The Effect of the U.S.S. Monitor and the C.S.S. Virginia on Naval Warfare

Reuben D. Ferguson
AMH6939
Civil War & Reconstruction
Dr. Stephen D. Engle

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U.S.S. Monitor vs. C.S.S. Virginia, March 9, 1862

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Figures 3 and 10 can be accessed at *Images of The Civil War* at: http://www.treasurenet.com/images/civilwar/civil012.html

Figures 4, 11, 12, 13, and 14 can be accessed at *The Naval Historical Center* at: http://www.history.navy.mil/photos/sh-usn/usnsh-m/monitor.htm

Figure 7 can be accessed at *The United States Navy Fact File* at: http://chinfo.navy.mil/navpalib/factfile/ship-sea.html

Figure 15 is a reprint of a section of a National Geographic Society fold-out map insert (The Mid-Atlantic States) from the October, 1976 issue

THE EFFECT OF THE U.S.S. MONITOR AND THE C.S.S. VIRGINIA ON NAVAL WARFARE

INTRODUCTION

Captain Ericsson has established, by the most decisive of all tests, actual experience, his title to the gratitude of the country, and to the respect of the world. He has practically introduced a weapon which will revolutionize the whole system of naval warfare. - (The *New York Times*, March 17, 1863)[1]

MARCH 9, 1862, the date of the famous battle between the *Monitor* and the *Virginia,* was much more than a military boxing match. Endless debates have taken place over which vessel was the true victor, to little result other than to promote the debater's general position concerning the superiority of either the Union or the Confederacy. A much more important aspect which sometimes receives less emphasis than it should is the absolutely revolutionary effect this battle would have on centuries of naval vessel construction, combat theory, tactical and strategic ideas, and even crew composition. It has been said that this battle instantly made every other navy in the world obsolete. Though at this time neither the Union nor Confederate navy was in any position to threaten England, France, or any other country, it is true that wooden ships very quickly fell from the important position they had occupied for centuries, and a new emphasis was placed on developing and refining ships constructed of iron, and later of steel.

These two vessels displayed more innovation than simply the use of armor plating. Wooden ships had already been fitted with iron plate in an effort to give greater protection against the ever more powerful naval guns of the time. The *Virginia* was the less revolutionary of the two, having been built on a pre-existing hull and using smaller, more common cannon. (She did, however, sport

a ram, hardly a new development, but one that had not been employed by an important naval power for centuries).[2] The *Monitor*, on the other hand, employed many new ideas not previously utilized in ships, and will receive a greater emphasis in this paper. Both ships, of course, employed the relatively new screw propeller.

These new design concepts consequently called for a review of the entire body of thought concerning naval tactics, strategy, and even crew complement. Some of these revisions were embraced very quickly indeed, while others would need several years to be widely adopted. This paper will deal with some of these important changes.

Part One
Ship Design

Now comes the reign of iron - and cased sloops are to take the place of wooden ships.[1] - (Captain John Dahlgren)

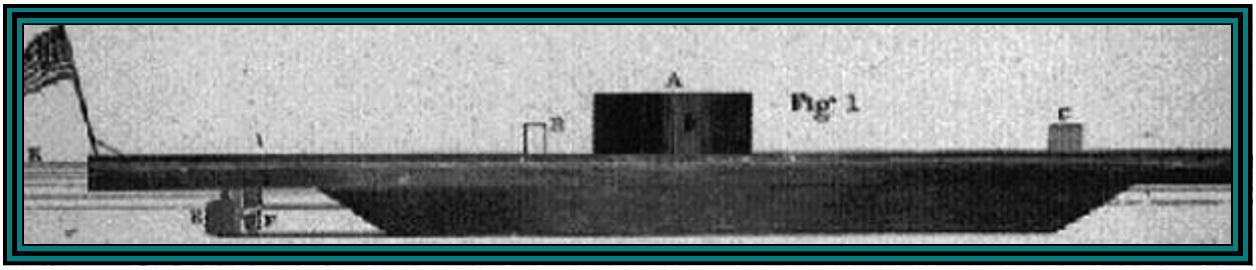

Figure 1 - Profile of the *Monitor*

CHAPTER 1
THE GUNS

Naval guns involve special conditions, which naval men surely may be expected most clearly to perceive.[1]

IN HORATIO NELSON'S DAY, only a half-century before the advent of the *Monitor* and *Virginia*, the guns on board most large ships were 24 lb. or 32 lb. cannon, rarely anything larger. Although immensely strong for wooden structures, these ships could not have withstood firing guns of much larger throw weight without being shaken apart by repeated recoil shock. Indeed, some of the smaller bomb ketches carrying large mortars would only be useful for a relatively short time before being rendered unsafe by the trauma of firing their own armament.

In contrast, *Monitor* mounted two 11-inch guns which fired either 187 lb. wrought iron balls, 175 lb. cast iron balls, or 155 lb. shells manufactured by the Novelty Iron Works.[2] Probably because of the experience with the bomb ketches as stated above, there was even concern in some quarters that the force of firing huge guns across an armored deck would "demolish" the deck![3] John Ericsson, the designer of the *Monitor*, had wanted larger guns, but the 11-inchers were the only ones available. His design called for the most powerful guns then in the naval inventory: 12-inch Dahlgren smoothbore cannon. Unfortunately, when the request was made of the Navy for the 12-inchers, Ericsson and Worden, the captain of the *Monitor*, were told that none were available. However, a shipment was expected and Worden put in for two of the guns. The

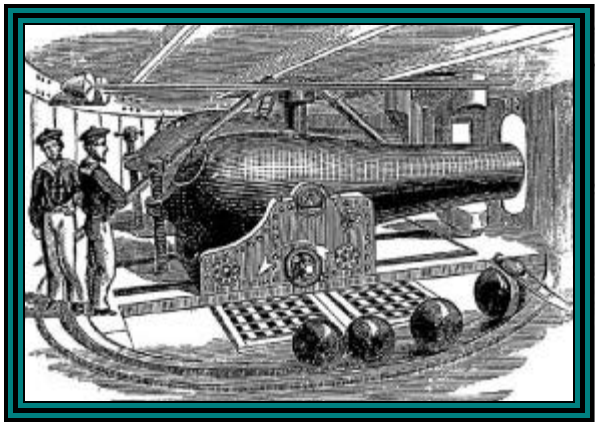

Figure 2 - *Monitor*'s turret and cannon

cannon never arrived, and *Monitor* was forced to mount two 11-inch guns taken from the steam sloop

Figure 3 - A Dahlgren cannon and crew on board the gunboat U.S.S. Mendota, 1864.

Dacotah. The guns were relatively new, and both men hoped they would be up to the task ahead.[4]

"Captain" Ericsson had specified a 30-pound powder charge for the guns, and predicted they would wreak havoc on the *Merrimac.* Some twenty years before, the Navy had ordered that no more than 15 pounds of powder be used. Ironically, this was the direct result of the explosion of a gun on board the *Princeton* in 1843 which killed the Secretary of the Navy Thomas W. Gilmer and Secretary of State Abel P. Upshur.[5] Ericsson had been unjustly blamed for this mishap, and this incident goes far to explain his mistrust of the Navy. When Ericsson heard of the battle and a description of the cannon balls bouncing off the casemate of the *Virginia*, he was mystified. He had felt certain that the shot would go right through the *Virginia*'s plating. Upon being informed of the Navy's restriction, he was characteristically, and justifiably, furious. Later tests would prove him correct in his calculation of the effect of 30 lb. charges. Lieutenant Samuel Dana Greene, who would assume command of the *Monitor* during the battle after the blinding of Captain Worden, stated:

> Had the gun been loaded with thirty pounds of powder, which was the charge subsequently used with similar guns, it is probable that [the] shot would have penetrated [*Virginia*'s] armor; but the charge being limited to fifteen pounds, in accordance with peremptory orders to that effect from the Navy Department, the shot rebounded without doing any more damage than possibly to start some of the beams of her armor-backing.[6]

It is interesting to think of the change in the outcome of the battle had the *Monitor*'s fire succeeded in blowing the *Virginia* to pieces.

Ericsson's original design, presented to Napoleon III in 1854, was even more innovative than the *Monitor.* Perhaps the most surprising idea was the use of a gun that propelled projectiles not with gunpowder, but with steam! This powerful weapon was to have had a 20-inch bore, dwarfing even the 16-inch guns of the *Iowa*-class battleships built by the U.S. Navy near the end of World War II.[7]

The *Iowa*-class ships' armament would be exceeded only by the Japanese battleships *Yamato* and *Musashi* with their 46 cm. (18-inch) guns.[8] The big gun, (called "a tube for projecting the shells" by Ericsson), was to be constructed of iron or brass of 2 inch thickness, and be ten feet long. The steam would be supplied by the ship's main boiler. Ericsson goes on to describe the mechanism of the gun:

> It is open at one end, the other being closed by a door moving on hinges provided with a cross-bar and set-screw, in order to be quickly opened and afterwards firmly secured. The shell is inserted through this door, and projected by the direct action of steam admitted from the boiler of the vessel through a large opening at the breech.[9]

This is a description of a breech-loading weapon.

The other main weapon Ericsson envisioned in his early design should be mentioned, even though it was not, strictly speaking, a gun, nor was it implemented on the *Monitor*. He indicated that his ship should be equipped with a pair of tubes mounted on the sides of the ship beneath the waterline. These were to fire "hydrostatic javelins" - ten-foot-long underwater projectiles equipped with explosive charges.[10] Instantly recognizable as today's torpedoes, it is interesting to note that the torpedoes employed by submarines during both World Wars would be powered by a variant of steam: compressed air. (Later in the second World War, torpedoes would be powered by electric motors). In the 1870s Ericsson would design the *Destroyer*, a ship that could fire subsurface torpedoes, thereupon transforming naval warfare once again.[11]

Chapter 2
The Turret

The turret of the *Monitor* has long been considered an innovation attributed to Ericsson. There are, however, other opinions on this subject, one of them being stated by Ericsson himself! He is said to have never taken credit for the invention of the turret, saying the idea went back to the ancient Greeks.[1] But, as stated in an article titled "The Real Genius Behind The *Monitor*" in *Civil War Times*, that, too, is a question left open. In the article, author Arthur Farr presents a case that implies that Ericsson stole the idea of a rotating turret from another inventor: Theodore Ruggles Timby. In the opinion of this student, Farr's argument is unconvincing, but does raise some interesting facts from obscurity. Apparently, Timby had worked on the idea of a "metallic rotating fort" able to point its guns in any direction long before the construction of the *Monitor*, and indeed a 15-foot diameter working model went on display in Old City Hall in New York City in 1843. In view of Ericsson's statement about the turret being as old as the ancient Greeks, it would seem that Ericsson probably thought that Timby had

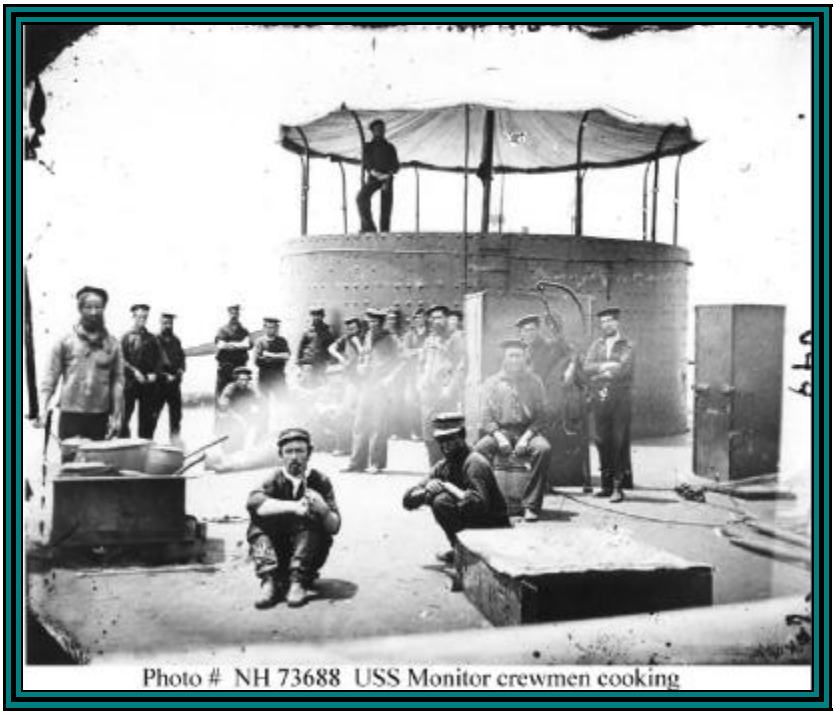

Figure 4 - Photo of *Monitor* showing the turret.

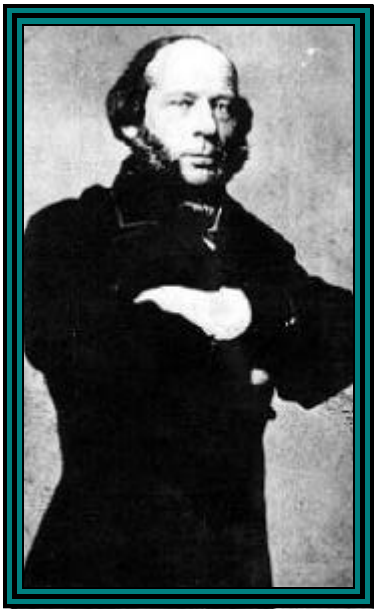

Figure 5
John Ericsson

stolen the idea from them, and therefore felt no qualms at stealing it from Timby! Farr states that Ericsson was living only a few blocks away from the well-publicized display of Timby's turret at Old City Hall, but there is no record of Ericsson's having visited the exhibition. Farr cites several examples of correspondence from and to Ericsson's financial partners in the building of the *Monitor* which address the involvement of Timby in the invention of the turret. It would seem from the tone of the letters that Ericsson's partners were more inclined to take Timby's side over Ericsson's. In a December, 1862 letter from William L. Barnes, (who signed the *Monitor* contract as a witness) to John A. Griswold (one of the financial partners in the *Monitor*'s construction), Barnes makes the following observation:

> There are, of course, many things that [Ericsson] could patent about the vessel of value, but as far as the revolving turret is concerned and any means of rotating it, Timby covers the whole grounds .... I regret extremely that [Ericsson] is not the real inventor of the idea as well as its practical exemplification - but facts are facts.[2]

Unfortunately, Farr's article contained no notes or other bibliographic source information, making it impossible to check his sources.[3] The following, which appeared in the March 17, 1862 edition of the *New York Times,* puts the question of priority of invention in a better perspective. The *Times* article does not stipulate any specific claims being made against Ericsson, but the viewpoint is still valid:

> Whatever may be the value of competing claims to absolute priority of invention, [Ericsson's] boat is the first with which actual trial has been made, and his name will be forever connected, therefore, with this most important revolution in the

naval contests of the world.[4]

Timby's claim against the Monitor's turret design is also mentioned by William C. Davis in *Duel Between the First Ironclads*. In addition to Timby's turret, Davis mentions several earlier examples. The first cited was a submission in 1798 to the French Directorate which was described as a "floating circular citadel". This interesting design was also quite impractical, being powered by windmill-driven paddlewheels located on the perimeter of the craft. It featured guns arranged in a circle all the way around the circular design, a characteristic which Timby's turret would also utilize. An 1805 design by a Scot named Gillespie and an 1807 plan by Abraham Bloodgood are mentioned, as well as a model constructed in 1855 by Captain Cowper P. Coles of the Royal Navy. Although Coles' ship was never built, it was well-publicized in both England and the United States, making it probable that Ericsson was aware of it. Surprisingly, Davis states that there were six designs that featured turrets, including Ericsson's, submitted to the Navy's review board headed by Commodore Joseph Smith [5] (the two other members were Commodore Hiram Pauling and Captain Charles H. Davis).[6] Nevertheless, it was Timby who received $5000.00 from the *Monitor* partners, who hoped the payment would deter Timby from further claims. Ericsson would never acknowledge any debt to Timby.[7]

Interestingly, the turret in Ericsson's original design was quite different from the one that would eventually appear on the *Monitor*. In a description of his "Sub-Aquatic System of Naval Warfare" sent to Napoleon III in 1854, the turret on the proposed ship was a perfect hemisphere, presenting an even more hopeless target to an enemy's guns than the cylindrical shape would.[8] Presented with the difficulties in building the *Monitor* within the stipulated time limit of one hundred

days, the formidable task of constructing a hemispherical turret was avoided by using a cylindrical one instead.[9]

Today, turrets are standard fare on warships of all nations. Oddly enough, for a time after the Civil War, the French navy abandoned turrets for barbettes. The barbette, a fort-like arrangement, is open at the top and designed so the gun fires over the wall. This apparent step backward was the result of the weight of turrets at that time, which made sea-going turreted ships impractical (at least to the French). The British experimented with central-battery and casemate ships in an effort to circumvent this same problem. Several masted sailing ships were outfitted with turrets of various design, but the presence of masts and rigging severely limited their usefulness.[10] Eventually, these problems were solved, and the turret took its place among the blue water navies of the world.

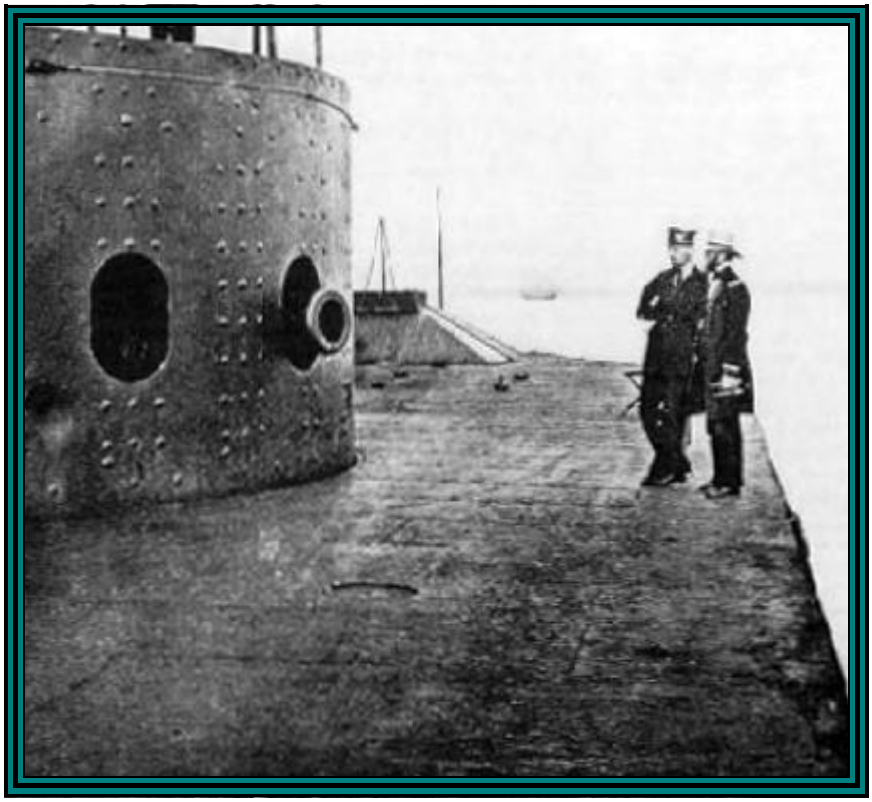

Figure 6 - *Monitor*'s deck and turret. Note the large dent to lower left of the left gunport.

Chapter 3
Decks, Hulls, Casemates, and Other Components

Although the turret may be the most obvious innovation used in the *Monitor*, it is certainly not the only one. The exclusive use of iron in her construction was in itself a departure from the norm; by way of contrast, the *Virginia* was built using the wooden hull of the sunken *Merrimack*, upon which a wooden casemate was constructed, which in turn was covered with two 2-inch layers of iron plate for a total of four inches of armor. The turret of the *Monitor* was built from eight 1-inch layers of iron (eight inches total), with no wooden backing. (Ericsson had requested four 2-inch layers, but was told it would take two months just to retool to produce 2-inch plate).[1] The almost exclusive use of iron was one of Ericsson's fundamental concepts for the *Monitor*, decided upon long before the actual construction of that ship would become a reality. In the description of his "Sub-Aquatic System", he begins the cover letter to Napoleon III with the blunt statement: "The vessel [is] to be composed entirely of iron..."[2] The subsequent realization of his original "Sub-Aquatic System" would involve extensive compromise and adjustment, but the concept of an all-iron ship was retained. The importance of this idea was recognized immediately after the famous battle:

> We trust this incident, disastrous as it has been to us, will convince Congress of the absolute necessity of at once ordering the construction of enough iron-clad[3] gunboats to meet every probable emergency. Not long since, they rejected a proposition to appropriate $15,000,000 to this purpose. Recent events have shown that there is no possible way in which that sum of money can be put to better uses.[4]

Rarely in American history has such a suggestion to Congress been followed so quickly by action. In the March 14, 1862 New York Times, only three days after the above quote was printed,

this brief report appeared on the front page:

> The Senate Naval Committee to-day authorized the Chairman to offer an amendment to the Naval Appropriation bill, to change the appropriation of fifteen millions for gunboats to iron-clad steam vessels-of-war. The Committee also favor the appropriation for completing the Steven's Iron Battery, which will be offered in the Senate when the bill comes up for consideration.[5]

And on the 17th:

> THE ERICSSON NAVY - We are glad to see that the Naval Committee, in the Senate, has promptly responded to the voice of the country, and has recommended an appropriation of $15,000,000 to the construction of iron-clad vessels of war, and $750,000 to the completion of STEVENS' Battery.[6]

These two quotes exemplify the immediate recognition, even by "landlubbers", of the fact that naval warfare would never be the same.

Ericsson's use of the term "sub-aquatic system" also was indicative of a radical departure from previous ship design. It had long been recognized that the safest place in a wooden ship during a battle was below the waterline; solid shot quickly loses its velocity when it enters water. (Most shot that did pierce a hull below the waterline were able to do so due to the ship listing to the opposite side when the shot hit, thus temporarily exposing the side of the hull to enemy fire). Ericsson used this observation to form his idea of putting as much as possible of the ship below the surface, thus shielding it from the majority of projectiles. In the U.S.S. *Princeton*, designed by Ericsson some years before, all of the boilers and other machinery were below the waterline.[7] In the *Monitor* design, almost all parts of the ship were "sub-aquatic", the only significant parts which were above water were the turret and the pilot house. Of course, this design was only possible in a ship which had no sails, and so was impractical until the advent of steam power and the screw propeller, both of which

Ericsson had improved and patented in 1833 and 1836, respectively.[8] Screw propellers had been around for quite a while; the *Turtle*, an egg-shaped submarine used by the Americans during the Revolutionary War had moved by use of hand-powered screws. (In reality, the submarine is simply the idea of moving important parts of a ship below the waterline taken to its logical conclusion). The concept of the screw can be traced back to Archimedes, who designed a water pump using a screw enclosed in a tube. Not only did the *Monitor* use a screw propeller, the screw was protected from collision and ramming by a significant overhang of the deck, another innovation that would become a common feature of ship design even today.[9] Her lower hull was 124 feet in length and 36 feet wide at the top, while her upper hull (the deck) was 172 feet long and 41 feet 4 inches in width.[10]

Monitor's deck was simultaneously one of her strengths and her greatest weakness. Ericsson gave the *Monitor* only 18" of freeboard, meaning the deck was only that far above the waterline.[11] The intent was to give as small a target to the enemy as possible, and in that respect, it was a near-perfect design. Unfortunately, when the enemy was the sea, the design had serious drawbacks and would be the direct cause of *Monitor*'s eventual sinking.[12] Even on her first trip to Hampton Roads to meet the *Virginia*, she was almost lost twice in storms due to water rushing unimpeded across her deck and pouring down the air vents and the seal between the turret and deck.[13]

Virginia's casemate design gave much more protection against being swamped in high seas. For her, however, the tables were turned; by enjoying a high freeboard, she was a much easier target to hit and her weight of armor was much greater. *Virginia*'s sloping armor design was used extensively by the Confederacy for its ironclads, and is an idea that was adopted for armored land vehicles during World War II in the German Panzer V and the Soviet T-34.[14] Interestingly, the design

is still finding applications; Lockheed in conjunction with the U.S. Navy has built an experimental vessel called the *Sea Shadow* that bears a startling resemblance to the *Virginia*. As in the Air Force's Stealth Fighter, the *Sea Shadow*'s sloping sides are built to deflect radar waves, not 175 lb. solid shot. This "Stealth Ship" has only been unveiled for about two years, and very little is known about its capabilities. Her dimensions are known:

Figure 7 - *Lockheed Sea Shadow*

Length: 164 ft.
Beam: 68 ft.
Draft: 14.5 ft.
Displacement: 560 tons full load
Crew: 10 [15]

Compare to the *Virginia*'s statistics:

Overall Length: 262 ft., 9 in.
Length of Casemate: 178 ft., 3 in. at base.
Freeboard: 24 ft.
Draft: 22 ft.
Crew: over 200 [16]

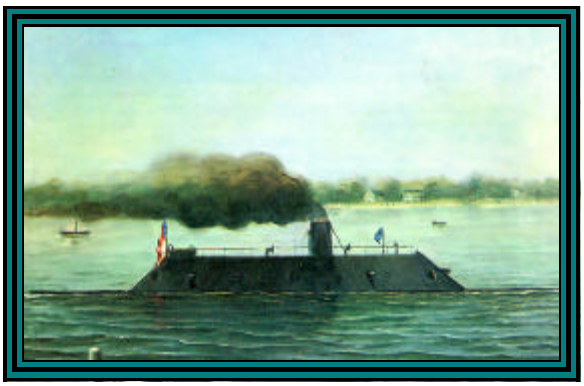

Figure 8 - *C.S.S. Virginia*

One cannot help but wonder what effect a few rounds of eleven-inch solid shot from the *Monitor*'s guns would do to this new incarnation of casemate design!

Casemate-type ironclads were certainly easier for the Confederacy to build than turreted ships, but they had several drawbacks. First among these was the limited traverse of the guns, which necessitated turning the entire ship to bring the guns to bear. A related reality was the fact that only half of a casemated ship's weapons could be brought to bear on a single enemy. Finally, a casemate

design requires a larger armored area, which contributes to greater weight and deeper draft. These last two considerations, weight and draft, were significant problems for the *Virginia* during the battle with *Monitor*.

Ericsson included several other inventions in *Monitor*'s design that would become standard in military ships of the future. One of these was a periscope-like arrangement:

> The turret is pierced in different places with four holes for the insertion [of] telescopes, and just outside of the holes reflectors are fixed to bend the ray of light which comes in a direction parallel with the guns through the axis of the telescope, which is crossed by a vertical thread of spider's web through the line of collimation.[17]

Not only would periscopes be absolutely essential for submarines, but at least as late as World War II, spider silk was still being used for the crosshairs in these instruments.

It would seem, too, that Ericsson had to devise a completely new head (toilet) for his ship. Previously, this had not been much of a problem for surface ships; in a frigate, for example, there was a set of seats with circular holes cut in them which were suspended over the water. These seats were located in the bow, or "head", of the ship; hence the name still used today. (If not the most convenient arrangement, it at least had the virtue of low maintenance). Unfortunately, when nature called in the *Monitor*, things were a bit more complicated. Ericsson had created an ingenious arrangement of valves and pipes that would serve to flush an inboard head out to sea without sinking the ship in the process. Essentially the same system would be used in submarines up to World War II.[18]

Since so much of the *Monitor* was below the waterline, provision had to be made for enough air for the crew of fifty-seven to breathe. To this end, Ericsson assembled a system of ventilators and blowers. The placement of the blowers on the flat deck led to some serious problems; when subjected to high seas, water would pour down the ventilator shafts, soak the belts that were used to turn the

blades, and threaten the whole crew with asphyxiation. Ericsson himself addresses these concerns in a letter published in Scientific American:

> New York, March 15, 1862
>
> MY DEAR SIR: - It may safely be asserted that the *Monitor* is the best ventilated vessel afloat. The blowers draw in from the external atmosphere upwards of four thousand cubic feet of fresh air in every minute, part of which passes through the boiler furnaces and part through the entire vessel. The trouble during the passage to Fortress Monroe was caused by the sea breaking over and passing into the ventilating trunks, these not being made high enough. - John Ericsson [19]

It would seem that this passage contains a rare admission of error on the part of Ericsson as to the height of the vents. Of course, his claim that *Monitor* "is the best ventilated vessel afloat" presupposes that the blowers work properly and are not flooded by incoming seawater, a circumstance that was by no means guaranteed.

Yet another *Monitor* innovation which would be adapted in a modified form by modern vessels was the specialized well for the anchor. Ericsson had included a system for raising or lowering the anchor without the necessity of exposing men on deck. The anchor was suspended in its own armored well in the bow, and was completely hidden from the view of the enemy. Modern vessels, while not completely hiding the anchor itself, use a similar internal windless system to service the anchor.[20]

Part Two
Naval Theory

The news of the fight between the *Monitor* and the *Merrimac[k]* has created the most profound sensation amongst the professional men in the allied fleet here. They recognize the fact, as much by silence as words, that the face of naval warfare looks the other way now - and the superb frigates and ships of the line ... supposed capable a month ago, to destroy anything afloat in half an hour ... are very much diminished in their proportions, and the confidence once reposed in them fully shaken in the presence of these astounding facts.[1] - (Captain Levin M. Powell, U.S.S. *Potomac*).

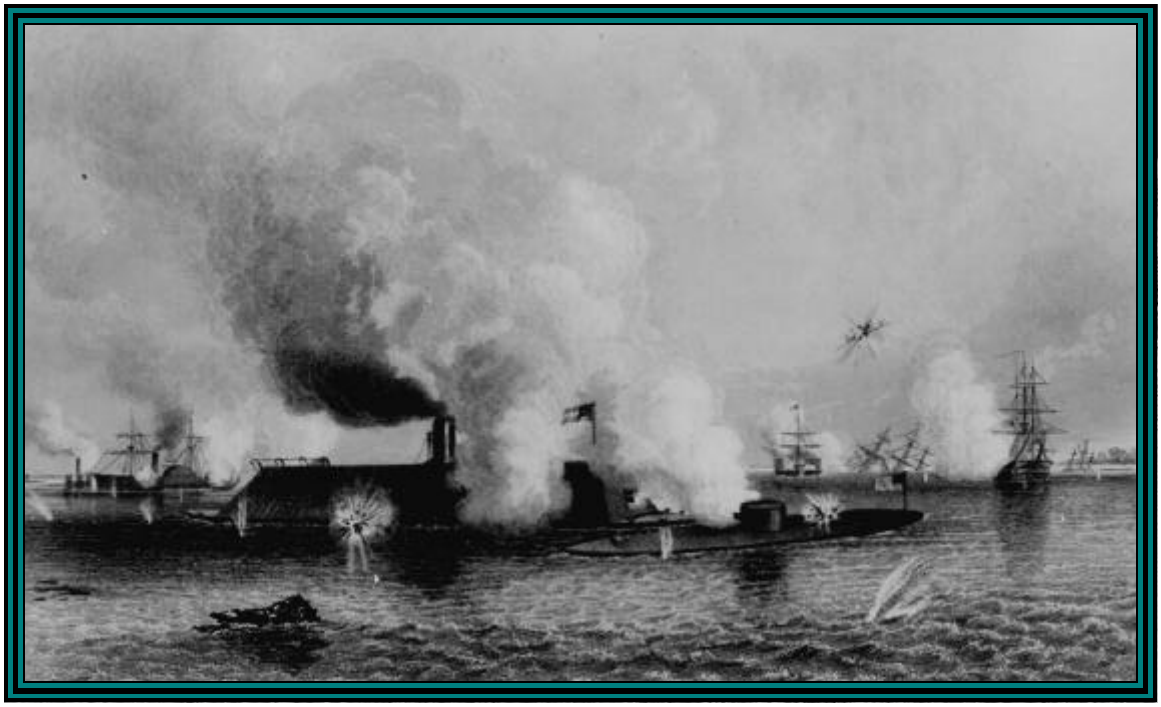

Figure 9 - U.S.S. *Monitor* and C.S.S. *Virginia*

CHAPTER 4
TACTICS

The Merrimac has got out of harbor, and had pretty much used up our ships at Hampton Roads.[1] - Jno. A. Dahlgren, Commandant, Navy Yard.

ONE OF THE PROBLEMS faced immediately by the opposing naval forces was how best to use the new ironclad ships in battle. The old notion, voiced by England's Admiral Lord Horatio Nelson, was to lay one's ship close alongside that of the enemy, and pound away until one or the other sank. This was exemplified in his order to his ships during the Battle of Trafalgar: "Engage the enemy more closely".[2] After the engagement between *Monitor* and *Virginia*, however, it became apparent that this tactic was no longer sufficient to ensure victory; neither ship suffering enough damage to put it out of action. In his report to Adjutant and Inspector General S. Cooper, Confederate Army officer Major-General Benjamin Huger in command of the Department of Norfolk expresses his concern after viewing the battle:

> This action shows the power and endurance of iron-clad vessels; cannon-shot do not harm them, and they can pass batteries or destroy large ships ... How these powerful machines are to be stopped is a problem I cannot solve. At present, in the *Virginia*, we have the advantage; but we cannot tell how long this may last.[3]

Major-General Huger's opinion that the *Virginia* was the more powerful ship is called into question by the report made by Flag-Officer Franklin Buchanan, who was in command of *Virginia* until injured by a rifle bullet after imprudently leaving the protection of the *Virginia*'s armor and going on deck. Reporting from his hospital bed, Buchanan quotes from Lieutenant Catesby ap R. Jones' report:

> Our loss is 2 killed and 19 wounded. The stem is twisted and the ship leaks. We have lost the prow, starboard anchor, and all the boats. The armor is somewhat damaged; the steam-pipe and smoke-stack both riddled; the muzzles of two of the guns shot away. It was not easy to keep a flag flying.[4]

In contrast, after taking 21 or 22 hits, the *Monitor* suffered no significant damage other than to the pilot house, and only the captain, Lieutenant Worden, was seriously injured.[5] Even though the *Monitor*'s low freeboard served it well in battle, as was stated earlier, it was a direct cause of the *Monitor*'s demise. No satisfactory solution was ever found for this problem, and the monitors that followed the original ship were confined to operations in coastal regions and rivers; indeed, this was what Ericsson had intended for his design, having no illusions as to the sea-going capabilities of his ship. This is one innovation of Ericsson's that has been largely abandoned in today's navies; ignoring submarines, no warship with such low freeboard is now at sea.[6]

After the battle, old tried-and-true boarding tactics were considered in order to disable or capture the *Virginia* given the opportunity to do so. In a March 9th letter to Colonel Ingalls, Quartermaster at Annapolis, the Quartermaster-General M.C. Meigs wrote from the Executive Mansion (the White House) in Washington:

> Should the Merrimac, which did so much damage at Newport News, attempt anything at Annapolis, it is believed that the best defense would be an attack by a number of swift steamers, full of men, who should board her by a sudden rush, fire down through her hatches or grated deck, and throw cartridges, grenades, or shells down her smoke-pipes; sacrifice the steamers in order to take the Merrimac.
>
> If an overwhelming force can be thus thrown on board there will be little loss of life, though the steam transports may be destroyed.
>
> Promotion, ample reward, awaits whoever takes or destroys her.[7]

In the humble opinion of this writer, it was a good thing that Quartermaster-General Meigs was not in the Navy, and thereupon in a position to try this suicidal plan. He seems to have forgotten

the main lesson of the battle on the 8th, i.e., wooden ships did not stand a chance against the *Virginia*, particularly small transports. Against such small ships it can be safely assumed that one or two good hits from *Virginia*'s big guns would probably sink them outright, and, with a crew of over 200, the ironclad could be expected to put up a good fight even if she were boarded. Meigs recognizes that the "... transports may be destroyed", but doesn't seem to realize that the likely time of their probable destruction would be *before* their arrival alongside the *Virginia*, while still loaded with men. Perhaps his last line should have read: "Promotion, ample reward, *probable death or dismemberment* awaits whoever *tries* to take or destroy her".

Figure 10 - *Monitor* vs. *Virginia*

Similar tactics were considered likely to result in the capture or disablement of the *Monitor*. Intriguingly, this approach was conceived by none other than Worden, who relayed his concerns to Abraham Lincoln when the President came to visit him while Worden was recovering from his wounds. Worden claimed that the *Monitor*'s turret could be jammed into immobility by means of enemy boarders driving wedges between the turret and the deck. Likewise, the boiler fires could be extinguished by pouring water down the exhaust ports, and grenades tossed through the gunports into the turret would likely disable the crew there.[9] Worden's concerns would lead to Gideon Wells sending a telegram on March 10th to Captain G.V. Fox, Assistant Secretary of Navy, Fort Monroe at Hampton Roads:

> It is directed by the President that the *Monitor* be not too much exposed, and that in no event shall any attempt be made to proceed with her unattended to Norfolk.[9]

Worden goes on to say that, with enough room to maneuver, this danger could be controlled. Nevertheless, one wonders what would have resulted had the Confederate commanders been inclined to try boarding as a method of attack.

Ultimately, it was recognized by both sides that the only currently available defense against an ironclad was another ironclad. The Confederacy would build several more casemate ironclads: *Tennessee, Albemarle, Virginia II, Richmond, Fredericksburg,* and others. Although about fifty ironclads were supposed to have been constructed, the serious construction problems experienced by the South allowed the completion of only twenty-two.[10] The Union Navy's ironclad fleet would eventually number forty ships, (thirty-five of these were monitors), and many more were built after the war ended. Amazingly, the last monitor, the U.S.S. *Cheyenne*, was in service until 1937, when it was finally decommissioned.[11] All of these ships share the turrets and low freeboard of the original "Ericsson Battery".

Figure 11 - U.S.S. Monitor

Monitors

Figure 12 - U.S.S. Monadnock

Figure 13 - U.S.S. Monterey

Figure 14 - U.S.S. Miantonomoh

CHAPTER 5
SEAMANSHIP & MANEUVERS

The fight raged hotly on both sides, the opposing batteries moving around each other with the skill, ease, and dexterity of expert pugilists.[1]

A PROPER TREATMENT of the evolution of naval seamanship and tactical maneuvers would require volumes. However, a brief discussion would seem to be necessary for completeness' sake. The major cause of the revolution in ship handling was caused not so much by the ironclad as the arrival of steam on the high seas. As it happens, the development of the techniques and skills necessary to the building of ironclad vessels were evolving at the same time as the evolution of steam power. By the time of the maiden voyage of the *Monitor*, steam was finally getting to the point where it could be relied upon as the primary means of ship propulsion, not merely as an adjunct, as had been the case with previous steam equipped warships. Immediately apparent to the seaman is the huge advantage of being freed from the vagueness of the wind. Wind and sail had been the only means of ocean travel for centuries, and an entire science/art had been developed to wring out the fullest advantage from the marriage of moving air and canvas. The advent of steam power at sea put an end, almost totally, to the knowledge and skills necessary for the completion of long ocean voyages in large ships powered by sail. No longer was it considered essential for a ship handler to know how to tack his ship in order to proceed against the wind. The exploration of tidal waters, confined waters between islands, or reefs becomes several orders of magnitude easier, and therefore safer. The almost arcane knowledge and terminology associated with sail became unneeded; after all, what use of stun'sls, or shrouds, or spankers would an ironclad steamer find?

The combination of the turret and steam removed the emphasis from sailing skill and placed it upon technical expertise. The relationship between a ship, her captain, and the weather would remain, but the total reliance upon favorable winds in order to get to one's destination became a thing of the past. One of the most hallowed maneuvers in naval warfare, i.e., "crossing the T", lost much of its importance.

"Crossing the T" was the maneuver that all captains aspired to while engaged in combat. It entailed manipulating one's ship in such a fashion so as to present the broadside of one ship directly adjacent with and perpendicular to the long axis of the opponent's vessel. This would have the advantage of presenting to the attacker's guns the whole length of the outmaneuvered ship. A cannon shot, if powerful enough, could smash through the entire vessel from stem to stern, causing vast damage. As the attacking ship proceeded past the other vessel, each gun on the broadside would discharge one by one, as the guns came to bear. The other ship would be completely helpless, since all main armament was mounted on the sides of the craft, and would be unable to train a single heavy gun on the attacker.[2] This was a tactic which won battles. When this movement was attempted with sail, it required great skill and experience in order to make it work. The combination of steam and the turret, however, transformed the "T" formation from a desirable method of attack to a situation which should be avoided. The turret, of course, could traverse in any direction, so the ineffectiveness of laterally-mounted cannon was no longer a problem. In fact, showing one's broadside to an enemy simply increased the size of the target (that is, *you*!).

Conclusion

IT SHOULD BE CLEAR that the advent of the *Monitor* and the *Virginia* drastically changed the way that naval warfare would be conducted in the future. All interested parties seem to have spent little time in reaching this conclusion: the swift Congressional appropriation of funds for building additional ships; the many references in official reports to the need of building more ironclads; the allocation of scarce resources in the South to the construction of additional vessels; and many proclamations by naval authorities on both sides attesting to the effectiveness of the ironclad concept. Foreign nations were quick to appreciate these new ships as well; only two days after the news of the famous battle reached England, the Admiralty declared a moratorium on the construction of wooden vessels, stating that England must have an ironclad navy.[1] A great many innovative concepts that grew from the iron seeds planted by Ericsson and others are still in use today, and, in some instances, have crossed the line from naval warfare to tank warfare on land. (For example, the defensive position of "hull-down", in which the tank sits in a depresion to shield itself from enemy fire is a case in point; the "sub-aquatic system" has become the "sub-terranian system"). All modern navies owe a large debt of gratitude to the designers, thinkers, craftsmen, and machinists working for both sides during America's Civil War.

Appendix 1

Map of the Hampton Roads Area

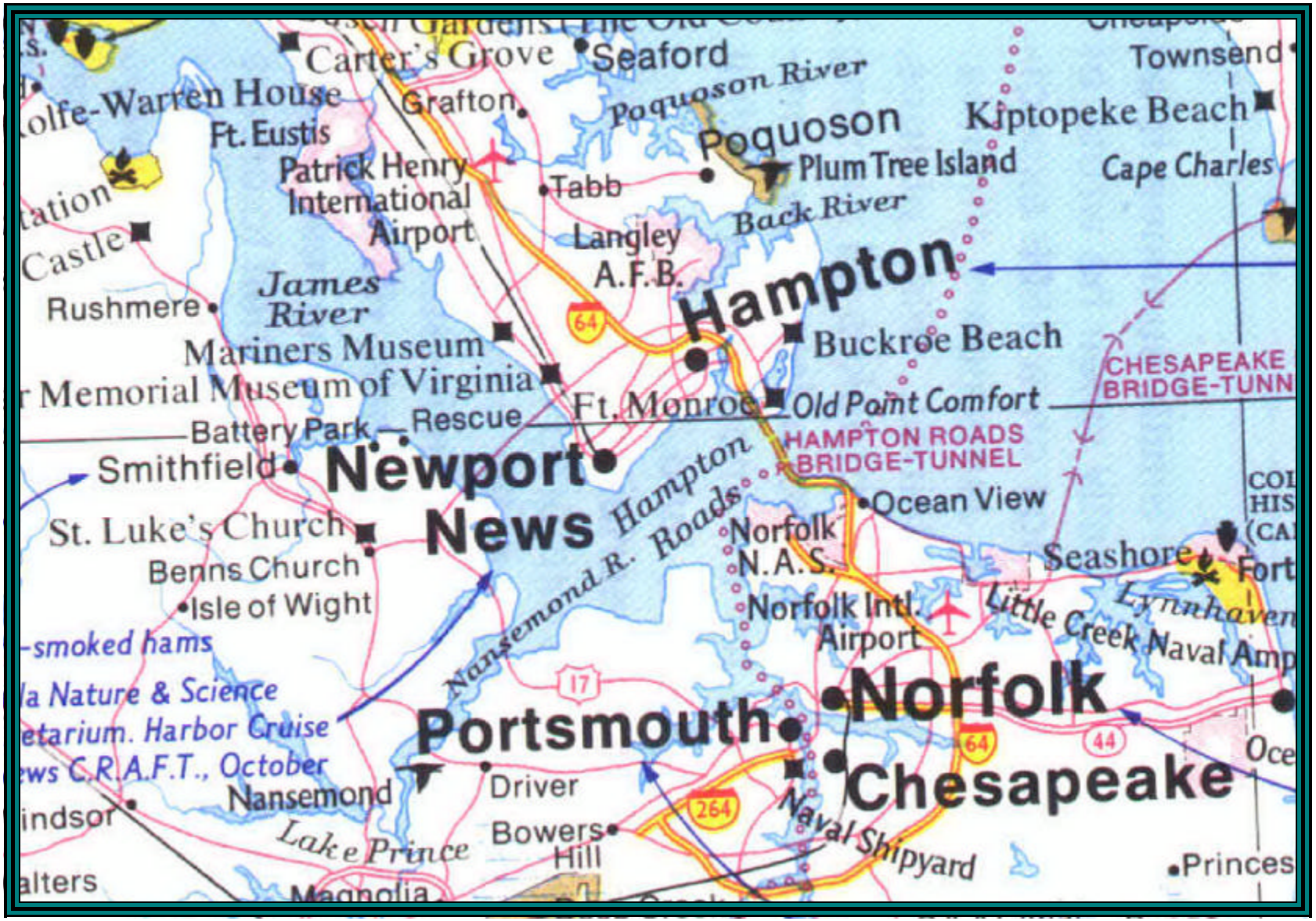

Figure 16 - Map of the Hampton Roads area
Copyright 1998 by National Geographic Society

Notes

Introduction

1. " The Ericsson Navy" New York Times, 17 March, 1863, 4:6.

Part One

1. Naval History Division, Navy Department, Civil War Naval Chronology, (Washington, D.C.: U.S. Government Printing Office, 1971), p. II-31.

Chapter 1

1. "The Armstrong Gun", Scientific American, 6, no. 12, (New York: Scientific American Press, 22 March, 1862), 192.

2. New York Times, 10 March, 1863, 1:1.

3."Coast and Harbor Defence", New York Times, 11 March, 1863, 4:4.
This concern was actually expressed about the Stevens Battery, an armor-plated floating battery designed for harbor defense.

4. James Tertius deKay, Monitor, (New York: Walker and Company, 1997), 123-4.

5. Gene A. Smith, Iron and Heavy Guns: Dual Between the Monitor and Merrimac. (Fort Worth: Ryan Place Publishers, 1996), 45.

6. deKay, Monitor, 193-4.

7. Ibid, 29.

8. Siegfried Breyer, Battleships and Battlecruisers 1905-1970, (Garden City, New York: Doubleday & Company Inc. 1978), 359-360.

9. deKay, Monitor, 29-30.

10. Ibid, 30.

11. Smith, Iron and Heavy Guns: Dual Between the Monitor and Merrimac. 41.

CHAPTER 2

1. deKay, Monitor, 28.

2. Arthur Farr, "The Real Genius Behind The Monitor," Civil War Times 36, no. 3, (June 1997): 34-6.
Despite Ericsson's idea of a ship constructed completely out of iron, *Monitor* had thirty inches of white oak backing up her armored sides

3. According to a note after the article, Arthur Farr holds a Master's degree in American Studies from Pennsylvania State University. This was the only note of any kind.

4."The Ericsson Navy", New York Times, 4:6.

5. William C. Davis, Duel Between the First Ironclads, (Garden City, New York: Doubleday & Company, Inc., 1975), 18.

6. Ibid, 14.

7. Ibid, 24.

8. deKay, Monitor, 27-28.

9. Ibid, 90.

10. Breyer, Battleships and Battlecruisers 1905-1970, pp. 19, 25-33.

CHAPTER 3

1. deKay, Monitor, 89.

2. Ibid, 27.

3. It should be noted that the use of the term "iron-clad" was used indiscriminately to describe both true iron-clads, (i.e., wooden ships clad with iron), and ships such as the *Monitor* and her descendants, which were not clad with, but composed solely of, iron.

4."Iron-Clad Vessels", New York Times, 11 March, 1862, 4:4.

5."Iron-Clad Vessels", New York Times, 14 March, 1862, 1:2.

6."The Ericsson Navy", New York Times, 17 March, 1862, 4:6.

7. Smith, Iron and Heavy Guns, 40-41.

8. Ibid, 40.

9. Scientific American, "The Steam Battery 'Monitor'" 6, no. 12, (New York: Scientific American Press, 22 March, 1862), 177.

10. John Lorimer Worden, New York Times, "Lieut. Worden's Description of the *Monitor*", 14 March, 1862, 2:1.

11. Ibid

12. National Geographic Magazine, "Geographica: Historic Casualty: The *Monitor* Disintegrates", (Washington, D.C.: National Geographic Society, June, 1994), xii.
Monitor was swamped and sunk on December 31, 1862 in a gale off Cape Hatteras, North Carolina. Her low freeboard offered practically no protection from even moderately high seas.

13. deKay, Monitor, 142.
Ericsson had designed the turret to seat snugly upon a brass ring when not turning; it was raised slightly off of the brass seal when turned. The weight of the turret was intended to make the seal watertight, and probably would have done so, but during construction the order was given by navy yard officials to caulk the seal with oakum. The high seas experienced by *Monitor* while being towed to Hampton Roads washed away part of the oakum, leaving a rather large opening for water to enter, and she almost sank before her first battle.

14. Kenneth Macksey, "The Tanks", Tanks and Weapons of World War II, ed. Bernard Fitzsimons (London: BPC Publishing Ltd., 1973), 43.

15. United States Navy, "Navy Fact File: Sea Shadow", Internet: http://chinfo.navy.mil/navpalib/factfile/ships/ship-sea.html

16. Davis, Dual Between the First Ironclads, 36, 126.

17. Scientific American, "The Steam Battery 'Monitor'", 177.

18. deKay, Monitor, 112.

19. Scientific American, "The Working of the 'Monitor'", 6, no. 13, (New York: Scientific American Press, 29 March, 1862), 194.

20. deKay, Monitor, 110.

Part Two

1. Naval History Division, Civil War Naval Chronology, p. II-31.

Chapter 4

1. War of the Rebellion, Series I, Vol. 9, (Washington, D.C.: Government Printing Office, 1889-1890), 20. Hereinafter referred to as the O.R.

2. A.B.C. Whipple, *Fighting Sail*, The Seafarers. (Alexandria, Virginia: Time-Life Books, 1978), 146.

3. O.R., Ser. I, Vol. 9, 6.

4. Ibid, 10.

5. Scientific American, "The Working of the 'Monitor'", 194.
There seems to be some confusion as to exactly how many shots struck the *Monitor*. In the letter from Lieutenant S. D. Greene printed in this issue of *Scientific American*, Greene states that *Monitor* "... received twenty-one shots". However, in the next letter in the same column, Ericsson quotes from a report written by Chief Engineer Stimers of the *Monitor* which gives the number at twenty-two and stated specifics: "... we were struck twenty-two times, pilot house twice, turret nine times, side armor eight times, deck three times". Regardless of the exact tally, this is a remarkable number; the battle lasted more than three hours by Stimers' account, and was, for the most part, fought at close range. For the *Monitor* to have been hit only twenty-one or twenty-two times by *Virginia*'s guns during an engagement of that length speaks volumes about the success of Ericsson's "sub-aquatic system" of naval warfare. In Dual Between the First Ironclads, author Davis states on page 42 that when in port for repairs, one hundred indentations were found in Virginia's armor; author deKay in Monitor cites ninety-seven hits on page 201, at least twenty of which could be certain to have come from *Monitor*.

6. Breyer, Battleships and Battlecruisers 1905-1970, 27.

7. O.R., Ser. I, Vol. 9, 23.

8. deKay, Monitor, 203-4.

9. O.R., Ser. I, Vol. 9, 25.

10. William N. Still, Iron Afloat (Indianapolis: Vanderbilt University Press, 1971), 91, 222, 227.

11. deKay, Monitor, 207.

Chapter 5

1. "The Naval Combat in the Chesapeake", Harper's Weekly, (New York: Harper's Weekly, 22 March, 1862), 183.

2. Discussions concerning the tactic known as "crossing the T" can b found in a variety of books dealing with naval warfare as waged by wooden sailing ships. Two good sources are: C.S. Forester, The Hornblower Companion, (New York: Pinnacle Books, 1974), 61-3.; and Henry E. Gruppe, *The Frigates*, The Seafarers, (Alexandria, Virginia: Time-Life Books, 1979), 100-4, et al.

Conclusion

1. Davis, Dual Between the First Ironclads, 140.

Appendix 1

1. The Mid-Atlantic States, National Geographic Maps, 1947

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