BROADSWORD EXERCISE ON MEN-OF-WAR.

Since the old days when vessels fought on the Spanish Main, after the adversaries had hulled each other until one of the vessels was hors de combat, "boarding" was resorted to. The sailors, literally armed to the teeth, for they often carried knives in their mouths, rushed upon the deck of the doomed vessel and with pistol, cutlass and knife fought to the death. These days are pretty much over and now when the boarding party reaches the vessel the ship has usually surrendered and the sailors are only needed to police it. Their comrades stand at the deadly rapid-fire and machine guns, and any attempt at interference with the boarding party would result in the deck of the ship being swept by a hail that nothing could withstand. It might be supposed that our modern methods of warfare, deadly though they are, would have relegated the cutlass to the limbo of things forgotten, but this is not the case, for there are still many occasions where sailors could use them effectively, as in landing troops on a hostile shore, and broadsword exercise is regarded by naval officers as an excellent means of keeping their men in a good physical condition.

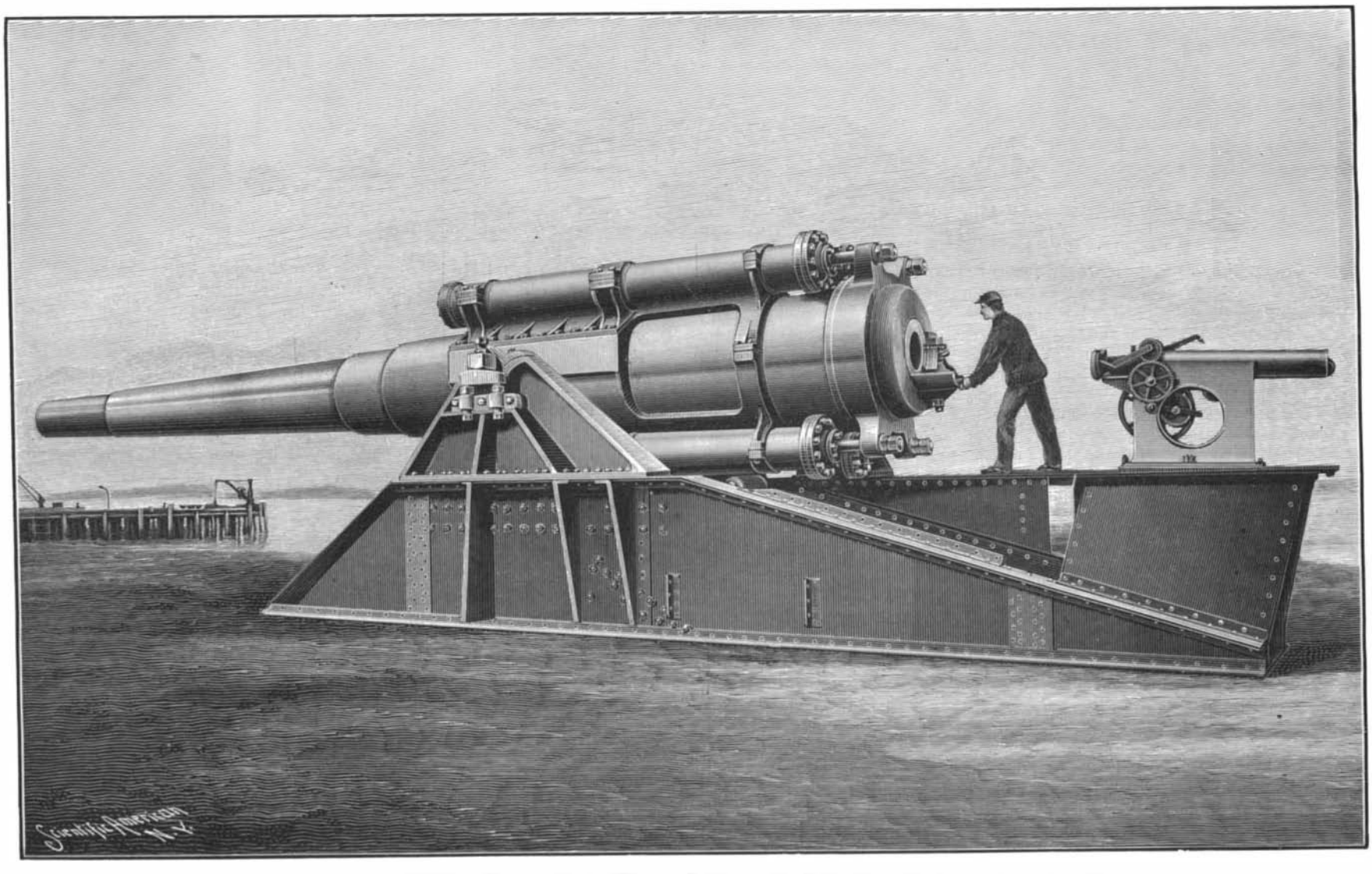
To-day we really fight by machine, and the personal equation does not enter to any great degree as regards the larger part of the rank and file. It is obvious that in a battleship, where the bulk of the heavy work is done by some fifty distinct engines and electric motors, the occupation of the sailor is pretty well gone, unless he is also an engineer, electrician or mechanic, and there is no work aloft in modern warships provided with military masts. While this has undoubtedly limited the labors of the crew, it also makes it incumbent upon the officers to devise some substitute, so that the efficiency of the sailors shall not be impaired for lack of proper exercise which cannot be obtained in the ordinary routine, various drills have been devised. We have already illustrated the "setting up" drill, both with and without arms (see the SCIENTIFIC AMERICAN, August 14, 1897), and we now show a broadsword drill between two pairs of sailors under the lee of one of the turrets of the "Terror." The exercise is exciting and is much enjoyed by the sailors, and has a great advantage over the "setting up" drill, as the sailors exercise in pairs, thus introducing the personal element. Our engraving is reproduced from a photograph by Frank M. Boetler.

BROADSWORD EXERCISE ON THE MONITOR "TERROR."

OUR NEW THIRTEEN-INCH GUNS.

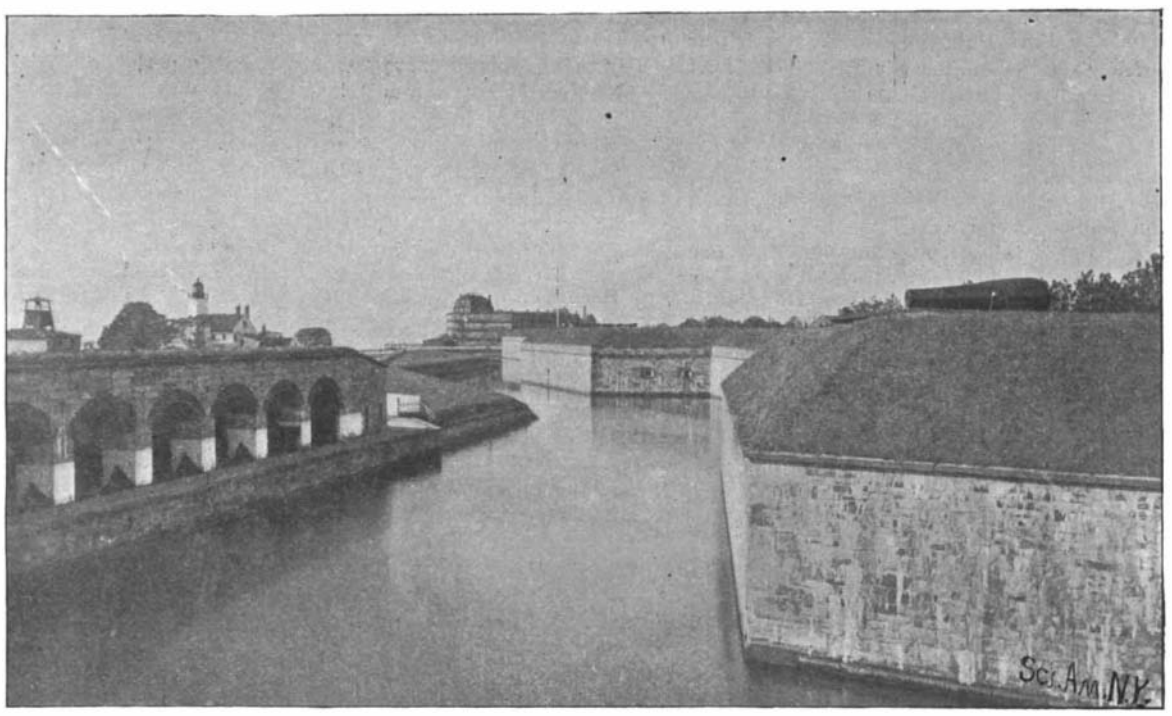
The high power rifle of to-day is the crowning feature of the modern floating fort—a battleship. Although the old gun founders cast beautiful cannon of artistic design which modern ordnance cannot approach for beauty, still the modern gun, though exceedingly plain, is a work of the highest mechanical order. The gun shown in our engraving is a 13-inch rifle with a turret mount and it is made on the "built-up" principle. Although many foreign gun makers have discarded the hooped gun, we still continue to make them, and our guns are inferior to none. The distinguishing feature of our American rifles is their great life, and one of the 10-inch guns on the "Miantonomoh" has been fired over a hundred times at the Indian Head proving grounds, and many more times after being placed on the ship. It is believed that the war with Spain will give data which may determine the average life of our 12 and 13-inch guns, but it is not expected that the war will last long enough to put any of our guns out of action on account of weakness caused by repeated firing. Out of all of the guns made at our Washington gun factory, not one has ever burst in service, while abroad gun accidents under service conditions are of not infrequent occurrence.

The navy of the United States has twenty-eight of these 13-inch guns. The battleships "Indiana," "Massachusetts," and "Oregon" have already been furnished with them, and the "Kearsarge," "Kentucky," "Alabama," and "Wisconsin" will each have four mounted in their two turrets. The gun is built of three parts, tube, jacket and hoops. The bore of the gun is formed of a tube which is of uniform diameter throughout, except where the powder chamber cuts it away. The gun is built up around this tube by shrinking on bands which, while really smaller than the tube itself, are expanded by heat and then shrunk on, producing great compression; care is of course taken to prevent the tube from being compressed beyond its elastic limit. What is termed the "jacket" is another approximately cylindrical tube which is more than one-half as long as the gun. This reinforces the tube where it is cut away for the powder chamber and also gives the necessary support for anchoring the breech mechanism. The



THIRTEEN-INCH NAVAL GUN WITH TURRET MOUNT AT THE INDIAN HEAD PROVING GROUNDS.

gun is further strengthened by additional pieces called hoops, also shrunk on. Even the jacket, in turn, is reinforced by hoops or bands, which are interlocked in an ingenious manner. The gun forgings are made from open-hearth steel, cast in ingots, each being about twice as heavy as the finished piece. The ingot is forged down, rough-bored and turned nearly the finished dimension, and test specimens are taken from one or both ends after the forging has been annealed, oil-tempered and again annealed. If satisfactory, the ingots are then accepted by the government. The pieces are then sent to the gunshop, at Washington, which is shown in our issue for February 26, 1898. The gunshop work is principally turning and boring. The work has to be done with the utmost accuracy; for shrinkage it is done to $\frac{1}{1000}$ of an inch. The tubes are bored as well as the jacket, and the hoops are also accurately turned inside. After the tube is finished, the jacket is shrunk on by heating in a furnace forty feet deep to a temperature of about 550° Fah. Twenty or thirty hours may be needed to bring it to the uniform temperature. The jacket is then lifted out of the furnace by the crane and is lowered over the tube, and if the jacket is properly heated it goes smoothly to its seat and the embryo gun is allowed to cool. Then the fore part of the tube is turned for the chase hoops, which are then put successively in place; then the jacket hoops are shrunk on in the same general way. The next operation is to finish boring the gun, and then the rear of the gun is bored out to an increased diameter to form a chamber for the powder. This is connected with the main bore by a conical portion of the bore, termed a compression slope. Back of the powder chamber is a short box of still larger diameter, termed the screw box, which has a screw thread cut on its inner surface. Then sections of this screw thread are slotted out, forming the interrupted screw for the breech plug. The exterior of the gun is now finished-turned and the bore is rifled. The gun is then ready to receive its breech mechanism. The 13-inch gun shown in our engraving has a new arrangement of the breech mechanism, which is superior to the one formerly used, which required three distinct operations: 1, turning the breech plug; 2, withdrawing the breech plug; 3, swinging the breech plug and tray away from the breech. On the shaft, below the worm wheel, is a wheel which first acts as a gear wheel on a rack fastened to the breech plug, to slide the breech plug into the screw box when the breech of the gun is to be closed, and then acts as a worm wheel on a worm rack at the end of the gear rack and at right angles to it, thus turning the breech plug and locking it in place by means of the interrupted screw. The usual gas check and firing mechanism common to all large rifles is used in this gun.



VIEW OF MOAT AT FORT MONROE, VA.

The gun is mounted in a sleeve, a key or bar is secured to the gun and fits a groove in the sleeve, which permits the gun to slide longitudinally. The recoil is taken up by four recoil cylinders, which are shown in our engraving. They are mounted in collars, the lower portion forming an integral part of the sleeve. The piston rods are attached to a ring located near the breech end of the gun, so of course they travel with the gun. In the recoil cylinders are nests of heavy springs, which take up a large part of the recoil. The movement of the pistons is also regulated by a mixture of glycerine and water in the recoil cylinders. This fluid is allowed to escape slowly past the piston by grooves in the walls of the cylinder. At the point where the gun is to be brought to rest the groove ends, consequently the motion of the gun is arrested. The sleeve holding the gun is pivoted at its front end on two trunnions. Devices are provided for elevating and depressing the gun. This work may be accomplished by hand power or by a motor. An arrangement is made for allowing the screw to yield at the moment of recoil. At the rear of the gun will be noticed the rammer, which, though only five feet long, may be extended to fourteen feet by means of tubes that telescope. Hand gear is also provided for the rammer. Our engraving, which was made from a photograph taken at the Indian Head proving ground, shows the gun on a turret mount. The gun and its mount turns with the turret, and the gun captain in the sighting hood directs the elevation and depression of the gun so as to get the proper range, sighting through a telescope secured to the sighting hood. By means of levers connected with the sleeve, the sighting telescope is always maintained in strict parallelism with the gun itself. The gun captain discharges the gun with a lanyard or by electricity.

The following data referring to the largest gun now made for the navy are of interest: Diameter of bore (caliber), 13 inches; length of gun (479·1 inches), 39 feet 9¼ inches; weight of gun, 136,000 pounds; weight of full charge of powder, 520 to 560 pounds; weight of projectile, 1,100 pounds; velocity at muzzle, 2,100 feet per second; velocity at 2,500 yards, 1,805 feet per second; thickness of steel which shell will perforate at 1,000 yards distance, 24·54 inches.

A DIAMOND in constant use for cutting cold glass lasts about three months, but if used to cut hot glass, it would only last for one day.

SOME AMERICAN FORTS.

BY C. F. HOLDER.

The forts of the great American seaboard present an interesting spectacle at the present time, being in a state of transition. Nearly all still retain the old form and outline, but many have been adapted to modern guns and provided with defenses which will make them effective against the most powerful foe.

An examination of the old forts which gave such accounts of themselves during the civil war tells a remarkable story of the progress of military science and shows that within a few years the old methods have been completely overturned.

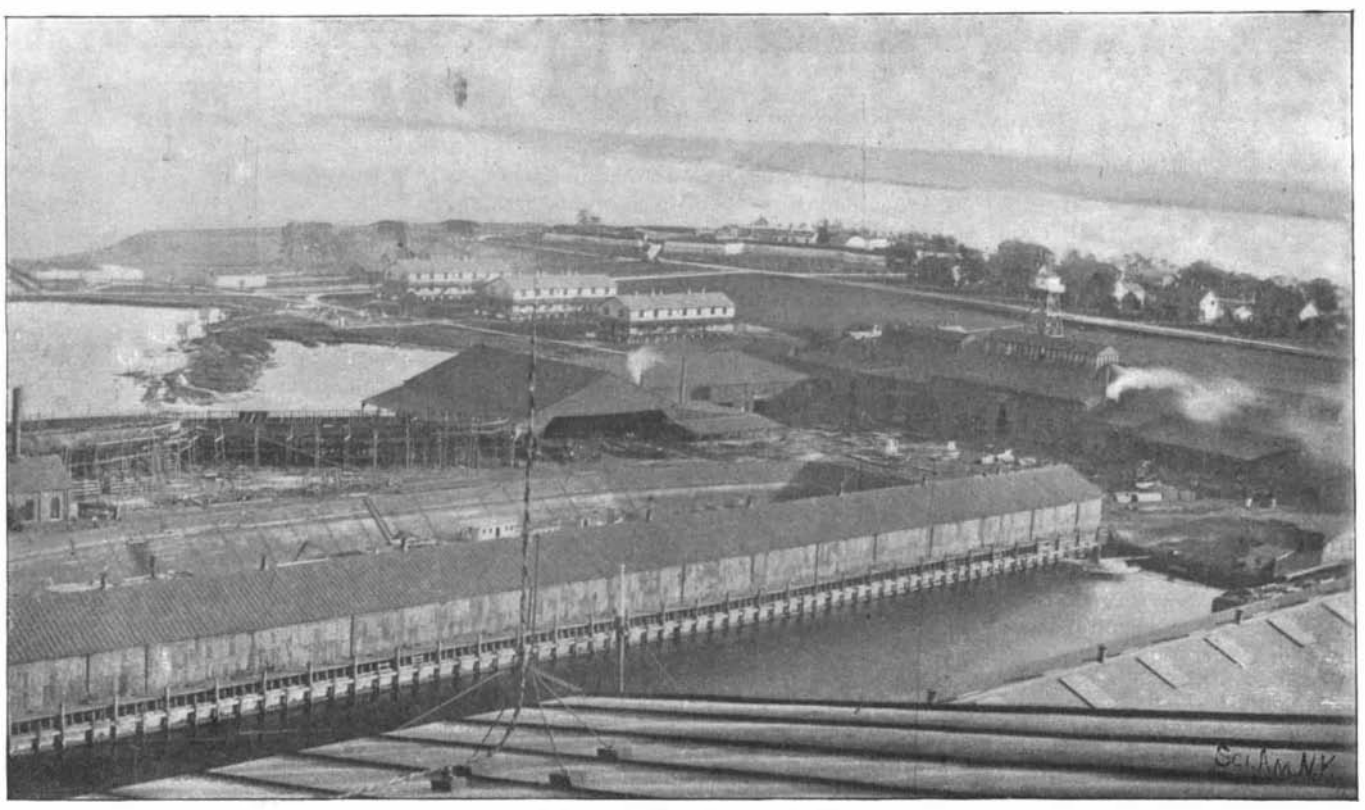
So radical has been the change that the government has done almost nothing with many of the old forts, and for thirty years they have been dropping to pieces in the hot sun of the Southern border, a semblance of care being taken of them by a corporal's guard stationed there to see that the property was destroyed by nature, not by man.

Among the forts attracting attention at the present time is Fort McHenry, which constitutes the defense of Baltimore. It is situated on a picturesque point and, while of an obsolete type, has some powerful modern guns which will prevent the advance of any Spanish warship in that direction.

Those who have not visited Old Point Comfort, Virginia, for several years would hardly recognize the old garrison at present. It is the center of army and navy activity. The Point is crowded with men, and has been of special importance, owing to the fact that it was the rendezvous of Commodore Schley's "Flying Squadron," before it was ordered southward.

Fort Monroe is perhaps the most important location on our entire coast line, so far as defenses are concerned, as it is supposed to command the approach to Washington, Baltimore, Richmond and many other cities of more or less importance.

Fort Monroe is the largest fort in the United States, possibly in the world, and embraces thirty or forty acres or more in its interior. It has two tiers, a casemate and parapet, is surrounded by a deep moat, and is protected by a water battery and batteries of heavy guns along the sandy beach. There are two entrances over bridges, and in the center is a fine parade ground, where are held the drills of the artillery schools. This famous school was established in 1868, and has become an important branch of the service, really a post-graduate West Point course, from which all the officers of the artillery branch of the service have graduated. It was here that the first experiments were made with 15-inch guns and sections of modern batteries and armor.



FORT McHENRY, MARYLAND.

In the center of the channel stands old Fort Wool, now of little use except as a lighthouse base and a monument of past methods. The government has permitted the construction of a number of buildings on the reservation at Old Point Comfort, which might have to either come down, in case of attack, or be blown down. Such is the big hotel which rises on the beach in front of the fort to the south, almost in line with the guns on the parapet.

Passing on to Charleston, South Carolina, we have Sumter, Fort Moultrie, and many batteries, and the