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.

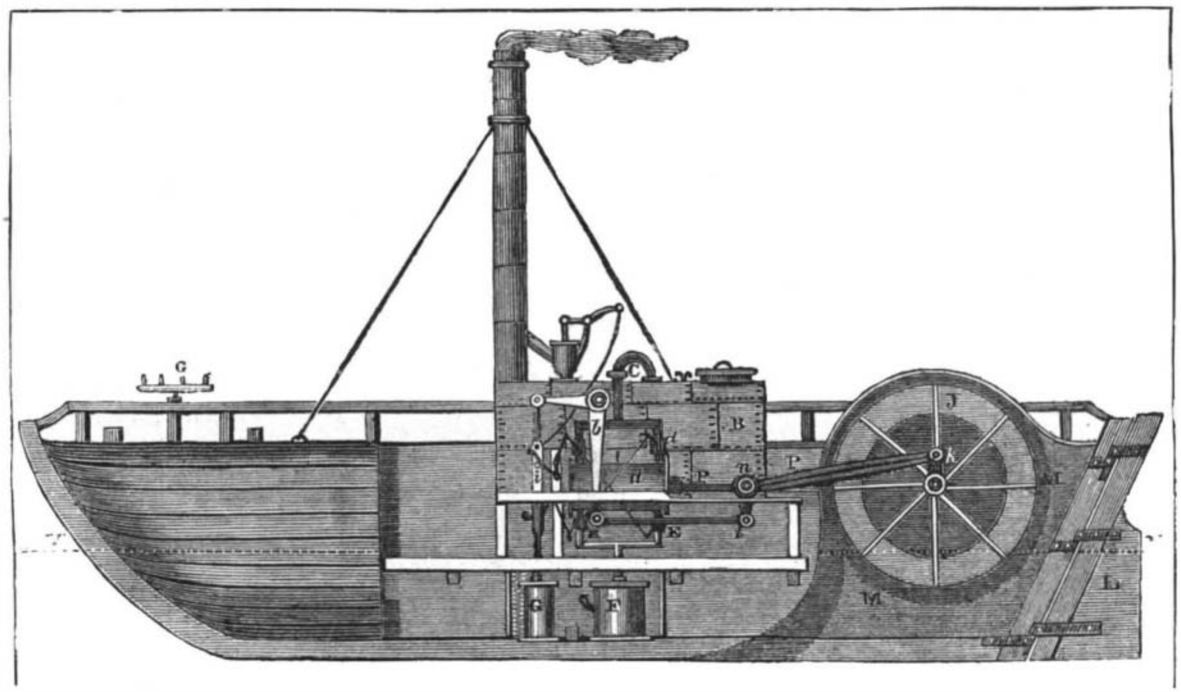
7-INCH SIEGE HOWITZERS AND 5-INCH SIEGE GUNS AT THE WASHINGTON ARSENAL.

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. He 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.

pelled by duckfeet paddles. In 1783 the public trial of one of his boats attracted much attention.

John Stevens built his first screw boat in 1804, his twin screws in 1805, and his first paddle steamer in 1807, almost simultaneously with Fulton's construction of the "Clermont." But Fulton had been at work a long time then.

Fulton was born in Little Britain, Pa., in 1765. He was an inventor and mechanic by nature, and as a boy did many remarkable things; inventing the lead pencil, a rocket, and an air gun and designing guns and gun stocks for the gun makers of his town. He invented a paddle boat in 1779, and finally went to England and to France to introduce his inventions in the improvement of canals, and for other purposes, and to seek fame as a portrait painter, in which art he was extraordinarily proficient. William Henry, Benjamin West, the American minister to France, Mr. Barlow, and other distinguished people were already on the list of his friends. While in France, in 1797, he proposed the construction of a steamboat; but it was not until 1802 that he was ready with his plans. In 1803 his boat was completed and a trial trip was made on the Seine. It made about 4½ miles an hour. One of its special features was a water tube "safety" boiler, invented by Barlow, and patented by him in France as early as 1793. This boiler may still be seen in the Conservatoire des Arts et Sciences in Paris.*

Meantime, Fulton was inventing forms of submarine boats and of torpedoes, and endeavoring to secure their adoption by all nations, with the hope, as he declar s, that their use would ultimately compel all countries to forego naval wars, and even, probably, to guarantee "the freedom of the seas"—an outcome for which he devoutly prayed and industriously worked. Fulton, failing to secure the recognition which he thus sought, finally returned to the United States in 1807.

While preparing for his return, he had ordered of Messrs. Boulton and Watt a steam engine of a special design, thought by him to be best suited to his purposes, and had contracted with a New York shipbuilder, Charles Brown, for a hull in which to establish his engine and boiler. On his arrival, he forwarded the work as rapidly as possible, the machinery having arrived and the boat being well in hand. The work was begun in the winter of 1806-7, and the boat started on her trial trip to Albany in August, 1807. The success of that experiment proved the foundation of our present system of steamboat transportation.

While Fulton was thus supplementing, with success, the work of earlier engineers and mechanics in the United States, and was inaugurating successfully the era of steam navigation, work was progressing in Great Britain. Miller, Taylor, and Symmington, building the "Charlotte Dundas" and other successful boats, led the way, and Henry Bell, building the "Comet" in 1812, finally took the place, in that country, that Fulton had conquered on this side the Atlantic.

It would be folly to attempt to discriminate accurately among the many zealous, ingenious, and persevering workers at this then familiar problem with a view to assigning to each his exact proportion of merit and of the awards of fame. Like the problem, to-day familiar to every engineer and mechanic, of perfecting the gas engine, or like the hardly less familiar problem, with men of science, of obtaining light or heat or electric energy, each distinct and unmixed, from fuel oxidation, the problem of steam navigation was in the minds of many men. As the famous civil engineer, Mr. Benjamin H. Latrobe, of Philadelphia, wrote at the time, "a sort of mania" prevailed for discovering a way to propel boats by means of steam engines. Fulton was one of these thus afflicted, and he proved successful commercially. Other quite as talented inventors, and quite as successful, so far as construction and invention went, were not able to attain a commercial success, and Fulton, as the fittest to survive, in a business sense, became immortal; though not an inventor like Watt, or like Fitch or Stevens.

John Stevens, and his talented nephew, Robert L. Stevens, were better designers and greater inventors than Fulton; but they were distanced in the race for fame and fortune, at the time, by Fulton. His mantle fell upon them after his death, and when the monopoly, illegally conferred upon Fulton and his backers, of the navigation of the Hudson River by steam, was destroyed by the courts, it was then to the Messrs. Stevens, not to Fulton, that the nation became indebted for the organization of steam navigation on the waters of our Atlantic coast, on an extensive scale and permanently.

As the writer has written in concluding the biography of this great mechanic, engineer, statesman, and prophet, for he was all these: "Steam navigation without Fulton would undoubtedly have become an established fact; but no one can say how long the world, without that great engineer and statesman, would have been compelled to wait, or how much the progress of the world might have been retarded by his failure, had it occurred. The name of Fulton well deserves to be coupled with those of Newcomen and Watt, the inventors of the steam engine, with those of George and Robert Stephenson, the builders of the locomotive, and with those of Morse and of Bell, who have given us the telegraph and the telephone."

"We use nor Helm nor Helms-man. Our tall ships
Have Souls, and plow with Reason up the deeps;
All cities, Countries know, and where they list,
Through billows glide, veiled in obscuring Mist;
Nor fear they Rocks, nor Dangers on the way."
—"Odyssey," Book VIII.

*Ibidem, p. 113. Vide Thurston's History of the Steam Engine; p. 255.

An Indian Hospital for Animals.

Orientals are proverbially obstinate, and it takes a long time and much patience to make them believe in ideas which emanate from the West. For example, horses are rarely seen running loose in a field in India, "because horses" says a native, "always have been tied up and they must always be tied up." This obstinate clinging to tradition is the cause of much of the Oriental indifference to suffering. The Bai Sakarbai Dinshaw Petit Hospital for Animals seems one of the most remarkable examples of the manner in which, by slow degrees, western civilization has influenced the Orient. The hospital is situated near the government house at Parel, Bombay. It was founded in 1883 by Sir Dinshaw M. Petit, Bart., a Parsee mill owner, and was formally opened in 1884 by Lord Dufferin. The hospital occupies an area of 40,000 square yards of ground, and there are about forty buildings, large and small, on the premises. The entrance gateway and the large fountain in the center are excellent examples of Indian architecture. The native cotton and grain merchants and mill owners of Bombay have organized a system of voluntary taxation upon the import and export of grain and seeds, and on the sale of cotton to the local spinning and weaving mills, by which the sum of 40,000 rupees a year is collected for the maintenance of the institution. There is also a large endowment, the interest of which is devoted to the current expenses of the hospital.

There are five cattle wards, two horse wards, one dog ward, a consultation ward, a forge shop, a dispensary, post-mortem and dissecting room, a chemical laboratory, a pathobacteriological laboratory, and a veterinary college is connected with the hospital. The college is maintained at the expense of the government. At the hospital there is accommodation for 200 head of cattle, 60 horses and 20 dogs.

The hospital is unique of its kind in the world, and animals belonging to poor owners of the public carts and conveyances plying for hire are treated free of charge. A nominal fee is levied for feeding the inpatients. The splendid manner in which the whole hospital is arranged and run is an object lesson to the countries of the West. The Graphic recently had interesting pictures of this hospital.

Another Gutenberg Bible Sold.

Recently at the Rev. William Makellar book sale in London a copy of the Gutenberg Bible on paper, with a number of margins mended and several slight defects remedied, was sold for £2,590. It is the same copy that in 1822 fetched £168 at the Perry sale, £190 in 1841 at the Duke of Sussex sale, and £3,900 in 1884 at the Sir John Hayford Thorold sale. At the Thorold sale, when it was described as a magnificent copy, it was purchased by Jackson, the book dealer. In January, 1897, it was catalogued by Bernard Quaritch and priced at £4,000, he showing how in 1471 it had belonged to Johan Vlyegher, a perpetual beneficed priest in Utrecht Cathedral. Later it was purchased by the late clergyman, whose library was sold recently at Sotheby's. He had had the old blue morocco binding (probably the work of Thouvenin) replaced by a modern binding of green morocco.

There are, says The New York Times, as most people perhaps do not know, three copies of the Gutenberg Bible, the first of printed books and incomparably the most precious of all books, in New York libraries —the Lenox copy on paper, for which James Lenox paid £500 in 1847, at the Wilks sale; the Brinley-Cole-Ives copy on paper, now in the library of J. W. Ellsworth, which brought $8,000 in 1881 at the third Brinley sale and $14,800 in 1891 at the Ives sale; and the vellum copy in the collection of J. Pierpont Morgan. The following are the highest prices given at auction for copies of the Gutenberg Bible:

Ashburnham sale, 1897, vellum copy	£4,000
Thorold sale, 1884, paper (present copy)	3,900
Perkins sale, 1873, vellum copy (resold at Ashburnham sale for £4,000)	3 400
Ives sale, 1891, paper copy	2,960
Perkins sale, 1873, paper copy (now in Alfred H. Huth's library)	2,690
Sotheby sale, 1898, paper copy (present copy)	2,590
Earl of Crawford sale, 1887, paper copy	2,460
Lord Hopetoun sale, 1889, paper copy	2,000

OUR French contemporary Cosmos recently published an interesting photograph taken with the telephotographic lens. Lenses of this kind have proved very useful in Europe; for example, officers of the Italian engineers have recently been able to discover in the Alps French batteries which had entirely escaped notice, and they were able to observe the details of their construction.

Science Notes.

Prof. Roentgen, discoverer of the X-rays, has been called to the Chair of Physics at the University of Leipsic from the University of Wurzburg.

A new dormitory has just been begun at Princeton University. It is the gift of Mr. H. S. Little of the class of '44, and is to be known as "Stafford Little Hall." It is near Blair Hall and follows out the same general design. Princeton is fast becoming a veritable Oxford in appearance. The new building will cost $100,000, and Messrs. Cope & Stewardson, who designed Blair Hall, are to be the architects.

A curious instance of dwarfism in pines is recorded by Mr. C. E. Bessey, of the University of Nebraska. On Green Mountain, near Boulder, Colorado, he found in a crevice of the rock at the summit a pine tree (Pinus albicaulis, Engelm.) only 13 centimeters (under 3 inches) high and 5 millimeters (⅕ inch) in diameter. It had no branches and bore a single tuft of needles at the top. Nevertheless, it showed 25 distinct annual rings, and was, therefore, 25 years of age.

It is not generally known that peat may be used for textile purposes, and also for paper making. The exhibits at the Vienna Exhibition last year demonstrated this fact conclusively. Peat straw may also be used for many purposes, such as fertilizing, packing, etc. When used for textile purposes it must be woven without the use of oils or water. Coats, hats, carpets, rugs, ropes, matting, and pillows are some of the articles which have been made and which have been found useful. It is also a valuable substitute for absorbent cotton, possessing antiseptic properties as well.

Ch. Michel publishes the results of recent analyses of woman's milk. Samples were taken morning, noon, and night, mixed and then examined. From the study of the data derived from seventy-two analyses, he found that it was possible to draw a wide distinction between the milk of women recently accouchees and those who had passed that stage, a period varying between two and twelve months. Thus the milk of the former was notably richer in nitrogen compounds, extractive matter, and mineral salts, while it was poorer in fat (beurre) and in lactose.—Répertoire, x., 452.

As is well known, Napoleon Bonaparte died of carcinoma of the stomach, at the age of fifty-two, his father having previously died, æt. thirty-eight, of the same disease. When Napoleon was born his mother was very young, between sixteen and twenty. In commenting upon these facts, Mr. Hutchinson, in the new number of his Archives, states that cancer is more common in the children of aged parents than of young ones, and suggests that the outbreak of cancer in Napoleon was probably due to inheritance, coupled with the depressing and annoying conditions under which his last years were passed.

We have recently published two illustrations of pygmy locomotives. We have been favored by Rev. J. J. Gilchrist of East Las Vegas, New Mexico, with the description of an engine built at a factory in that place by W. L. Adion. It is a passenger locomotive built to a scale of 1/8 of the standard, and is propelled by gasoline. It measures 4 feet 7 inches from the top of the cowcatcher to the back drawbar. The boiler is 20 inches long and the height from the rail to the top of the stack is 17 inches. The width of the track is 7½ inches and the diameter of the driving wheels is 5½ inches; the cylinders are 1½ × 2½ inches. The little locomotive has been used to run up and down the center of a dining table with small cars attached to facilitate waiter service. We have heard of miniature electric railways being used for the transportation of viands, but we have never before heard of a locomotive engine being used for this purpose. It might be a novelty, but, on the whole, we do not believe it would be agreeable or acceptable in the East.

Austrians are very methodical in many things, and they take no chances with their barbers. The barbers and wig makers' union of Vienna sees to it that only competent persons are admitted to practice. The barbers must of course have a thorough knowledge of the practical side of the subject, and they are questioned as to keeping razors, brushes, etc., clean, and the general idea of antiseptics must be well understood by them. When the barbers appear before the committee they have their razors dulled on a pine plank, and they must then sharpen them and proceed to shave a subject. These subjects are recruited from the poor and from among those who are fond of getting something for nothing. If the apprentice performs his work to the satisfaction of the judges, a certificate is issued to him and he must serve as an apprentice for two years before he can open a shop of his own. Provision is also made for women barbers who desire to carry on the business of their husbands. To do this the women have to be enrolled as apprentices for three years, and they must exhibit a great proficiency before they are allowed to open an establishment of their own. The barber business in Austria is not particularly lucrative, as one can be shaved for 5 cents and have one's hair cut for about 3 cents.