GOVERNMENT ORDNANCE EXPERIMENTS.

[OFFICIAL.]

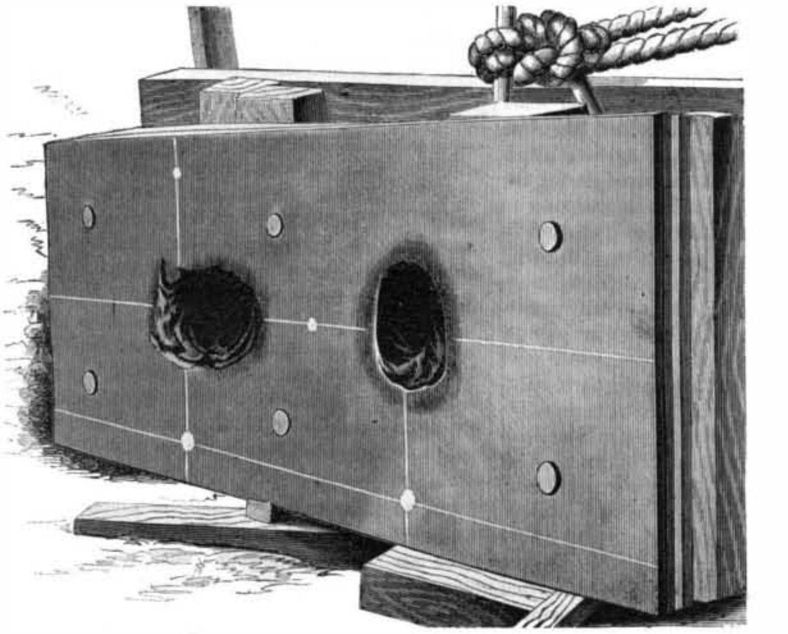
Practice at Iron-Plate Target No. 45.

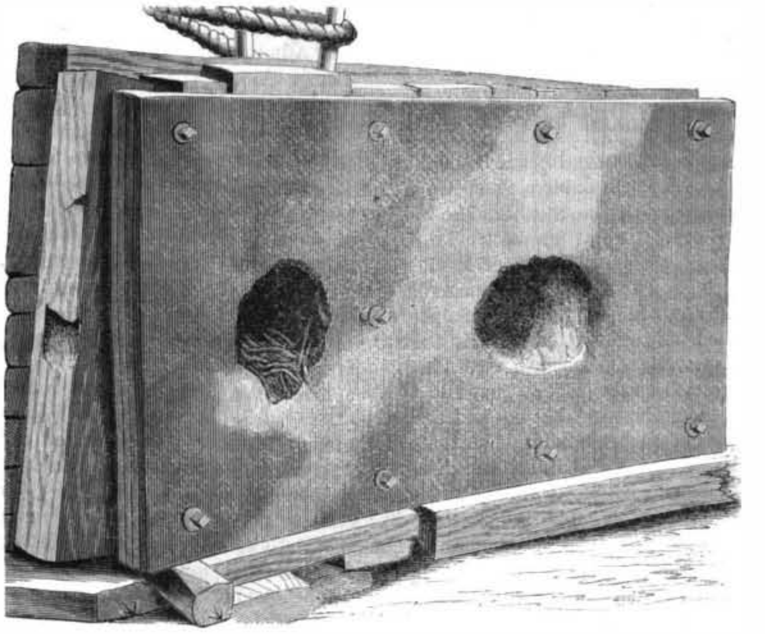
WITH RUBBER PLACED BETWEEN THE PLATES ON THE PLAN OF MR. J. L. JONES.

PENCOTE BATTERY, Oct. 3, 1863.

This target was made of four 1-inch wrought-iron plates and four sheets of rubber 1 inch thick, backed by 20 inches of solid oak and joined together with six 1¼-inch wrought-iron bolts with nuts. The plates, rubber and bolts were furnished by Mr. J. L. Jones, of St. Louis, Mo.

The first four inches nearest the timber were composed of alternate layers of rubber and iron, and





then two sheets of 1-inch rubber and two 1-inch wrought-iron plates, the latter being on the outer surface of the target. The target was placed against a bank of solid clay.

DIMENSIONS OF TARGET.—Length, 96 inches; width, 42 inches; thickness of rubber and plates, 8 inches; thickness of timber, 20 inches.

Gun XI. inches, No. 214, C. A. & Co., mounted on wooden pivot carriage in front of the battery. Charge, cannon powder. Projectiles, Cloverdale cast-iron, Primers friction.

No. from Gun.	No. to-day.	Charge.	Weight of Projectile.	Insertion	Recoil.	Time Fired.	Distance to Target	REMARKS.
		lbs.	lbs.	in.	ft.	P.M. h.m.	ft.	
	1	30	169	104	6·9	3.41	84	

This shot struck 20 inches from the right edge and 28 inches from the lower edge of the target, passing entirely through the plates, rubber and timber, and penetrating the bank a distance of 12 feet. Diameter of the shot hole 11¼ inches.

The timber in rear of the target around the shot hole is much broken. The plates are sprung outward, directly around the shot hole, 1 inch. All the bolts were slightly started, but none broken.

On the 6th inst., the target having been placed on its longest edge at an angle of 45° with the line of fire, another shot was fired at it from the same gun and under the same conditions, and with results as follows:—

No. from Gun.	No. to-day.	Charge.	Weight of Projectile.	Insertion.	Recoil.	Time Fired.	Distance to Target	REMARKS.
		lbs.	lbs.	in.	ft.	P. M.	ft.	
	1	30	169	104	4·6	3·40	84	

This shot struck 15 inches from the top and bottom edges, and 37 inches from left edge of the target, passing entirely through plates, rubber and timber, and penetrating the bank a distance of 6 feet. The shot appears to have been broken in its passage through the target, as several small pieces were taken out of the shot hole, and one small piece was found in the rear of the target, on the bank. Horizontal diameter of shot hole, 18¼ inches; vertical, 12½ inches.

The plates were sprung inward on the right edge of the shot hole half an inch, and on the left edge three-quarters of an inch. The plates have sprung forward on the right and left edges of the target half an inch. The timber in the rear of the target is completely shattered. No bolts were broken, but all are more or less started from the surface of the plates.

Practice at Iron-Plate Target No. 46,

FOR COMPARISON WITH J. L. JONES'S TARGET, NO. 45.

PENCOTE BATTERY, Oct. 3, 1863.

This target was made of four 1-inch wrought-iron plates (Abbott's), backed by 20 inches of solid oak, and joined together with ten wood-screw bolts. The target was placed against a bank of solid clay.

DIMENSIONS OF TARGET.—Length, 96 inches; width, 48 inches; thickness of plates, 4 inches; thickness of timber, 20 inches.

Gun XI. inches, No. 214 (C. A, & Co.). mounted on wooden pivot carriage in front of the battery. charges of cannon powder; proiectiles, Cloverdale cast-iron solid shot. Primers, friction.

No. from gun.	No. to-day.	Charge.	Weight of Projectile.	Insertion	Recoil.	Time Fired.	Distance to Target	REMARKS.
		lbs.	ibs.	in.	ft.	P. M. h.m.	ft.	
	2	30	168	104	4.10	3·55	84	

This shot struck 23 inches from the right edge and 21 inches from the lower edge of the target, passing entirely through plates and timber and penetrating the bank a distance of 5 feet. Diameter of shot hole 12 by 14 inches.

The plate is sprung inward on the left edge of the shot hole 1½ inches. The timber in the rear around the shot hole is much broken. One bolt was started forward 1⅝ inches, and five others slightly started, but none were broken.

On the 6th inst. the target having been placed on its longest edge, at an angle of 45° with the line of fire, another shot was fired at it from the same gun, under the same conditions, with results as follows:—

No. from Gun.	No. to-day.	Charge.	Weight of Projectile.	Insertion	Recoil.	Time Fired.	Distance to Target	REMARKS.
		lbs.	lbs.	in.	ft.	P. M. h. m.		
	2	30	169	104	4·06	3·63	84	

This shot struck 19 inches from the top, 14½ inches from the lower edge, and 56½ inches from the left edge of the target, tearing through the plates and the shot breaking into pieces, part of which glanced off at an angle of 45°, and penetrated the bank on the right of the target, the remaining portion (43 lbs.) remained in the shot hole. Horizontal diameter of shot hole 16½ inches, vertical 14¾ inches.

The plate is sprung inward on the right edge of the shot hole 3 inches, top edge 2½ inches, lower edge 2½ inches. The plates have sprung forward on the top edge 2½ inches. One bolt was started forward three-quarters of an inch; none are broken excepting the one in the center of the shot hole, The plates are cracked around the shot hole, one crack extending 8 inches. The timber is all completely shattered.

The experiment with this target was for comparison with Mr. J. L. Jones's target (composed of four 1-inch iron plates and four 1-inch sheets of india rubber), to obtain the relative resistance. The conditions of the two experiments were identical. The penetration of the projectile fired at this target was five feet from the face, while the penetration of that fired at the iron and india-rubber targets was twelve feet. In the second experiment, oblique firing, 45°, the shot at this target did not penetrate entirely through, and 126 lbs., of it were thrown out at an angle of about 45° into the bank of earth, while the corresponding shot at the iron-rubber target passed entirely through it and penetrated the bank of earth a total distance of 6 feet from its face.

The shot hole in the direct firing at the iron-rubber target is circular, and differs but 45 inches from the diameter of the projectile, while the corresponding shot hole in this target is irregular, and differs 2·20 and 4·20 inches. In the oblique firing it will be observed that the horizontal diameter of the shot hole in the iron rubber is the longer, while the vertical is shorter than those of this target; in both instances the face plate of the latter appeared to be slightly more damaged than the former. Whether it be the action of the rubber or difference in the character of the iron, it is difficult to determine.

Obstructions in Charleston Harbor.

A correspondent writing from Morris Island says:—

"In the Quartermaster's possession, on this island, are great masses of the 'obstructions' with which the beach has for some time past been lined, to the great impediment of locomotion and transportation. In addition to the huge rafts and linked railroad bars, are immense beams, squared on four sides, to fit into clamps of wrought-iron. The intention seemed to be that these clamps should fit loosely around the beams to allow them play. The bar iron of which they are wrought, is one and a half inches wide and half an inch thick, and is of excellent quality. To the clamp is attached an iron ring-bolt, strong and massive, intended to bear the weight and strength of the railroad bars. Thus, it appeared that each alternate bar was affixed to a clamp and ring-bolt. The intermediate bar was linked or hinged to the extremity of the next. The squared timbers were evidently intended to support the bars suspended in the water beneath them. Thus, rafts made of four squared timbers, fifty feet long and at least fifteen inches in diameter, either way, were lashed transversely to four pine sticks or perfect trees. These formidable rafts, secured by strong lashings and chains to each other, stretched across the North Channel of Charleston harbor. They only gave way to the constant swaying and surging of the tempestuous waves; but, once loose, the great currents and high tides brought them to us, and cast them like mere drift-wood at our feet. The beams, now lying in the yard of the Quartermaster's store on Morris Island, are worm-eaten through and through. The far-famed waves of the Euxine are not more destructive to vessels than are the wrigglers of these waters. Wherever a little copper sheathing becomes displaced from the bottom of a timber ship, the worms get in, and work through, after them the water insinuates itself. Leaks and foundering are the next consequences in strictly natural series.

In one mass of obstructions hauled away from the beach of Morris Island, are 16 bars of T-iron rails, each 23 feet in length. So great was the weight of the mass that the bars to which the hawser was attached were bent to a curve of about 35°. The hawser, a new one of six inches circumference, was stretched out to only four inches. Fifty men were occupied four days in hauling out of the tide-water the mass I have described. Before the other obstructions can be removed the drifting sands will bury them, and they will be lost forever. The obstructions being removed by natural causes, nothing now prevents the taking of Charleston whenever the Admiral wills it."

PROGRESS OF ENGINEERING SCIENCE.

The above forms the text of an elaborate and able article in the *Quarterly Review*. From this we select several extracts which will be read with interest by all :—

WATER-PRESSURE ENGINES.—Recently a new application of water power has been effected by the inventive genius of Sir W. Armstrong. He first applied it at Newcastle, where the general level of the town is very much above that of the wharves of the harbor, and the waterworks in consequence provided a very tall column of water at the lower levels. Of this he availed himself by applying the pressure so obtained to force a piston along a water-tight cylinder, and with a simple multiplying gear the cranes on the quays were made, by the mere turning of a cock, to raise any weight their construction could support. By applying the water power alternately on both sides of the piston, and acting on a cranked axle—as done in the steam engine—a water engine was next invented, capable of exerting any amount of power that could be obtained from the hight of the column of water and the amount of supply. When a sufficient head of water is available, or where the work is intermittent, this is certainly one of the most successful applications of water power yet invented. At Great Grimsby Dock, and at Birkenhead, pipes are laid under the pavement from a reservoir at the top of a tall tower, to every part of the dock premises. At the foot of every crane, under the piston of every hoist, at every dock gate, unseen and noiseless, the power lies dormant; but a woman's hand, applied to a small handle, will set in motion a force sufficient to raise a mass weighing fifty or one hundred tuns, either to place it in the hold of a ship, or deposit it in any spot within reach of the arms of the crane. With equal ease the gates of locks 100 feet in width are opened or shut and the smallest as well as the heaviest works of the dockyard done, without a stranger being able to perceive what it is that sets everything in motion.

As an accumulator of power, Bramah's hydraulic press surpasses anything that has yet been invented, and may be carried to any extent that the strength of the metal will stand. The presses which were used to raise the tubes of the Menai Bridge when worked by a 40-horse power engine, were capable of exerting a power equal to that of 14,200 horses, and raised one-half the tube, or 900 tuns, slowly but steadily, through the 100 feet at which they were to be placed above the level of the water.

AIR-PRESSURE ENGINES.—The tunnel under Mont Cenis is to be rather more than seven miles and a half in length, and as it is one English mile below the summit of the mountain, no air-shafts could be sunk from above; and the first difficulty was to ventilate a cul-de-sac, that at one time, at least, must be nearly four miles in length. This has been accomplished most successfully by M. Someiller, the engineer, availing himself—on the Italian side—of a stream of water 80 feet above the mouth of the tunnel. This is used to force air into a chamber, where it is kept at a constant pressure of six atmospheres, by a stand-pipe 165 feet (50 meters) in hight. From this it is conveyed in pipes to the innermost end of the excavation, where it is set to work to bore holes in the face of the rock for blasting purposes. There are eight perforators, each of which sinks ten holes three feet deep in the face of the rock in six hours. It takes some time to dry each of these and to charge it with gunpowder; and it takes four hours to clear away the *debris* and to make all ready for commencing another set of perforations. So that practically only two sets are bored in twenty-four hours, and the progress is consequently 6 feet per day. At each blow on the head of the jumper a portion of the compressed air escapes, as steam does in a high-pressure engine. Its expansion is sufficient to cause a draft outwards, and keep the place perfectly ventilated; and even immediately after a blast, the tunnel is freed from the effects of the explosion very rapidly, and no inconvenience felt. By improvements in the machinery, the engineer hopes to bore one set of holes in eight hours; and as the more work it does the more air it blows off, not only will the work be expedited, but the ventilation improved by the more rapid working.

THE STEAM ENGINE.—Without doubt the invention of the steam engine is the greatest mechanical triumph which man has yet achieved. Although the invention of a practical engine is hardly more than eighty years old, and it is little more than half that time since its real value came to be appreciated, the mode in which engines have been multiplied and improved during the last forty years, and the thousand new purposes to which they have been and are daily being applied, is perhaps the most extraordinary fact in the industrial history of the world, It certainly is the one, the magnitude of whose results we are the least able to grasp. One of the greatest advantages of the steam engine, besides the power of placing it anywhere, is the wonderful flexibility with which it can adapt itself to almost any work it is set to perform. The difference between an elephant and a race-horse is not greater than between a Cornish pumping engine and an express locomotive. The perfection of the former arose from the necessity of importing every ounce of fuel to be used in Cornwall, and frequently of carrying it for miles over bad roads. This set engineers calculating how fuel could be saved, and with such success, that at one time a pound of coals did twice the quantity of work that it did elsewhere, though this difference is fast vanishing now. To any one accustomed to the noisy activity of most marine or manufacturing engines, nothing can be more remarkable than the sleepy quiet of Cornwall. The fire-bar area is so great, and the boiler arrangements so roomy and so carefully appropriate, that all the fuel and all the smoke are consumed, and none issues from the chimney. In the engine room nothing is seen but one great cylinder, hooped with wood, and looking more like a beer-vat than a part of an engine, and almost as cool to the touch. A few slender bright rods extend from the roof through the floor, and to these are attached some delicate bright handles, of rather fanciful forms, but these suffice to open and shut its valves and to regulate its expansion. As the stranger enters, all is quiet and at rest; no burst of smoke, no smell of oil, no escape of steam, and no noise; presently there is a click click among the handles, the great beam lazily raises itself and lifts 100 or 200 fathoms of heavy pit work some ten feet upward, and then as quietly drops it again into its place. Having done this giant's work it goes to sleep again for ten or twenty seconds, as the case may be, till called upon to make another effort. This it repeats at stated intervals during the whole twenty-four hours, week after week, or for months together, without rest or intermission.

Contrast this with the express engine, rushing past at a speed of fifty or sixty miles an hour, making 1,000 or 1,200 pulsations in a minute, consuming coals with reckless wastefulness, and casting its vital heat and life's blood to the four winds at each beat of its valves. Nothing that man has done comes so near to the creation of an animal as this—even the most unimaginative can hardly help drawing comparisons between the steam horse and his quadrupedal competitor. There is indeed more in the comparison than appears at first; especially when we see the monster fed with great spoonsful of cooked black vegetable food, from which it evolves its vital heat in its capacious lungs, which, after circulating through its tubular veins, is launched into the air with the waste products of combustion.

In this as in most things, the steam engine is strictly original, and, strange to say, no new principle has been invented since Watt left it, and no new form added which he did not at least foresee. The immense progress that has been made since his day has been due to the daily growing perfection of workmanship, and more perhaps to the careful adjustment of every part, and of every engine to the exact special work it has to perform. The progress is practically due to the knowledge which is obtained by the daily experience of those who watch the working of all these engines, from those which make three strokes in one minute, to those that make 1,000 in the same time, as well as all the intermediate grades between these two extremes, which are hourly performing every class of work under the most completely various circumstances.

There does not seem to be any theoretical limit to the size of a cylinder of a steam engine, or consequently to the power that may be given to it; but, practically, it is generally found more expedient to use two or more engines to do a given amount of work than to increase to any very great extent the power of one. Pumping engines with cylinders 100 inches in diameter and with 10 feet stroke, are common in Cornwall, and those used to drain the Haarlem Lake were 14 inches in diameter; and in the *Warrior* and *Achilles* the pair of engines are nominally 1,250 or 1,300 horse-power, but really work up to 5,000 or 6,000 horse-power. When more than this is wanted, it may be expedient to divide it, as was done in the *Great Eastern*, between two sets of engines; for it is not only the cylinder, but the crank shaft, and all the gear, that require to be increased in the same ratio. Although the power of our factories to produce the immense forgings requisite for these purposes has been increased tenfold within the last thirty or forty years and is daily increasing, there are inconveniences in dividing power, where there is room to do so, that will probably prevent any great increase in this direction.

THE COTTON MANUFACTURE.—In England it is calculated that, when the cotton manufacture is thriving, there are thirty millions of spindles constantly employed in spinning cotton alone, so that if every man, woman and child in the three kingdoms were to devote twelve hours a day to this occupation, they could not effect as much; and it would require another population of nearly equal extent to prepare the cotton for the spindles, and a very large number of persons to supply the place of the 300,000 power-looms that are employed to weave it, and to supplant all the mechanical appliances that finish it and fit it for the market. All this is required for cotton; but when we add to this the amount of power employed in spinning and weaving flax and wool, and all the different classes of fibers which we have enlisted in our service, the power employed in cotton alone sinks to a mere fraction.

STEAMSHIPS.—Till the invention of the compass, long sea voyages were of course impossible, and large vessels were consequently not needed for commercial purposes; but the discovery of the uses of a keel, or something to enable a vessel to hold a wind, even if she could not beat to windward, was almost as important, for propulsion by oars must always have been very expensive and inefficient in large vessels. An immense impulse was also given to the improvement of vessels by the discovery of America, and of the passage round the Cape, and since then the progress has been rapid and steady; but it was not till propulsion by steam cleared the problem of all extraneous considerations of weatherlyness, steadiness and handiness in maneuvering, &c., that marine architects fairly grappled with the subject.

In order to explain the problem the shipwright has before him, it may be necessary to state that a vessel, for instance, of 1,500 tuns, 36 feet beam, 250 feet long, and with 20 feet raft, displaces 20 tuns of water for every foot she moves forward, and the question is what is she to do with this? If she heaps it up before her, as the old bluff-bowed vessels did, she has not only to climb over it, but she has wasted an enormous amount of power in lifting what she might have left lying. As every contractor knows, he is paid the same for wheeling stuff twenty yards forward as for raising it one yard high; and what the naval engineer seeks to do is to spread his displaced water laterally, evenly and flatly, over as large a surface as possible. The progress already made in this direction will be understood if we take, for instance, the resistance of a square box as our unit. By simply rounding off the corners, the power requisite to force the box through the water is diminished by one-third; by introducing such lines as were usual in the best ships thirty years ago, the resistance is lessened by two-