Monitor and the Destruction of Fort Sumter, ed. Craig L. Symonds (Columbia, S.C.: University of South Carolina Press: 1987). The British Warrior, probably the most modern warship in the world at the time of the Civil War, devoted little in the way of technology to improving living conditions aboard ship. According to Lambert, "Warrior demonstrated the potential improvements in the seaman's environment that could be achieved, but did not make the greatest use of them. She was the inspiration, not the realisation." See Lambert, Warrior, 170. Conditions on board the U.S.S. Monitor in the summer of 1862 were described as intolerable by her commander, William N. Jeffers. Temperatures were as high as 164 degrees in the galley, 128 degrees in the engine room, and 120 degrees on the berth deck, with hatches open and ventilator blowers running. See Keeler, Monitor, 137.

GLOSSARY OF IRONCLAD TERMS

Berth deck: deck below the gun deck and the flush decks containing crews' quarters. Separated by engine and boiler rooms, the forward berth deck was usually reserved for enlisted personnel, the aft for wardroom and officers' quarters

Casemate (citadel, shield): an armor-plated enclosure, commonly sloped on sides and ends, containing guns which fire through ports.

Citadel: see casemate.

Depth of Hold: on virtually all purpose-built Confederate ironclads, a vertical measurement made from the top of the gun deck beam at the side of the hull to the lower edge of the keel rabbet, taken at the midship section. On ironclads with no keel, the bottom of the floor planks is used as the lower point of reference.

Eaves: see knuckle.

Flush decks: low, exposed decks fore and aft of the casemate, usually extensions of the gun deck within the casemate.

Gun deck: deck within the casemate on which guns are mounted, often on same level with the exposed fore and aft flush decks.

Knuckle (eaves, sponson): (1) angle formed by junction of casemate sides and built-on protrusion from the hull of standard hull and similar ironclads; (2) angle formed by junction of casemate sides and flaring hull of diamond hull ironclads.

Length between perpendiculars: on standard hull ironclads and most others, a measurement of length taken between the aft side of the stem post at the level of the flush deck (fore perpendicular) and the fore side of the stern post at the level of the flush deck (aft perpendicular). On diamond hull ironclads, because of the usual raking stem, the measurement in most instances is taken from the forward edge of the fore flush deck (usually underneath armor) to the fore side of stern post at the level of the flush deck. A notable exception is the centerwheel ironclad plan where the measurement is taken between the intersection of the knuckle and aft side of the stem post and the extreme aft end of the hull.

Moulded beam: on standard hull designs and others with built-on knuckles, the width of the hull at its widest point measured across the futtocks, not including hull planking or knuckles. On diamond hull ironclads and others without built-on knuckles, measurement is across the junction of hull and casemate frames, usually not including planking or armor plate.

Moulded dimensions: see depth of hold, length between perpendiculars, and moulded beam.

Pilot's hatch: positioned on the spar deck, an open hatch with nine-inch high sloped combings within which the pilot, mounted on a ladder with the ship's wheel on the gun deck below, peers from and conns the vessel. Common to several early ironclads, including the Savannah.

Pilot house: A small, truncated pyramid standing about three feet high on the spar deck, equipped with viewing slits or ports through which the pilot standing inside guides the ship. Although most often used singularly, some ironclads, like the Fredericksburg, had one mounted on each end of the spar deck.

Ram: a protrusion on the forward end of a vessel used for piercing the side of an enemy ship. On early ironclads the ram was usually formed by a heavy, pointed iron piece bolted to the stem. On many standard hull ironclads, particularly those designed by John L. Porter, the ram was formed by a forward extension of the knuckle, thus was an integral part of the ship's structure and not likely to be broken off. Rams on diamond hull ironclads were formed by a wooden extension of the stem covered with one or more layers of iron plate.

Shield: see casemate.

Spar deck (casemate deck, shield deck): the exposed weather deck forming the top of the casemate, usually equipped with hatches to the gun deck below, and through which the smoke pipe and other appurtenances pass or are attached.

Sponson: see knuckle.

APPENDIX

CONFEDERATE IRONCLAD CLASSES

Note: Length given is between perpendiculars unless otherwise noted.

I - Nonstandard Types

Conversions

Manassas (ex-Enoch Train) (143')

Virginia I (ex-U.S.S. Merrimack) (c. 280'9" loa)

Eastport (230') - captured before completion.

Baltic (182')

Mobile (164') - not completed.

John W. Crary's ironclad proposal - not built.

Individual Types

John M. Brooke 1861 ironclad design - not built.

John L. Porter harbor defense ironclad design - not built.

Arkansas Class (165')

Arkansas

Tennessee I - not completed.

Georgia

Louisiana (264' loa)

Mississippi (260') - not completed.

William R. Scott proposal for steam battering ram.

175' shallow-draft ironclad - not built.

153' shallow-draft ironclad - not built.

180' seagoing ironclad - not built.

Captured Ironclads

U.S.S. Indianola

II - Standardized Types

Standard Hull Types

Richmond Class (150')

Chicora

North Carolina

Palmetto State

Raleigh

Richmond

Savannah

Several (number unknown) proposed for construction at New Orleans, apparently not laid down.

Charleston Class (180')

Charleston

Virginia II

One contracted for by Porter and Watson, Oven Bluff, Ala., not completed.

One contracted for by H. F. Willink, Savannah - not built.

One contracted for by Krenson & Hawkes, Savannah - not completed.

Tennessee Class (189')

Tennessee II

Columbia

Texas - not completed.

Nashville Class

Nashville (271' loa)

One contracted for by Shirley and DeHaven, at Selma, Ala., damaged beyond repair when launched. Sold to private interests and renamed Phoenix. Sunk as obstruction in Mobile Bay.

One at Yazoo City, Miss. - not completed.

One contracted for by Moore & Smoker, St. Tammary Parish, La. Contract not approved by Navy Department.

Milledgeville Class (175')

Milledgeville - not completed.

Wilmington Class (226')

Wilmington - not completed.

Diamond Hull Types

Tuscaloosa Class (160'?)

Tuscaloosa

Huntsville

Two at Oven Bluff, Ala.(160') - not completed.

Albemarle Class (139')

Albemarle (152' loa)

Neuse (158' loa)

One at Tarboro, N.C. - not completed.

Fredericksburg Class (170')

Fredericksburg

Missouri Class (190' loa.)

Missouri (183' loa)

Jackson (aka Muscogee) (c. 224' loa) - not completed.

One in New Orleans area - not completed, if laid down.

One to be built by Mississippi Ladies Defense Association - apparently not built.

Turreted ironclad proposed by Chief Engineer James H. Warner (175').

III - European-Built Ironclads

Frigate No. 61 (270'). Later became Danish Navy Danmark.

Laird Rams (224')

North Carolina II (Hull No. 294). Later became H.M.S. Scorpion.

Mississippi II (Hull No. 295). Later became H.M.S. Wivern.

Stonewall Class (171')

Stonewall

One other. Later became Prussian Navy Prinz Adalbert.

Seagoing ironclad designed by John L. Porter (234') - not built.

Seagoing ironclad designed by John M. Brooke, plans by William A. Graves, 1862 - not built.

IV - Unknown Types

Dismal Swamp Ironclads - Six to eight small, flat-bottomed ironclads, to carry two guns and capable of traversing the Albemarle & Chesapeake Canal between Norfolk and the North Carolina sounds, were under construction in the Norfolk area in the spring of 1862. All were destroyed before completion.

One, Gilbert Elliott contract, April 16, 1862, Norfolk area - not completed (Dismal Swamp ironclad?).

One, Lindsey and Silvester contract, April 23, 1862, Norfolk - not completed (Dismal Swamp ironclad?).

Contract with Nathaniel Nash, date unknown (Dismal Swamp ironclad?).

Contract with R.L. Myers, date unknown (Dismal Swamp ironclad?).

One, Smith and Elliott contract, August 29, 1864, Halifax, N.C. (170') - not completed.

Double-ended, single casemate (220'), designed by William A. Graves.

One at Richmond - not completed.

One proposed for Charleston - not built.

Two ironclads at Charleston, one being built by Kirkwood and Knox, the other by James G. Marsh - neither completed.

Seagoing ironclad (216'2") - apparently not built.

Double-turreted ironclad designed at New Orleans - not built.

Note: The following builders were either constructing ironclads or had contracted to build ironclads in the New Orleans area at the time of the city's fall in April 1862:

James J. Watson, contract of March 24, 1862.

John Hughes, contract of March 7, 1862.

Two ironclads to be built by Asa and Nelson Tift after the completion of the Mississippi.

Ironclads (number unknown) being built by John Mahoney, Algiers, La.

Vallette and Sons.

Harrand and Anderson.

Hyde and Mackin.

James Martin.

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