SIEGE GUNS AT THE WASHINGTON ARSENAL.

The accompanying illustration shows two types of siege guns, several of which were shipped for use in army operations at Santiago, but, like much other of the war material, failed to be brought into active service. The plan of operations contemplated bringing up these powerful guns to the heights surrounding Santiago and subjecting the city to bombardment before the final assault was made. The collapse of the transport arrangements, as the result of poor roads and not a little confusion in the various departments, deprived our army of the indispensable assistance of its artillery, not merely in the final operations against the city itself, but in the desperate fighting against its outer defenses at San Juan and El Caney. Had it not been for the opportune fact that Admiral Sampson, by careening his ships and giving his guns their maximum elevation, was able to throw shells over the hills into the city, Santiago would have had to be carried by assault, with a frightful loss upon both sides.

The two guns in the foreground of the picture are known as 7-inch siege-howitzers, the others are 5-inch siege guns. Both of these weapons, together with the 7-inch mortar, are designed for the attack and defense of inland fortifications and the inshore front of coast fortifications. It will be noticed that the 5-inch gun is a much longer weapon than the other. The greater length is used to give a higher velocity and flatter trajectory to the shell, as this gun is used for "direct" fire, as distinguished from the "high angle" fire for which the shorter 7-inch howitzer is designed. The 5-inch gun would be used when it was desired to breach the walls of buildings, destroy the fronts of earthworks, or burst shrapnel above and in front of bodies of troops. For the first kind of attack the 5-inch shells would be fitted with percussion fuses and the shrapnel would carry time fuses.

The particulars of these two weapons are as follows:

	Weight.	Length.	Weight of Charge.	Weight of Projectile.	Muzzle Velocity.	Muzzle Energy.	Penetration of Steel at Muzzle.
	lb.	ft.	lb.	lb.	f. s.	f. t.	in.
5-inch gun	3,660	12·2	12·5	45	1,830	1,045	6·2
7-inch howitzer	3,710	8 5	10·0	105	1,085	857	3·8

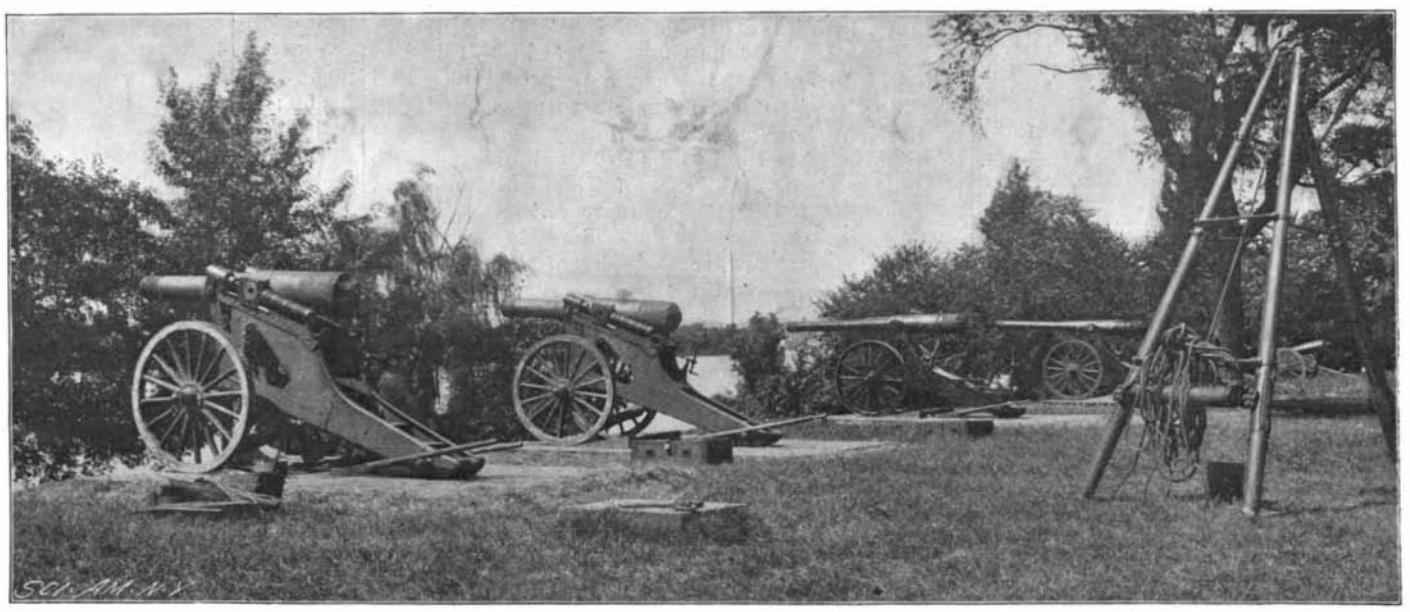
Although the penetration of the 5-inch gun at the muzzle is about double that of the 7-inch howitzer, the velocity of the lighter projectile falls off so rapidly that at 3,500 yards the penetration of the two projectiles is about the same, being 2·5 inches of steel for the 5-inch and 2·4 inches for the 7-inch weapon.

In the illustration the guns are shown in battery, or in the position they would assume when engaged in active firing. The carriage of the howitzer is made of two "cheeks" of ½-inch steel plate, which are tied together and stiffened by transverse plates, as shown in the engraving. The forward end of the carriage is securely fastened to a solid axle, and the cheeks are drawn together toward the rear to form the "tail," which rests upon the ground and forms with the wheels one of the three points of support. The gun rests by its trunnions in sliding trunnion-pieces, which during recoil travel upon planed surfaces upon the top edges of the cheeks. The recoil is governed by two hydraulic cylinders in front of the sliding trunnion-pieces and the gun is returned to the firing position by strong coiled springs behind the trunnion-pieces. Below the carriage is a hydraulic buffer, one end of which is fastened to the timber gun platform and the other to the gun carriage. When the piece is fired, the first shock of recoil is taken up by the upper buffers and through them is transmitted to the buffers below the carriage. The latter can be plainly seen in the second of the 7-inch guns in our illustration.

To the rear of the recoil springs will be noticed a second pair of trunnion beds. These are used when the gun is "limbered up" for transport, the gun being placed in them for that purpose. The object of thus shifting the gun is to divide its weight more evenly between the gun carriage wheels and the wheels of the limber. The gun is elevated by means of the hand-crank, seen at the rear of the carriage, which acts through a shaft and worm on an elevating arc attached to the howitzer at the trunnions. To allow for recoil, the worm is left free to travel along the shaft.

The 5-inch gun-carriage is similar to that of the howitzer, except that there is no sliding trunnion-piece, the gun resting directly on the cheeks of the carriage. The recoil is checked by a hydraulic buffer below the carriage, the cylinder of which is fixed to the platform and the piston-rod to the carriage.

The gun is elevated by means of the double screw which can be seen in the illustration, reaching from the carriage to the breech of the gun. Like that of the howitzer, the carriage is provided with traveling trunnions into which the gun is shifted when limbering up.



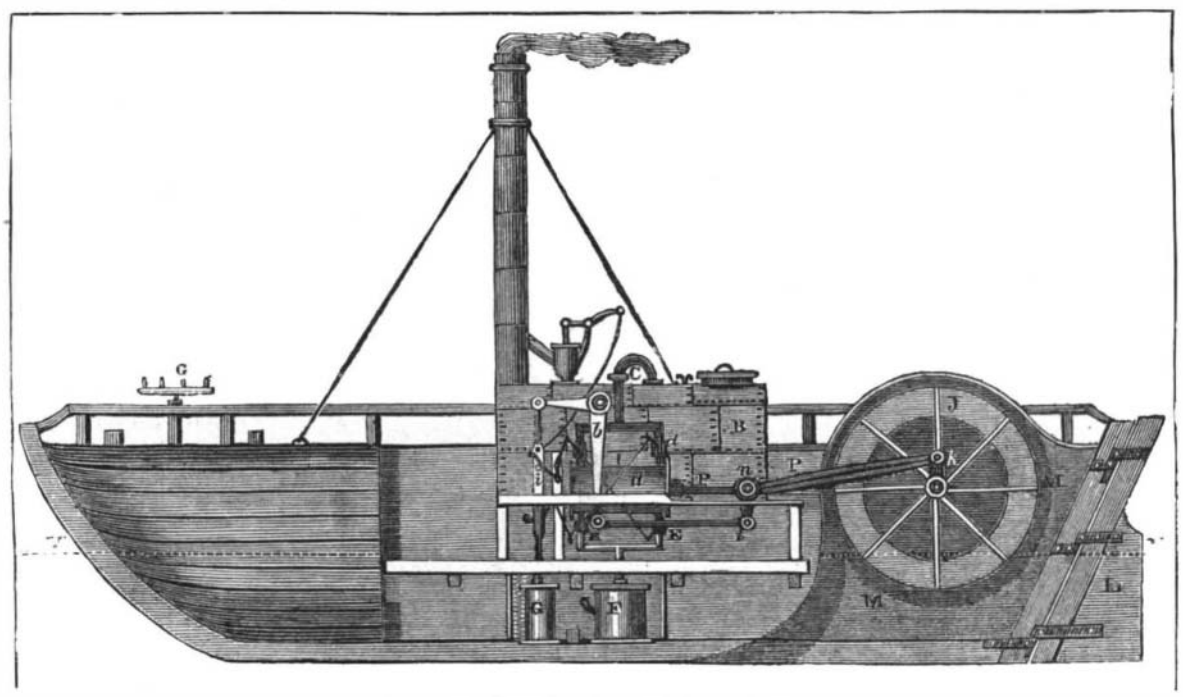
7-INCH SIEGE HOWITZERS AND 5-INCH SIEGE GUNS AT THE WASHINGTON ARSENAL.

A CURIOUS land subsidence took place at Northwich, England, November 15, 1898. The inhabitants were alarmed by the sudden subsidence of a portion of the London main road. The road was built on timber, and when the subsidence began it shortly—within an hour, in fact—became impassable. Buildings were thrown nearly four feet off the perpendicular, and the supply of water, gas, and electricity was interrupted. The area of the depression extended to about 440 yards and was 9 feet deep in the center. The cavity thus formed was filled with water. Great fissures appeared in two buildings, which had to be steadied with bolts and timber.

ROBERT FULTON AND THE STEAMBOAT.

BY PROF. ROBERT H. THURSTON, OF CORNELL UNIVERSITY.

In an early volume (1833) of The Journal of the Franklin Institute, our oldest technical periodical, is published a letter from Mr. W. Symmington, referring to a steamboat built by his father in 1803, and asserting that Robert Fulton, "the American engineer, was on board the 'Charlotte Dundas,' took sketches of her machinery, and received ready answers to the questions he thought proper to put. Several years after his first vessel appeared in America." It is stated that the boat, of which a picture is given, was successfully used in towing, and took two ships at one time against a strong head wind. In view of these claims for the foreign inventor, I have been often asked where lie Fulton's claims, and to what degree is he to be credited with the origination of this modern system of transportation.



SYMMINGTON'S STEAMBOAT, 1803.

In a word, it may be said that Fulton is entitled to quite as much honor for originality in the invention of this system as any one of the many men working at the problem in his time—a problem as old as the steam engine, or older—and attempted by many men before either Fulton, Symmington, or Bell, the Scotch engineer, who is also often upheld as "the" inventor of the steamboat. As regards Fulton, and probably, in their various ways, many other men as well, as the writer has elsewhere remarked, "He was an inventor, and a great one; but he did not invent the steamboat, or, so far as is known, any part of it. H was a talented artist, but his renown does not in the least rest upon his fame on that score. He was a civil engineer and accomplished in that branch of the constructive professions; but the fact is, to-day, almost unknown, even to members of his craft. He was an eminent mechanic; but the 'Clermont,' his first steamboat in America, did not illustrate his genius in that direction."*

The statement of Symmington may be, very probably, found positively and precisely correct; but it detracts not an iota from the merit or fame of Fulton. He had then long been engaged in the prosecution of the task which, ultimately, made him famous by its successful completion. Steamboats had been experimentally built, in 1707, by Papin on the Fulda, in 1736 or earlier by Jonathan Hulls in England, in 1763 by William Henry in the United States, in 1774 by James Rumsey on the Potomac, and later tried in the presence of Washington and other notables. In 1786 John Fitch built his first steamboat, and, for several years, he was experimenting, often with considerable success, on the Delaware. His boats ran thousands of miles, and carried many passengers and much freight between Philadelphia and the towns along the Delaware. He built a screw propeller in 1796; but the idea of a screw was older than James Watt, and, certainly, as old as Bernouilli. Patrick Miller, in Great Britain, built a steamboat in 1786 or 1787, and Symmington was one of his partners in 1788. In France, the Count d'Auxiron, as early as 1770, proposed to build a steamboat planned by the Marquis de Jouffroy, and one was constructed on the Seine in 1772; but it was unsuccessful, and renewed attempts were made, some with fair success, for several years.

In 1776 the same plan was constructed by the inventor, Jouffroy, as was later adopted by Fitch, a boat pro-

*Life of Robert Fulton; "Makers of America Series," 1891.