guns of 50 calibers length—a new piece with a velocity of 3,010 feet per second, and an energy of 54,200 foot tons. By placing two of the turrets amidships, one on each side of the superstructure, the end-on fire is increased at the expense of the broadside fire. Six 12-inch can be fired ahead, eight astern, and eight on each broadside. The forward pair are mounted on a lofty forecastle deck, and the wing guns and four after pairs of guns on the main deck, the forward of the two after pairs of guns being raised sufficiently to fire over the after pair.

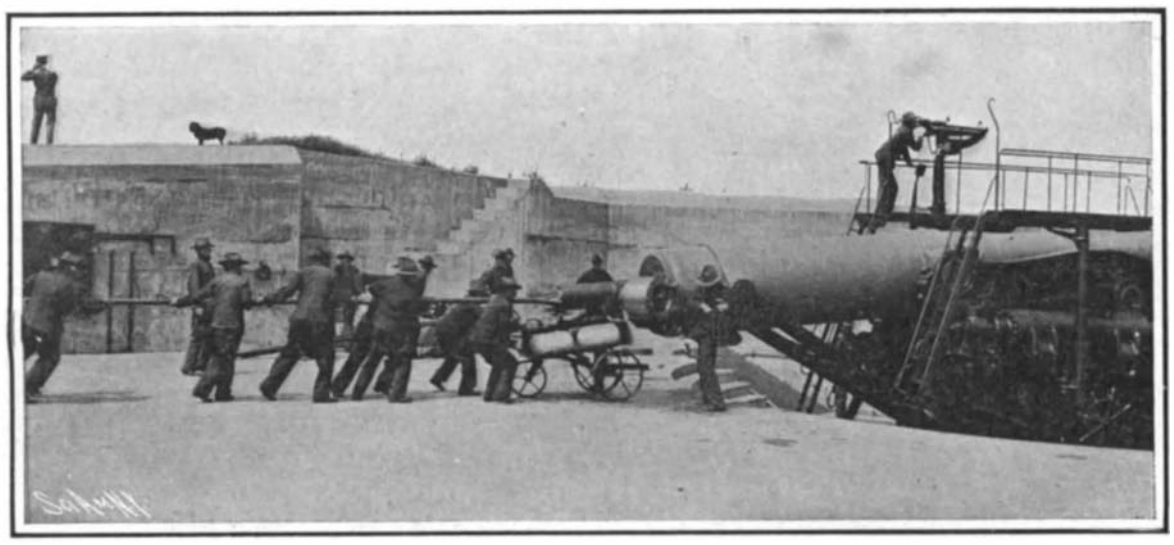
The "Florida" is the type ship of the American "Dreadnought." She is 518 feet long; 20,000 tons displacement; is protected by 11- to 12-inch armor, and mounts ten 45-caliber guns on the axis of the ship, so disposed that four can be fired ahead, four astern, and ten on each broadside. Her broadside fire is therefore 25 per cent greater than that of the "St. Vincent."

France is represented by the "Danton," 480 feet long; of 18,400 tons displacement; armed with four 12-inch 50-caliber guns, two forward and two aft, and twelve 9.4-inch 50-caliber guns mounted in turrets six on each broadside. The armor is from 10 to 12½ inches in thickness.

Germany is represented by the "Nassau," a 19,000-ton ship, 472 feet in length. If there was any mistake made in arming the earlier German battleships with too light a battery, no such criticism can be directed against this latest design. By mounting two of her turrets *en echelon* amidships, the Germans secure from their twelve heavy armor-piercing guns of 11-inch bore and 50 calibers length the heaviest broadside of any of the "Dreadnoughts"—the heaviest, at least, in the total number of large guns that it includes. At the same time, her end-on fire is also heavier than that of any other ship of the "Dreadnought" type. Two pairs of turrets are mounted forward, the guns of one firing over the other; two turrets are mounted similarly aft, with the result that the "Nassau" can deliver a fire of eight 11-inch guns ahead, eight astern, and twelve on each broadside.

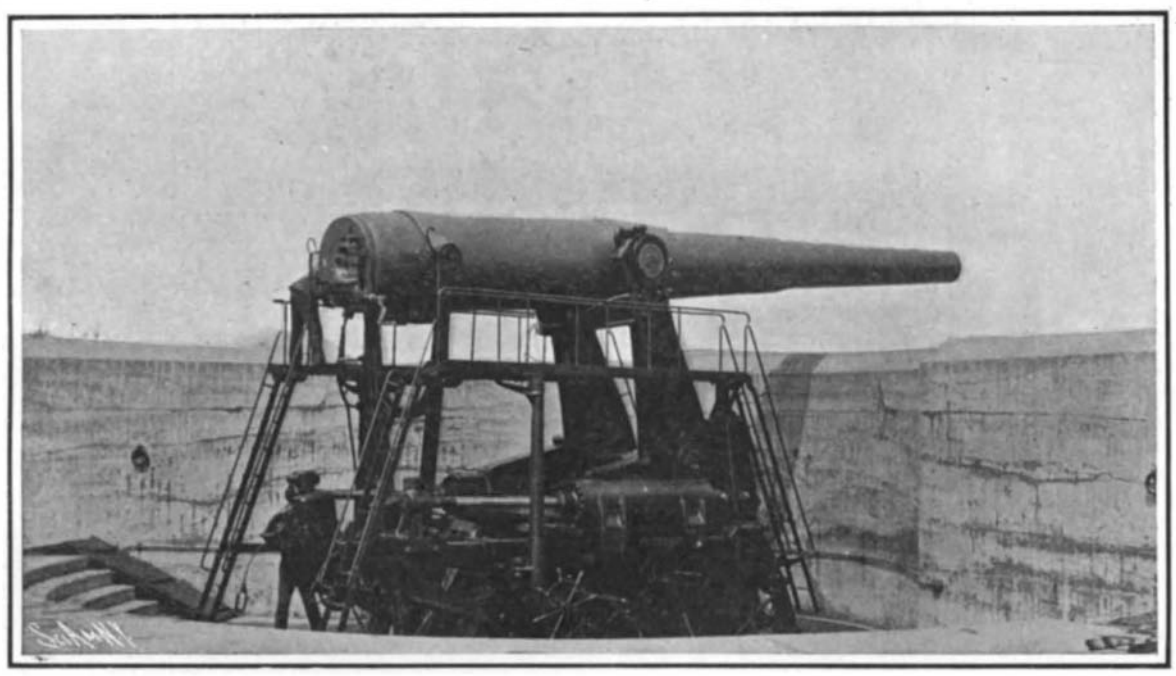
The Japanese are represented by a ship of about 21,000 tons displacement and 481 feet total length, carrying twelve 45-caliber 12-inch guns in six turrets, two forward and two aft, arranged as in our own "Florida," and two amidships, one on each broadside, the concentration of fire being eight ahead and eight astern, and ten on the broadside.

So much for a comparison of the fighting strength of the navies of the world based upon the total displacement of the battleships and armored cruisers. If the mere question of tonnage, or even of the number of guns carried and the thickness of the armor, alone determine fighting strength, the accompanying diagram would pretty closely represent conditions. But there is another element of strength, perhaps the most important of all, which might entirely alter the relative standing. We refer to the human element—the skill of the admirals and officers in strategy and tactics; the accuracy of the men behind the guns; the general *morale* of the whole fleet. Japan has recently proved her efficiency; and we know that in skill, discipline, and courage her navy apparently leaves little to be desired. The published reports of the target practice in the British navy and in our own would make it certain that the shooting of these two navies is of a very high order. In the United States navy, when the ships have been firing under battle conditions, the average of hits has risen, in the case of one ship, as high as eighty per cent, and the average for the Atlantic fleet is probably about sixty per cent. The results obtained on the recently completed voyage around the world would give us reason to believe that both the ships and the personnel have reached a point of excellence which is fully equal, and perhaps superior, to that of any other navy.

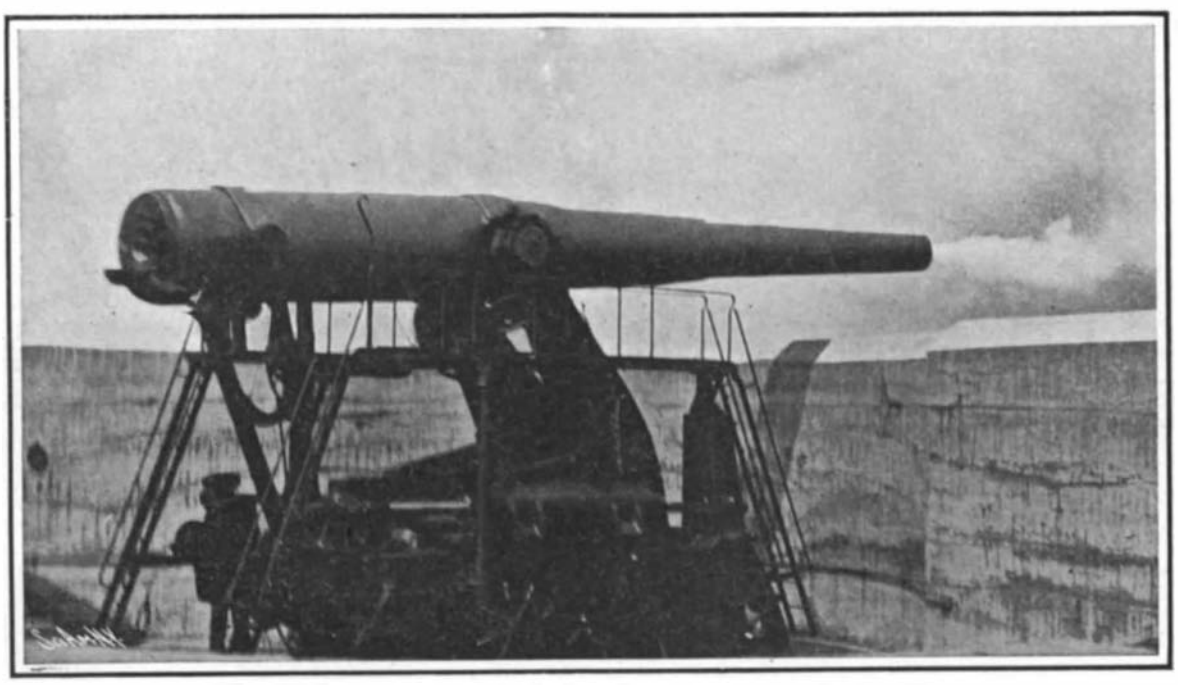


The gun is below the parapet, protected from the enemy's fire.

Loading a 12-inch coast-defense gun.



Loaded and elevated, ready to fire.



The recoil; gun swinging back and down to the loading position.

OUR SYSTEM OF SEACOAST FORTIFICATIONS.

The best system of defense of the seacoast of the United States is an adequate fleet of seagoing battleships, and the nearer this line of defense can be placed to the coastline of the enemy, the more secure from attack will be our own seaboard. If, however, a fleet of the enemy's battleships should arrive off our coast, after either meeting and destroying our own fleet, or skillfully eluding it, the defense of our maritime cities must depend upon fixed seacoast fortifications and their accessories. The present scheme for seacoast fortifications is outlined in the report of the National Coast Defense Board, under date of February 1st, 1906. The original scheme, as drawn up by a similar board, in 1886, has been practically completed, and our principal harbors and seacoast cities may be considered as well equipped for defense. The fortifications are equipped with batteries of 12-, 10-, 8-, 6-, 5-, 4.7-, and 3-inch guns. The heavy 12-inch and 10-inch guns are mainly relied upon to prevent the approach of the enemy through the channels and entrances defended. They are mounted upon heavy foundations of concrete, and protected in front by parapets of the same material and of great thickness, in front of which are deep sloping embankments of earth. The majority of the guns are mounted, similarly to the 12-inch gun which forms the subject of our illustration, upon what is known as the Buffington-Crozier disappearing gun carriage. In this mount the gun is pivoted at one end of a pair of massive levers, at the other end of which is suspended a weight which is sufficient, after the gun is loaded, to bring it into battery above the parapet. The gun is brought back and down to the loading position by the energy of the recoil. While in the loading position, it is entirely below the parapet, and both the gun and the gun detachment are fully protected from direct fire. The ammunition is kept in massive concrete ammunition rooms, from which it is wheeled on a truck, as required, up to the open breech of the gun, and loaded into the powder chamber. The sighting of the gun is done while it is in the depressed position. At the word of command a catch is released, and the heavy counterweights bring the gun into battery above the parapets. This disappearing mount is used for the 12-, 10-, and 8-inch guns.

Our latest 12-inch coast defense gun has an initial velocity of 2,550 feet per second, and a muzzle energy of 47,299 foot tons. If it strikes a normal blow (a blow at right angles to the plate) it can penetrate the 12-inch armor of battleships at 8,700 yards, and the 7-inch armor of armored cruisers at all practicable fighting ranges. To obtain this energy, it is necessary to use such a high pressure in the powder chamber that the corresponding high temperature and high velocity of the gases burns and abrades away the interior of the gun, shortening its life to such an extent that, after sixty rounds, it loses its accuracy. With a view to preventing this rapid deterioration, the Board of Ordnance have decided to build a bigger gun, firing a heavier projectile with a lower powder pressure, thus

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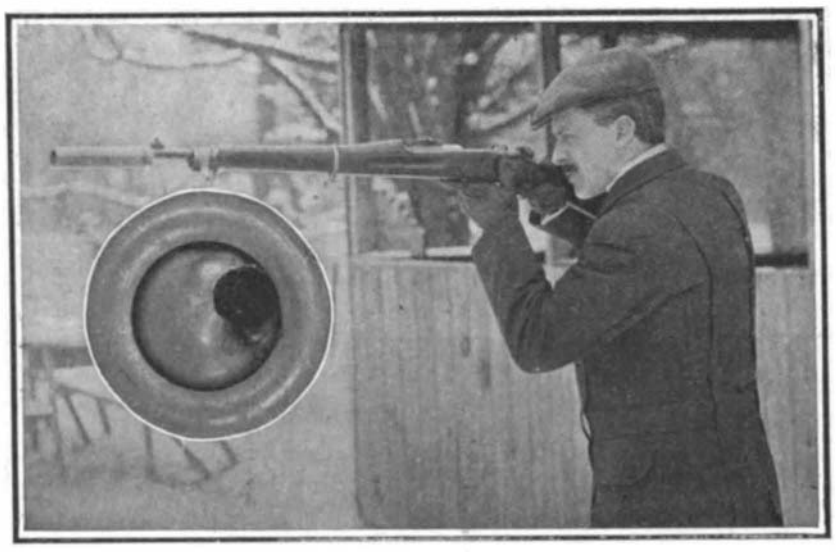
Gray Stain for Ivory.—Lay the parts in a solution of 1 part of pyrogallic acid in 20 parts of water, for about 20 minutes, allow them to dry thoroughly, then immerse in a solution of 1 part of green vitriol in 25 parts of water.

reducing the temperature of the gases and the consequent erosion. A 14-inch caliber has been adopted, and several guns are being built. The new 14-inch gun will fire a projectile of 1,660 pounds, with a muzzle velocity of 2,150 feet per second. It will have about the same penetrating power at 8,700 yards as the 12-inch gun; and it will carry a bursting charge of high explosive over fifty per cent greater than that of the 12-inch projectile. Because of its shorter length, its weight, 49.5 tons, will be about the same as that of the 12-inch gun.

There are several objections to the 14-inch gun. In the first place, the rate of fire will be necessarily much slower than that of the 12-inch. Another objection is that the trajectory, or curve of flight, of the projectile is not nearly so flat as that of the 12-inch gun, and, therefore, the danger space, in which the enemy is liable to be hit, is less. On the other hand, instead of losing its accuracy after firing sixty rounds, the 14-inch gun would fire 245 rounds before deterioration set in. The original plan for arming our coast defenses included a large number of 16-inch guns. Only one of these, however, has been built. It is at present at Sandy Hook, where it underwent its trial successfully, but we believe it has not as yet been mounted in any permanent emplacement. This huge gun, the most powerful in the world, weighs 74 tons, and fires a 2,400-pound projectile with a muzzle energy of 77,000 foot tons, and a remaining energy at 8,000 yards of 40,540 foot tons. Its rate of fire is thirty rounds per hour, and it will lose its accuracy after 175 rounds. The gun cost nearly $200,000. It is too costly, and its rate of fire too slow, to make it a suitable weapon of defense against modern 50-caliber 13½- and 14-inch guns, such as are now being contemplated by foreign navies, whose striking energy will be not very much less at ordinary fighting ranges, and whose rate of fire will be at least four times greater. Hence, we are not likely to build any more 16-inch guns.

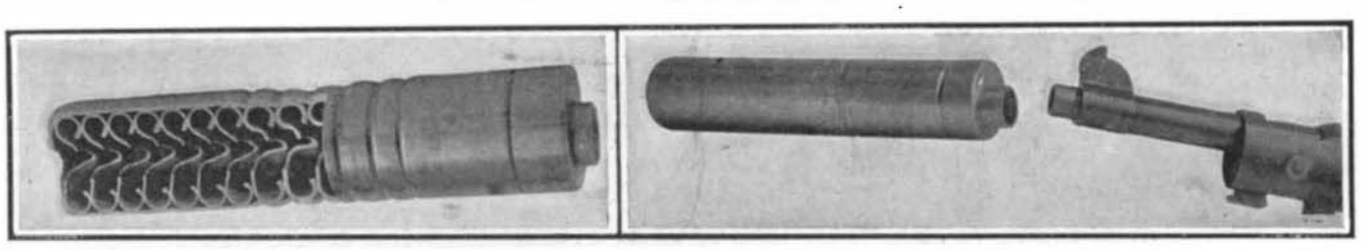
Although the heavy guns mainly will be depended upon to prevent the approach of the enemy, there will be two auxiliary elements, the submarine boat and the submarine mine, which, in our opinion, will be even greater deterrents in keeping the enemy well off-shore. The submarine is no longer an experiment, at least for sea-coast defense. An enemy's fleet attempting to enter, let us say, New York harbor, must be prepared, at any time after it has passed the three-mile limit, to receive the blow of the torpedo, delivered by an unseen and practically undetectable enemy. Should the fleet evade the submarines, at a distance of five miles it would come within range of the 10-, 12-, and 14-inch guns, and, because of the wonderful accuracy of modern range finders, these guns would be laid with deadly accuracy. Should the attacking fleet, however, pass without mortal injury through this five-mile zone of armor-piercing fire directed upon it from Sandy Hook, and through another five miles of fire of triple intensity, rained upon it from the combined batteries of Sandy Hook, Fort Wadsworth, and Fort Hamilton, it would have to pass through one or more fields of submarine mines laid in the manner described and illustrated in our issue of January 23rd, 1909.

Now, a modern battleship costs from $8,000,000 to $10,000,000, and it might take but one blow by gun, torpedo, or mine to so cripple the ship as to place it at the mercy of the coast defenses. Moreover, the bombardment of cities will prove merely a strong irritant, and can never exercise a conclusive effect in determining the issues of a war. It is very unlikely that the costly battleships of the future will engage seacoast fortifications—certainly they will never risk the enormous losses involved in forcing an entrance through well-defended harbors such as those of New York, Boston, or San Francisco.



Front view of a disk.

A military rifle with silencer attached.



Half sectional view, showing the method of assembling the spiraled disks.

The silencer ready for screwing on to the threaded end of barrel.

THE SILENT GUN.—COUNTERPART OF SMOKELESS POWDER.

The public demonstration by the inventor, Mr. Hiram Percy Maxim, of his silent gun introduces a weapon which is destined to affect the conduct of military operations of the future in much the same way, and to almost the same degree, as did the introduction of smokeless powder. For many years past the military authorities have been devising ways and means for rendering the presence and movement of troops invisible. The first successful step in this direction was the introduction of smokeless powder, and this was followed up by a careful study of the uniform and equipments, in the effort to secure those colors which would blend most completely with the surrounding landscape, and render the presence or movement of troops difficult of detection. Smokeless powder and earth-brown khaki suits have done wonders in this direction. So perfect is the concealment, that, were it not for the rattle of the discharge of musketry, it would be well-nigh impossible definitely to locate the positions of a line of skirmishers, or even of a large body of troops taking advantage of natural cover. In determining the position of the enemy and strength of the attacking force, the leader of a body of troops is dependent almost entirely upon the sound of the enemy's rifles. In reading descriptions of battles, either by war correspondents or as contained in official reports, one frequently comes across such a phrase as this: "There was a sound of heavy firing on our right." If the sound of discharge could be eliminated, the principle of concealment would be worked out to theoretically perfect conditions; for it would be possible for an attacking force to deliver its fire, without the enemy having the slightest idea as to the range or direction from which it was delivered, or the strength of the force engaged.

The recent public demonstration made before a party of invited guests, including a representative of the Scientific American, occurred in an office building in this city, where a temporary shooting range, about 15 feet in length, had been erected, at the far end of which was a box of sand to receive the bullets. For the purposes of the test, a dozen modern rifles of high power, in which were included the best-known military rifles of Europe and America, had been provided, and from each of these a couple of shots were fired—one without the silencer, and the other with it attached.

The silencer is a small sheet-steel tube, 1½ inches in diameter, and from 4 to 6 inches in length according to the gun to which it is attached. For a .22-caliber rifle, it is about 4 inches long, and for a .30-30 rifle it is 6 inches long. The weight varies from 6 to 9 ounces. The silencer is attached by pushing it home on the barrel, and giving it a quick three-quarter turn to engage the threads. The report of a rifle is due to the sudden liberation of the powder gases, which occurs immediately after the base of the bullet has left the muzzle. The gases, rushing out, expand into mushroom form, and their impact on the air causes the characteristic sound of a swiftly-delivered blow. The object of the silencer is to arrest these gases; change their forward direction into a rotary one; slow down their velocity; and allow them to pass out through the air so gradually as to produce a but slightly audible sound. The principle upon which this is done was illustrated in a very homely way by the inventor, when he likened it to the effect produced when the stopper is taken out of a basin full of water, and a swift rotary motion is imparted to the contents, when the centrifugal force holds the water against the sides of the basin. As the rotary motion decreases, the water begins to descend and flow through the plug hole, the basin being slowly emptied. In the silencer, the gases are caught upon a series of spiral vanes, where their motion is turned from a rectilinear to a circular one. After the velocity is decreased, they flow out gently and without sound.

The construction of the silencer is shown very clearly in the half-sectional view, and in the photograph of one of what might be called the small turbine elements. Each of the latter consists of a sheet-steel disk, having a hole near the center slightly larger than the bullet, and with its outer edge turned over, so as to form an annular path in which the gases rotate. The inventor describes the action of the device as being practically the reverse of that of a turbine engine. In a turbine-driven engine the gases advance in an approximately rectilinear line, parallel with the axis of the turbine; and their effect is to make the bucket wheel revolve. In the silencer the bucket wheel or rotary blades are held fast, and as a result the steam, or gases, as in this case, are given the rotary motion. The central holes in the disks are all aligned perfectly with the axis of the rifle; and, as they are slightly larger in diameter than the bullet, the latter passes through them without being in any degree affected as to its velocity or accuracy. The gases, as explained above, are caught in the successive disks; their motion is changed from a rectilinear to a circular or spiral one, and their velocity is gradually reduced to a point at which they fail to make any audible concussion on leaving the silencer. In the demonstration referred to, the audible sound was mainly that produced by the impact of the bullet in the bed of sand and the click of the firing mechanism. In tests which had previously been made by the army authorities, observers standing several hundred yards away from the gun were able to hear only the ripping sound of the bullet as it cut its path through the air, and the blow as it struck the target.

SANTIAGO AND ATLANTIC FLEETS COMPARED.

It is probable that few people, outside of the navy, appreciate the astonishing growth which has taken place in the fighting power of our ships during the ten years intervening since the Spanish war.

We can vividly recall the profound impression of the destructive power of our little fleet of battleships under Admirals Sampson and Schley, which we all felt on reading the dispatches of July 4th, 1898, announcing that in a few brief hours their guns had completely annihilated the ships of Cervera's squadron, setting them on fire; driving them ashore, or, as in the case of the torpedo boats, quickly sending them to the bottom. In the present hour, when the Atlantic fleet of sixteen battleships have returned intact to a home port after a voyage of 42,000 miles around the world, it is opportune to compare this armada with that which made the eventful voyage to the south coast of Cuba to find and destroy the fleet of the enemy.

To state that in the fleet of 1908-9 there are sixteen battleships as compared with the five which we were able to muster off the south coast of Cuba, is to merely lay the foundation for our comparison. In the intervening period there has been a steady increase in the size of the battleship, until the largest unit, represented by the flagship "Connecticut," is over fifty per cent heavier than the "Oregon," our most powerful fighting ship in 1898. The Santiago fleet consisted of five battleships: the "Oregon" class, of 10,288 tons displacement; the "Iowa," of 11,410 tons; and the "Texas," of 6,300 tons. The total displacement of the fleet was 48,525 tons. The Atlantic fleet as it steamed into Hampton Roads consisted of five battleships of the "Connecticut" class, each of 16,000 tons; five of the "Virginia" class, of 14,948 tons; two of the "Ohio" class, of 12,500 tons; two of the "Alabama" class, 11,552 tons; and the "Kearsarge" and "Kentucky," of 11,500 tons; the total displacement of the fleet being 225,884 tons. In displacement, then, the Atlantic fleet is four and three-quarter times that of the fleet that fought at Santiago.

Mere size, however, is of little value, unless it is taken in connection with other elements of efficiency; and the first among these that we will consider are those of horse-power and speed. The "Oregon" class were designed for 9,000 horse-power and 17 knots speed; the "Iowa," for 11,000 horse-power and 16.5 knots; the "Texas," for 8,000 horse-power and 17 knots