APPENDIX O.

Trial of the Hotchkiss revolving cannon, caliber one and one-half inches.

OFFICE OF THE ORDNANCE BOARD, U. S. A.,
New York City, June 18, 1877.

SIR: I have the honor to transmit herewith the report of "The Ordnance Board" of the trial of the Hotchkiss revolving-cannon, caliber one and one-half inches, made at Sandy Hook, New York Harbor, from September 11, 1876, to February 15, 1877, under your instructions.

Very respectfully, your obedient servant,

S. CRISPIN,
Bvt. Col. U. S. A., Lt. Col. of Ord., President of the Board.

The CHIEF OF ORDNANCE, U. S. A.,
Washington, D. C.

A description of the Hotchkiss revolving cannon.

THE GENERAL SYSTEM.

The Hotchkiss revolving cannon cannot be classed with mitrailleuses in the ordinary sense of the latter term, as explosive shells are fired with the former, and it has a range equal to that of field-artillery.

The system of this gun may be explained as follows:

Five barrels, grouped around a common axis, are revolved in front of a solid breech-block, which has in one part an opening to introduce the cartridges, and another opening through which to extract the empty shells, while the cartridges are fired after being revolved and while motionless in front of the solid portion of the breech.

The exterior aspect of this revolving cannon resembles the Gatling mitrailleuse, it being, on the other hand, entirely different in its interior mechanism.

The system is composed of two distinct parts, viz, the barrels with their disks and shaft, and the frame and breech containing the mechanism.

The five barrels, made of the finest oil-tempered cast steel, are mounted around a common axis, between two disks, on a central shaft. The series of barrels are in this way placed in a rectangular frame, which is attached to the breech, the near end of the shaft penetrating the same to receive the rotary motion from the driving-gear.

The breech itself is composed of a solid cast-iron breech-block, weighing about 386 pounds. This absorbs the greater part of the recoil. It has a door at the rear end, which can be easily opened, so that the mechanism is freely accessible, and can, if necessary, be dismounted and put back into its place in a few minutes, without the aid of any special tools.

A peculiar feature of this gun consists in the barrels remaining *still* during the discharge, so that there is no movement of any kind to impede the accuracy of the fire. This stop or lost motion is obtained by the shape of the driving-worm, which is so constructed that the inclined driving-thread only covers half its circumference, the other half of the thread being straight. The effect of this is that the barrels only re-

volve during half a revolution of the worm, and stand still during the other half revolution. The combination of the mechanism is so arranged that the loading, firing, and extracting takes place during this pause. This feature is of great importance for the accuracy of fire and the durability of the system.

The worm-shaft projects through the breech on the right side, and has a crank with which the whole system is moved; on the left side of the worm-shaft a small crank is attached, by which the loading and extraction of the cartridge-shells is effected in the following manner:

On the interior face of the left side of the breech a cog-wheel is mounted, with two horizontal racks, the one being placed above the other under this cog-wheel, and parallel to the axis of the barrels, so that in moving one of these racks the other is moved by the cog-wheel in the opposite direction. Part of the lower rack forms a vertical slot, in which the small crank on the left side of the worm-shaft works. The rotation of the latter consequently gives an alternating and opposite movement to the two racks, so that while the one is going forward the other moves back, and reciprocally.

The under rack forms the extractor; the upper one moves a piston which drives the cartridge into the barrels, the cartridge being placed before the piston, in the trough in which it moves; and during the time the barrels are motionless it is introduced into the one standing before the trough. The cartridge is not "driven home" entirely, but its head is in view of an inclined plane, cut into the metal of the breech, on which it slides when it is moved by the rotation of the barrels. This completes the introduction of the cartridge into its chamber. The piston itself is a simple cylinder connected with the rack, and running in a slot in the conducting-trough.

When the racks are in their extreme positions they remain still a moment. This stop is obtained by giving the slot in its center part a circular shape concentrically to the shaft of the crank. This is necessary, because at the moment of the barrels arriving at the end of their course the head of the cartridge-case becomes engaged in the hooks of the extractor, which would not be possible if it were in motion at the time.

The extractor is a large double hook at the end of the bottom rack; it is very solid, and its proper working is certain under all circumstances.

After the cartridge is extracted from the barrel it strikes against an ejector, which pushes it out of the extractor, and it falls to the ground through an opening in the under part of the breech. The firing-pin has an elongation, pointing downward, which, by the operation of a spring, is pressed against a cam on the worm, and as the worm rotates, the cam drives the firing-pin back and compresses the spring. The moment the firing-pin becomes liberated, it strikes the primer of the cartridge and the discharge takes place.

To obviate the difficulties which exist in other systems, when the cartridges are piled one upon the other, the opening of the introduction-trough is closed by a little door, which goes down by the weight of the cartridges, the first of which drops into the trough, and then the piston, in moving forward, raises the door and allows no more cartridges to enter until the proper time.

All parts of the mechanism are very strong and durable, and hardly exceed in number those of an ordinary small-arm, there being, besides the group of barrels, thirteen parts, viz:

1, 2. The breech-block, with its door for closing the rear end.

3, 4, 5. The crank-shaft, with its worm for moving the barrels, and small crank for working the loader and extractor.

6. The crank.

7, 8. The firing-pin and spiral spring.

9. The extractor.

10, 11. The loading-piston and rack for moving it.

12. The cog-wheel for transmitting the movement of the extractor to the loading-piston.

13. The door for regulating the feed of cartridges.

The operation of the mechanism, the rapidity of fire, and the number of men to work the gun.

The operation of the mechanism may be described as follows, supposing the crank to be in continual motion:

A cartridge is placed in the introduction-trough, the piston pushes it into the barrel, then the barrels begin to revolve, and the cartridge is carried on till it arrives before the firing-pin, which penetrates the solid part of the breech, and which has in the mean time been retracted by the action of the cam. Then, as soon as the cartridge has arrived into this position, the barrels cease to revolve, and the primer of the cartridge is struck by the firing-pin and discharged; then the revolution of the barrels begins again, and the fired cartridge-shell is carried on until it comes to the extractor; this, in the mean time, has arrived up to the barrels and the cartridge-head rolls into it. As soon as the head is laid hold of by the extractor, the barrels again cease to revolve, and during this period the cartridge-shell is withdrawn and dropped to the ground. As during every stoppage of the barrels the gun is supplied with a new cartridge, and the firing and extraction is also performed, during this time a continuous but slow fire is kept up. By supplying the gun in this manner with single cartridges, about thirty rounds per minute may be fired.

Should rapid firing be required, the gun is then supplied, not with single cartridges, but with "feed-cases," containing groups of ten cartridges each, and in this manner from sixty to eighty rounds per minute can be fired, with only three men to work the gun; viz, one man to train the gun and revolve the crank; one man to place the "feed-cases" containing the cartridges into the "feed-trough;" and a third man at the ammunition-chest to charge the "feed-cases" and to hand them to the charger.

Attached to the frame is a turn-table which connects the cannon to the "trunnion-saddle," arranged in such manner that without displacing the carriage a certain amount of lateral motion as well as of elevation may be given to the gun. Thus the gun is made to sweep horizontally along a line, by adjustment, between each single shot, or during rapid discharge.

THE AMMUNITION.

The ammunition for the revolving cannon consists of a center-fire metallic cartridge of special construction, holding in each one the powder, the projectile, and the lubricating-wad, arranged like the similar ammunition generally used for small-arms.

Two different kinds of projectiles are used, the one an explosive shell and the other a case-shot. Nothing need be said of the latter, as it does not differ from the common case or canister shot used in ordinary cannon.

THE SHELL.

The shell is of a novel construction; it is of cast-iron, of a cylindro-ogival shape, slightly rounded at the rear end. The packing consists of a brass coat of about one caliber in length, and placed equidistantly from the center of gravity. This coat is of soft brass tubing, contracted with great pressure over the body of the projectile, it being provided with longitudinal grooves, and two grooves encircling it at the top and bottom ends of the packing. The coating is forced into these grooves, and any disturbance of it on the body at starting is thus obviated. These grooves serve at the same time as breaking-lines of the shell.

After the coating is attached to the projectile, some small saw-tooth-like grooves are cut into it, to reduce the strain while being forced through the rifling of the barrel. These grooves can be filled with a lubricating substance, and this is then carried perfectly between the projectile and the bore of the barrel.

The coating of the projectile is conical at its front part, corresponding with the cone in the projectile-chamber, so that it is exactly centered in the bore as soon as the forward movement commences. Its rear end is cylindrical to within about one-third of its length.

The shell is turned smooth all over, and is nearly 0″. 016 in diameter less than the bore of the barrel. This projectile is made with great care and exactness, with only a very small deviation in dimension.

THE FUSE.

The fuse employed is that known as the Hotchkiss percussion-fuse, used in large quantities during the last war in America.

It consists of a gun-metal body closed at the front end with a nose-screw, forming the ogival point of the projectile; it has a conical hole at the rear, which is closed with a lead plug, (the safety-plug,) pressed in very tightly, so that the plug projects a little through the base of the body-case toward the inside.

The plunger is composed of lead cast into a brass casing to strengthen it, and to prevent the lead from being upset by the shock of discharge. A brass wire is cast into the lead of the plunger, and holds it suspended in the case, the wire going through the hole in the bottom of the case, and being held securely in position by the safety-plug. The plunger has a nipple cast into the lead, and is formed with an ordinary gun-cap; in its axis it has a powder-chamber containing the igniting-charge.

The operation of the fuse is thus: The safety-plug is dislodged backward into the interior of the projectile by the shock of discharge; the wire then being not held tight in the hole, the plunger is disengaged and rests on the bottom of the fuse-case, and is free to move in the line of axis. When the flight of the projectile is suddenly retarded by its striking any object, the plunger, in consequence of its inertia, is driven forward, and the primer strikes against the nose-screw, thus igniting the powder in the channel, and so firing the bursting-charge of the projectile.

The Hotchkiss percussion-fuse is extremely simple in its construction, and requires no adjustment before use. It is perfectly safe in transport, and during all manipulations with the projectile, as the plunger is held securely by the safety-plug, which must receive the great shock of the discharge to discharge it from its hole, and thus liberate the plunger.

THE CARTRIDGE-CASE.

The cartridge-case consists of a spirally-rolled tube of sheet-brass, strengthened at the head with an inside and an outside cup. The head is punched out of sheet-iron, and is fastened to the cups with three rivets.

The primer consists of a case holding the anvil, and is closed at the bottom end by the cap containing fulminate; it is fitted into a hole which penetrates the head and both cups, and it projects through into the inside of the cartridge-case.

This cartridge, which can be manufactured with great facility on account of its simplicity, has proved itself to be of a very durable quality, and it can be used repeatedly.

The construction of the body of the cartridge allows it to expand to the chamber of the gun without the metal being stretched, so that after the discharge it contracts itself again to its previous diameter, thus leaving the fired case perfectly loose in the chamber for extraction.

THE LUBRICATOR.

The lubricator consists of a wad of felt about 0″.236 thick, dipped in a solution of mixed tallow and beeswax. A paper disk is placed between the lubricating-wad and the charge to prevent the powder getting damaged by the greasy surface of the lubricator.

The projectile is merely pressed into the neck of the cartridge and is not clenched, as there is enough friction to hold it absolutely secure.

Of course the ammunition is, as in the case of all modern small-arm ammunition, which it resembles, rendered safe against influences of weather and danger of explosion.

Principal dimensions and weights, &c., of the gun.

Caliber	1.457 inches.
Total length of bore	4 feet 2.236 inches.
Length of rifling	3 feet 8.882 inches.
Rifling, one turn in	4 feet 1.212 inches.
(Twist and depth of grooves uniform.)	
Number of grooves	12
Width of lands	0.098 inches.
Depth of grooves	0.019 inches.
Number of barrels	5
Diameter of barrel over powder-chamber	3.464 inches.
Diameter of barrel at the muzzle	2.440 inches.
Weight of each barrel	77.166 pounds.
Radius of sights	2′ 3″.047
Vertical distance of the line of sight from the common axis of the barrels	2.0866 inches.
Horizontal distance of the line of sight from the common axis of the barrels	6.496 inches.
Weight of gun	1,047.25 pounds.
Total weight of gun with traversing apparatus	1,157.48 pounds.

Principal dimensions and weights of the ammunition.

EXPLOSIVE SHELL.

Length of body	4.10 inches.
Entire length with fuse	4.71 inches.

Length of brass coating, equidistant from center of gravity	1.5 inches.
Diameter of body	1.44 inches.
Diameter of brass coating	1.49 inches.
Weight of body of the projectile	1 pound 1.4 ounces.
Weight of fuse	3.3 ounces.
Weight of bursting-charge*	0.74 ounce.
Total weight of projectile complete for firing	1 pound 5.58 ounces.

Weights and dimensions taken from shell fired by the board.

CASE-SHOT.

Length of case	4.565 inches.
Exterior diameter of case	1.440 inches.
Number of balls	18
Diameter of each ball	0.62 inches.
Average weight of each ball	1.03 ounces.
Total weight of shot	1 pound 9.4 ounces.

CARTRIDGE-CASE.

Length of cartridge-case	4.724 inches.
Diameter of head	1.791 inches.
Diameter of the body near the head	1.641 inches.
Diameter of body in front	1.476 inches.
Weight of cartridge-case	3.88 ounces.

CHARGE OF POWDER.

Charge	4.23 ounces.
Proportion of charge to weight of projectile	4.33
Weight of complete cartridge	1 pound 10.46 ounces.
Length of complete cartridge	8.149 inches

THE CARRIAGE.

For the revolving cannon a special carriage has been constructed This was found necessary, as the ordinary field-gun carriage is not provided with the means for procuring an excellent and immovable rest for this gun.

The trail of the carriage consists of two brackets of steel plate, connected by three transoms and bolts, the rear end being connected by the trail eye-piece. The brackets diverge against the trunnions.

The trunnion-bearings, and the bearings for the axle-tree, are riveted to the outside of the brackets and are fitted in the ordinary manner.

The axle-tree is of steel, the arms being slightly conical. The wheels have metallic naves and ring-tires. The nave consists of two parts, the inside flange, with the pipe-box, and the outside flange. The spokes are cut in a conical form at their "hub" ends, so that they fill the nave-flanges, and the two parts of the nave are bolted together with the spokes with six screws.

These wheels are very strong, and have been found practical and economical in service, and they allow spokes to be easily substituted for others when broken.

* It would be advisable to use either gun-cotton or picrate-powder for the bursting-charge, as these would throw the fragments forward with more force than ordinary gunpowder, and thus produce a greater destructive effect.

The elevating arrangement consists of a screw working in a gun-metal nut, resting in the oscillating bearing. This nut is revolved by conical gear-wheels from the left side of the trail, the top-end of the screw being attached to the trunnion saddle-plate.

The handspike is hinged to the trail so as to fold back in traveling. A tool-box is placed between the trail; this at the same time makes a solid connection of the trail-brackets.

The carriage of the revolving cannon is usually provided with a light steel shield for the protection of the gunners from small-arms fire.

This shield is of three parts, made to fold together, thus forming seats for two men. It can immediately, when coming into action, be unfolded and only the muzzles of the barrels and the wheels of the carriage are exposed to the enemy. The steel plates are about 0.236 inch in thickness.

Two boxes are attached to the axle-tree, each to carry three feed-cases loaded with ten rounds of ammunition.

On the carriages not provided with a shield these ammunition-boxes are protected by light steel plates in front, and have a lid of steel, which, when raised, forms a small protecting-shield, and when closed they form seats for two gunners, so that with two or three gunners on the limber a sufficient number of men to serve the piece would be taken into action with the gun itself.

To check the recoil of the gun, a brake of the following construction is used:

Each axle-arm has a screw cut on its extremity; this carries a nut forming a conical cap, partly enveloping the front side of the wheel-nave, which is likewise conical, to fit the inside of the cap; this has a short crank, by which it can be revolved on the axle. When screwed up this cap grips the cone of the nave of the wheel, and the tighter the cap is screwed up, so the wheel turns with the more difficulty on its axis, until it gets immovably locked on the axle by the friction of the cones. When the cap is unscrewed, it is disengaged from the wheel, which can then turn freely on the axle. The screws on the ends of the axle-arms have right and left handed threads, so that the caps become tightened by the effect of the recoil.

This brake is used at the same time as an ordinary traveling-brake, and it can be applied without the carriage being stopped, as is necessary with the shoe-brake commonly used on gun-carriages.

Principal dimensions and weights of the carriage.

Weight of carriage, with wheels, ammunition-boxes, and accessories, complete	1,169 pounds.
Weight of steel shield	331 pounds.
Weight of wheels, each	187 pounds.
Diameter of wheels	55 inches.
Weight of trail on the ground	99 pounds.
Weight of trail when hooked on limber-hook	44 pounds.
Track of wheels	59 inches.
Angle of trail with the ground	17° 30′
Height of trunnions above the ground	42 inches.
Extreme angles of elevation and depression	−5°+25°
Greatest angle of dispersion with horizontal training apparatus	3°

THE LIMBER AND THE AMMUNITION-CHEST.

The limber resembles, in general construction, the French government service-limber; it consists of a frame-work of wood, placed upon wheels of equal size and construction as those of the gun-carriage.

The axle-tree is of steel; it has no axle-tree bed, but is attached directly to the "futchells."

The trail of the gun-carriage hooks up to a hook-pintail attached to the axle-tree. The limber has a swing splinter-bar to which the traces of the horses are attached, and the shaft is arranged for double-draught.

The limber carries an ammunition-chest made of wood, conveying four hundred rounds of ammunition, and it is fitted with four boxes, each containing one hundred rounds. The cartridges are held immovably in the boxes when the lids are closed to prevent their being injured in traveling over rough roads. The ammunition-chest is covered with painted sail-cloth, and is rendered water-tight; the corners are protected by angle-irons, and it is attached to the limber by two hooks and screws.

The weight of the limber, with ammunition-chest complete, is 661 pounds.

Summary of principal weights.

	Pounds.
Gun, with lateral-training apparatus	1,213
Carriage, with all accessories	926
Limber, with ammunition-chest	661
Four hundred and sixty rounds of ammunition	761
Four gunners	529
Total	4,090

This weight distributed over six horses gives 680 pounds per horse, a very low rate, the usual weight for the draught of a horse in light-artillery being about 771 pounds, so that this gun possesses that which in modern warfare is so necessary—the quality of easy transportability to a satisfactory extent.*

Since the publication of the above, Mr. Hotchkiss has made a slight improvement in his shell, which has been satisfactorily tried by the board.

The improved Hotchkiss shell is with its fuse a little less than three calibers in length, or about seven-sixteenths inch shorter than the one just described, from which it differs, with the above exception, in the following particulars only: The new shell has four circumferential grooves separated by ribs about one-twentieth inch wide, and longitudinal cuts between ribs. The tubing, about one caliber in length and one-sixteenth of an inch thick, instead of being corrugated on the exterior, as in the old shell, is perfectly smooth, and is contracted into place by a *slight* pressure only. The gas from the discharge presses the packing so firmly into the grooves and cuts that it cannot rotate independently of the projectile, and the rifling is impressed on the ribs only covered by the tubing.

Its dimensions and weights are as follows:

Length of body	3.66 inches.
Entire length with fuse	4.27 inches.
Length of brass coating	1.5 inches.

* The foregoing description of gun, shells, &c., was taken from the phamphlet of Mr. Alfred Koener, published in Paris, 1874. The French measures have been transferred into our own for convenience of reference.

Diameter of body	1.44 inches.
Diameter of brass coating	1.49 inches.
Weight of body of the projectile	1 pound 1.4 ounces.
Weight of fuse	3.3 ounces.
Weight of bursting-charge	0.88 ounce.
Total weight of projectile complete for firing	1 pound 5.58 ounces.

RESULTS OF FIRING AT SANDY HOOK, NEW YORK HARBOR.

On the 11th of September, 1876, the preliminary trial of the gun took place, Mr. Hotchkiss being present.

Forty rounds were fired with new mortar-powder, testing the working of the gun. On the 12th and 22d, same month, the gun was fired for *initial velocities*, the average of three rounds new mortar-powder giving 1,294 feet; of 12 rounds, musket, 1,572 feet, and of 18 rounds, old mortar, 1,458 feet. September 21 and 22, 72 rounds were fired at a target 1,000 yards distant, and 51 rounds at a 2,000-yard target, not including sighting-shots. (See targets marked A and B, plates 5 and 6, appended.) September 22, 4 rounds of shell and 26 of canister were fired at a 200-yard target. The working of the canister not being very effective, no further trials were made with it at even these short ranges, the shell, everything considered, being deemed more satisfactory than canister. On the 3d of October the gun was again fired 72 rounds, testing its workings. Up to this time 309 rounds in all had been fired.

A supply of 3,000 rounds of ammunition having been procured, the board resumed its experiments November 23, 1876, and concluded them February 15, 1877.

November 23, 1876, 115 rounds were fired at target 2,000 yards distant, and the time taken of firing 20 and 51 shots; and on the 24th of November, 15 rounds were fired at targets 2,640 yards distant, but owing to high winds the firing was suspended and targets not tabulated.

On the 2d of December 143 rounds were fired at 1,000-yard targets, not including 7 sighting-shots. (See targets marked C, plate 7, appended.) One hundred and seventy rounds were fired at 2,000-yard targets, not including 4 sighting-shots. (See targets marked D, plate 8, appended.)

On January 25, 1877, 102 rounds were fired at 10 targets, the first being 200 yards distant; and on same date 100 rounds were fired at 2 targets, the first the same distance from gun. (See targets marked E and F, plates 9 and 10, appended.)

On February 14, 1877, 44 rounds were fired at targets 200 yards distant, and on the 15th 100 rounds were fired at targets 1,000 yards distant, not including 12 sighting-shots. (See targets marked G and H, plates 11 and 12, appended.)

This makes a record of 1,136 rounds in all fired, and throughout the firing the gun worked well. There were four failures in the ammunition during the early part of the firing, owing to the weakness of the firing-pin spring, but after this spring was changed no failures occurred.

The fuses, with one exception, worked perfectly; on examining this fuse after firing, it was discovered that the fuse-firing pin on nose-screw was broken, which would readily account for the failure to explode.

The cartridge-cases, of wrapped metal, worked well, extracted easily, and no gas escaped. The loader and extractor worked easily and well, as did the mechanism generally. There was no wabbling, tumbling, or stripping of projectile, the brass coat or packing taking the grooves well in all cases. In fact, with the exception of the four miss-fires and one

failure to explode, already explained, everything worked very satisfactory during the entire firing.

The special carriage for this cannon seems strong, compact, and serviceable, and possesses some novel features. The recoil-brake, which takes the place also of the ordinary shoe-brake, is secured to the axle-arm, and works by means of a short lever. This brake, and also the shield, which, when not in use, folds and forms seats for the cannoniers, have been fully described heretofore. There is also at the end and under side of trail a pointed, wedge-shaped piece of iron, which, being forced into the wooden platform or ground, prevents the trail from moving during firing.

ACCURACY AND EFFECTS.

The targets were made of one-half inch and one-inch boards, and were constructed in sections, which enabled them to be rapidly erected and placed in their required position.

It will be seen (Record of Firing, appended) that they were grouped for the different ranges of 200, 1,000, and 2,000 yards, and that the sizes were such as to cover, generally, all cases of different army formations. All the useful effects of fire were thus recorded on them, and its full value made apparent.

Results at 200 *yards. Targets E, F, G, appended—Plates* 9, 10, *and* 11.

Three different series of targets were placed at 200 yards. At the first (10 targets, 52 feet by 6 feet, 50 feet apart) 102 shells were fired, giving 2,140 hits. At the second (2 targets, 52 feet by 11 feet, 75 feet apart) 100 shells were fired, giving 1,045 hits. At the third (2 targets, 26 feet by 6 feet, 75 feet apart) 44 shells were fired, giving 309 hits.

The destructive effects on the first series are apparent, giving about 1,600 hits per minute, and using only about 125 pounds of metal.

The other series also illustrate the destructive power of this weapon at short ranges, such as would be used in the service of our armament for the flank-defenses of our sea-coast fortifications.

Results at 1,000 *yards. Targets A and C, appended—Plates* 5 *and* 7.

Two targets (11 feet by 26 feet) were made at this distance, firing in the first case 72 rounds, and in the second 143. The total number of hits was 1,597 for 215 projectiles in all fired. As the time of firing is about 80 rounds per minute, an analysis shows that a continuous and dangerous fire (about 590 hits per minute) can be secured at this range. A third series, (target H, appended, Plate 12,) firing at 10 targets (52 feet by 6 feet, 50 feet apart, and representing a regiment in column) was made, using 100 shells; 1,626 hits were noted. This gives a continuous and dangerous fire of 1,300 hits per minute, and using only 125 pounds of metal—results not yet attained in any other machine-gun, nor with our present field-artillery. The range of 1,000 yards, however, is one too long for accurate effects, generally, from the lighter caliber of other machine systems, (fired even with great deliberation.)

Results at 2,000 *yards.—Targets B and D—Plates* 6 *and* 8.

The targets made at this distance were accomplished by firing 221 rounds; and the total number of hits was 1,019; a continuous and dangerous fire, at this range, of 370 hits per minute.

Any comparison at this distance ceases with other machine-guns; and we have to consider the system at this range, as a competitor of field-cannon.

No direct comparisons have been as yet made by the board between the Hotchkiss revolving cannon and the ordinary field-pieces, but it is thought well to allude in this connection to the more recent practice with the most approved field-artillery. The recent experiments in Austria are probably the best so far made, and will afford us a fair comparison. This comparison will be incomplete, but this incompleteness will favor the field-artillery rather than the Hotchkiss system.

The records alluded to show that 40 shells, "with double walls," weighing in the aggregate, say, 560 pounds, gave 1,497 hits on targets placed at 1,658 yards. The time required for accurate firing could not have been less than ten minutes. This amount of metal if delivered from the Hotchkiss revolving cannon would, if a ratio following from the results already quoted is accepted, give 2,000 hits, and at a distance of 2,000 yards, and in a time of seven minutes.

Comparison cannot be made at the maximum ranges (4,000 yards) reported by the Austrian artillery, as no records are yet made at this distance with the revolving cannon.

RESULTS IN FRANCE AND BRAZIL.

An inspection of the results of firing at Gavre (Appendix 1) will show that, at a range of nearly 2,000 yards, as favorable results as those given at Sandy Hook were attained; the rapidity of fire being the same, and the number of hits (354) in a record of 80 shots showing nearly the same percentage as our results at the above-mentioned range. The range and accuracy attained also show a capacity for effective fire up to about 5,500 yards.

The trials also at Gavre with the revolving cannon, (Appendix 2,) French marine model, also gave strong confirmatory evidences of its superiority in range and accuracy, besides its effectiveness in other respects.

The results in Brazil also highly favorable to the gun, and the official opinions of its merits decided. (See report annexed, Appendix 3.)

DISCUSSION OF THE SYSTEM.

The introduction of this gun has marked a new departure in that class of arms which next succeeds in power the personal weapons of the soldier; and it gives fair promise as a powerful auxiliary to our modern field systems, and to our present contemplated armaments for the defense of the short flank-lines of our permanent works.

It is evident that, in the latter service, a long-range gun capable of securing an intense, accurate, continuous, and deadly fire at the short ranges ordinarily employed for this service, and having most of the advantages of the howitzer-fire, formerly fully, and now partially, relied upon for protecting our ditches and flank-lines, under all ordinary circumstances of attack, must prove a highly desirable adjunct, if not a superior means of defense to the present systems employed; limited as they are in power, and consequently in range, and without superiority in rapidity and continuity of fire, or in deadly effects.

Its range is at least 5,500 yards, which renders it equally as powerful as a shell-gun in this respect, and one capable of guarding the approaches to works, either permanent or field, at shell-gun distances,

while at the same time being effective at ranges of 1,000 to 1,500 yards, the maximum distances ordinarily required to be covered by our flank-defense armaments.

Its power for delivering a continuous and uninterrupted effective fire at ranges indifferently from the shortest range required up to three miles, would seem to point to it or a similar system—employing the same general principles—as being a *necessity* for introduction in the future armament of our forts, and for service, when occasion demands, in our field-works.

In this connection, as germane to the question of flank-defense, the board would call attention to the importance of the introduction into our service of a shell-gun of more accuracy, length of range, and destructiveness and rapidity of fire than the present 8-inch howitzer. This, it is believed, can be attained by a breech-loading rifle-howitzer of a caliber of 6 inches, throwing canister for short ranges as well as case-shot, and using the latter with percussion or concussion fuses; and for all ranges a special case-shot weighing 65 pounds, and containing bullets, 14 to the pound; also canister of a weight of, say, 54 pounds, using 0.8-inch lead bullets, and a shell of 61 pounds.

The effects with these projectiles must be decidedly superior to those attainable with our present 8-inch-howitzer ammunition, and in order to perfect a flank-defense howitzer, it is recommended that experiments in the direction indicated also be undertaken in connection with others now pending, looking to a proper armament of our flank-defenses.

REGARDING FIELD-SERVICES.

It is evident that this system gives promise of proving a valuable and powerful auxiliary to the light artillery of our service.

Its equality in range, its greater capacity for delivering a deadly, incessant, and widespread fire at all field-ranges, and with decidedly superior rapidity; its stability when fired, abolishing all but the ordinary initial pointings, and its evident superiority in pursuing retreating columns, give it some decided advantages, apparently, over our ordinary field-guns.

For the effects of artillery-fire, however, where penetration is desirable, and where destructive effects of solid shot and shell, in rapidly demolishing large objects, &c., are required, we must, of course, yield the advantage to the larger calibered field-pieces.

Its uses, however, as a powerful auxiliary to the service under consideration cannot be doubted from the above considerations; and the board believes that its great efficiency as a field-piece, when tested, will probably be established.

RECOMMENDATIONS.

The results of the above-recorded tests of the Hotchkiss revolving cannon at Sandy Hook, and the records of the results obtained abroad, lead the board to recommend, further, more extended and exhaustive trials to fully determine its merits, with a view to its final adoption as an auxiliary arm, not only for flank-defense, but for other branches of the service. To further this end, the board recommends the procurement of at least 4 guns (the number to be governed by the state of the appropriation) of the model and caliber tested; and with a supply of ammunition not exceeding 2,000 rounds per gun, the carriages needed to be made at the Watervliet arsenal, after well-matured drawings to

suit the nature of our service. Two of the guns procured to be placed in the field, to be reported upon after thorough trial, and two, with carriages adapted for flank-defense casemate-service, to be placed in some of our casemated works for trial and tests. It further recommends that experiments be continued with the present gun at Sandy Hook.

S. CRISPIN,
Bvt. Col. U. S. A., Lt. Col. of Ord.,
President of the Board.
T. J. TREADWELL,
Major of Ordnance.
T. G. BAYLOR,
Major of Ordnance.
FRANK H. PHIPPS,
Captain of Ordnance, Recorder.

Extract of the report of the trial of B. B. Hotchkiss revolver cannon, made by the French government at Gavre.

GENERAL OBSERVATIONS.

The mechanism of the cannon revolver is simple, and substantially made.

The traverse apparatus is simple, and works satisfactorily.

The iron gun-carriage has worked well during all the trials.

The fuse is simple, without any danger for manipulation, and requires no preparations on the battle-field.

Ballistical properties.—The elevation for the maximum range is about 5°; range, 4,600^{m}, (about 5,031 yards.) The accuracy of the revolver cannon in horizontal deviations is remarkable, and very much superior to that of the mitrailleuse.

Obturations.—The gas-check produced by the cartridge has been constantly good. The system of the cartridge-case is a good one.

Working of mechanism.—The working of the firing-pin has been constantly good. The loader worked always well during all trials. The principle of the extractor is a good one. The traverse motion and the elevating-screw worked always well.

Working of the brass coats of projectiles.—The projectiles examined after firing showed the print of the bands on the coat very distinctly, and of the same width as the bands. The results show this principle of the brass packing to be a good one.

Time of salvos.—Mean time for ten shots, 11.6 seconds.

RESULTS OF FIRING, (EXTRACT OF REPORT.)

Firing against a battalion in columns by division at entire distances. (Experiments of 27th February, 1873.)

The batallion is represented by 3 targets of 1.80 meters (about 6 feet) height, and 70 meters (about 230 feet) width. The first at 1,650 meters (about 1,804 yards) from the cannon. The second at 1,720 meters (about 1,881 yards.) The third at 1,790 meters, (about 1,957 yards.) Powder-charge, 85 grains; bursting-charge, 20 grains, powder du Repault.

Angle of fire, 6° 36′.

Two salvos of 40 shots fired, the first without traversing, the second with traversing.

The number of projectiles or pieces which, per hundred, reached the targets are, for the revolver cannon, 70.

In comparing this result with those obtained by the Gatling mitrailleuse in the same condition, it was found for the—

Caliber .45, Gatling mitrailleuse No. 150, number of hits, 11.25.

Caliber .45, Gatling mitrailleuse No. 161, number of hits, 3.72.

The superiority of the revolver cannon is well marked.

Firing with shells against a battalion in column by division at entire distances. (*Tests of 25th July*, 1873.)

The battalion is represented by 6 targets of 1.80 meters (about 6 feet) height, and 35 meters (about 115 feet) width. The distance between is 35 meters, (about 115 feet.) The last target 1,795 meters (about 1,963 yards) from the revolver cannon.

Powder-charge, 85 grains; bursting-charge, 20 grains; powder of Ripault. The firing is regulated to drop the projectiles between the 3d and the 4th targets.

Angle of fire, 6° 30′.

Two salvos of 40 shots fired without traversing.

The number per hundred of hits is, for the revolver cannon:

1st salvo, 109; the second salvo of 40 shots fired in 30 seconds: 2d salvo, 245.

For the 1st caliber, Gatling mitrailleuse No. 81: 1st salvo, 24; 2d salvo, 48; 3d salvo, 57.3.

For the .65 caliber Gatling mitrailleuse No. 10: 1st salvo, 25; 2d salvo, 35; 3d salvo, 54; 4th salvo, 18.7.

The Hotchkiss revolving cannon, therefore, produces a much superior effect to that of the mitrailleuse Gatling.

Firing against a steel plate of 10 millimeters (about 0.3937 inch) thick; distance, 150 meters, (about 492 feet.) (*Experiments of July 25, 1873.*)

Three shots.

1. Goes through and explodes in coming out.
2. Goes through and explodes in coming out.
3. The shot, badly directed, hits at left a sheet-iron of 10 millimeters (about 0.3937 inch) thick, supported by a piece of oak of 20 centimeters (about 7.874 inches) square. The projectile exploded in the wood, which was split to the length of about one meter, (about 3.28 feet.) The hole measures behind about seven centimeters (about 2.76 inches) of width. The piece of iron detached from the sheet went through the wood, and dropped at 4 or 5 meters (about 15 feet) beyond.

SENSIBILITY OF FUSES.

The cannon was pointed seaward and fired.

1. Two shots at an angle of 2′. The shell exploded on touching the water.
2. One shot at + 15′. The shell exploded on touching the water.
3. One shot at 2°. The shell exploded on touching the water.
4. One shot at 3°. The shell exploded on touching the water.
5. One shot at 5°. The shell exploded on touching the water.

TRIAL OF SAFETY OF FUSES, (25TH JULY, 1873.)

Three shells were suspended by a string, the point downward. When the string was cut, the shell with the fuse fell on a sheet-iron plate the height of 3.32 meters, (about 11 feet.) The fuse did not explode and the mechanism did not move.

TRIAL OF FUSES, (EXPERIMENTS 21ST JANUARY, 1874.)

All the empty shells penetrated into the earth from 30 to 40 centimeters (about 13 inches) depth. The fuse had exploded in all that were found.

RANGE, (EXPERIMENTS OF JANUARY 20, 1874.)

Charge of powder, 150 grains "R. L. G." Some of the projectiles fired at 30° elevation, which were not found, struck the ground at a distance of 5,000 meters, (about 5,468 yards.)

The projectile fired at 35° elevation had a range exceeding 5,000 meters, (exceeding 5,468 yards.) Some of the assistants saw it fall, but could not find it because the ground was too rough.

ACCURACY, (EXPERIMENTS OF JANUARY, 1874.)

Powder-charge, 100 grains, powder of Ripault; angle of fire, 35°.

Shell.

Mean range, 4,014 meters, (about 4,390 yards.)
Maximum range, 4,023 meters, (about 4,400 yards).
Minimum range, 3,998 meters, (about 4,372 yards.)
Difference in range, 25 meters, (about 27 yards.)
Maximum deviation, 64.2 meters, (about 70.21 yards.)
Minimum deviation, 60.2 meters, (about 65.83 yards.)
Difference in deviation, 4 meters, (about 4.38 yards.)

The shells fired hit the ground at over 4,000 meters (about 4,375 yards) distance, within a space of 25 meters (about 27 yards) length and 4 meters (about 4.38 yards) wide.

Solid shot.

Mean range, 4,454 meters, (about 4,871 yards.)
Maximum range, 4,466 meters, (about 4,884 yards.)
Minimum range, 4,442 meters, (about 4,857 yards.)
Difference in range, 24 meters, (about 26 yards.)
Maximum deviation, 62 meters, (about 67.8 yards.)
Minimum deviation, 60.6 meters, (about 66 yards.)
Difference in deviation, 1.4 meters, (about 1.5 yards.)

The projectiles hit the ground at a distance near 4,500 meters, (about 4,921 yards,) within a space of 24 meters (about 26 yards) length and 1.4 meters (about 1.5 yards) wide.

Extract from the report upon the Hotchkiss revolving cannon, model of the French marine.—(Experiments of Gavre, February and March, 1877.)

The modifications applied to the cannon-revolver for the service of the marine have had for their principal object the giving to the piece a sufficient lightness and mobility to enable the same man to execute a continuous fire, and to rectify the pointing at each shot.

The necessary mobility has been obtained by mounting the piece upon a fork pivoted in a socket, and this is rendered sufficient, because the cannonier who points supports the left shoulder against a trail-piece, and holds with the left hand a handle placed under the breech, and, while turning with the right hand the crank, is able at the same time to follow the object with the line of sight.

It is proposed to have some small pieces, which, placed upon different parts of a vessel, shall be able to protect disembarcation from small crafts and torpedo-boats.

To fulfill this object we should have great accuracy up to 2,187 and 2,734 yards, sufficient rapidity of fire and penetration, at these distances, of plates from .20 inch to .24 inch; also the piercing of sheathing of launches.

PENETRATION OF THE SHELLS.

The shell of 14.85 ounces, of ordinary cast iron, gave dangerous fragments in bursting on its passage through a plate of sheet steel of .24 inch, with a velocity at impact reduced to 482 feet (corresponding to a distance of 2,187 yards) under an angle of 22°, or with a velocity at impact of 623 feet (corresponding to a distance of 1,640 yards) under an angle of 30°.

It gave more than six dangerous fragments per shot in passing with a velocity at impact of 1,302 feet in normal fire against a steel plate about .6 inch thick. It gave again some dangerous fragments after having traversed 11.8 inches of wood under an angle of 0°, with a velocity of about 722 feet; after having traversed 11.8 inches of wood, under an angle of 30°, with a velocity at impact of 1,302 feet, and after having traversed a wall of 3.9 inches, under an angle of 30°, with a velocity at impact of about 722 feet.

FIRING AT VESSELS IN MOTION.

This firing was easily done by two men, although the gunner was not accustomed to fire upon the sea at a movable target, nor to the sight that was used. This firing showed remarkable accuracy, since fifty good shots were observed out of 108 fires. The balloon which served as a target (31½ inches diameter) was reduced to pieces; and the stem, the upper part of which was attached to the balloon and had 2.36 inches of cross-section, was cut away and riddled with shot, and the remaining stump, of which the lower part was about .45 inch cross-section, bore the trace of many shells, attesting the efficacy of the fire against a target of very small dimensions.

RESISTANCE OF THE CARTRIDGE-CASES EMPLOYED IN FIRING.

It is found that the same case can be used (by re-priming) four or five times.

GENERAL SUMMARY AND CONCLUSIONS.

The Hotchkiss revolving cannon (marine model) fulfills the many conditions for the employment to which it is destined—that is to say, the defense of vessels against small crafts and torpedo-boats.

The commission thought, in addition, that it was fitting to examine if this arm would serve to a good use in the protection of the embarcation of troops.

The extent of its ranges and its longitudinal accuracy are remarkable, and its lateral accuracy is satisfactory.

The results of firing-practice aboard ship, executed with shells of 14.85 ounces, showed that the ballistic qualities of the revolving cannon would be utilized in the most difficult conditions of a movable target.

For a distance estimated at the beginning of a volley, and variable, a mean velocity of fire of about one shot in five seconds in regular working and practice is reasonably sufficient to secure the effects of each fire.

The shell of 14.85 ounces, of ordinary cast iron, charged and fitted with a percussion fuse, normally pierced plates of steel of .24 inch and up to 2,187 yards distance; and under an angle of 30° up to about 1,640 yards. This same shell normally pierced 11.8 inches of oak wood at 547 yards, and 3.9 inches of oak wood under the angle of 30° at the same distance. Its explosion gave, even after the perforation of those obstacles, some dangerous fragments.

The shell of about 1 pound, of the same metal, will have a greater effect, especially at great distances.

Two men are sufficient for serving the cannon.

[Translation.]

Report of the minister of war to the general legislative assembly of Brazil, on the Hotchkiss revolving cannon, made at Rio de Janeiro, 1875.

[Extract.]

The artillery committee highly recommend the Hotchkiss revolving cannon, and state that the smallness of its caliber is compensated for by the rapidity of fire, as about 80 rounds per minute can be discharged from it, while one round can only with difficulty be discharged from other systems, (Whitworth, Krupp, &c.)

Each shell of the revolving cannon gives 10 to 11 useful fragments; the gun produces, therefore, about 800 fragments per minute. The Whitworth and Krupp guns give only 7 to 9 useful fragments during the same time, having the same range and precision as the revolving cannon.

The maximum range of the gun is 4,500 meters (about 4,921 yards) with French powder, or about 5,000 meters (about 5,468 yards) with our own powder, which at present appears to be of the best quality.

The sample gun purchased by the imperial government, at the request of the artillery committee, (though not quite complete, as it was not provided with the shield to protect the gunners against sharp-shooters,) proved at the experiments on the firing-grounds to be an excellent weapon, as it possesses the following qualities:

Great range.
Perfect accuracy of fire.
Absence of recoil, due to the special brakes.
Quick loading, simple and almost automatic.
Great rapidity of fire.

Metallic cartridge, which can be reloaded on the average 8 times, and allowing the primers to be changed with great facility.

Simple and strong mechanism, composed of only 7 parts, which load, fire, extract and drop the empty cartridge-shell to the ground.

Complete obturation and forced projectile.

Operation by only four men, who can easily be protected by entrenchment of the gun.

The artillery committee express the opinion that the practical results will perhaps recommend the adoption of this system as the only artillery for our army.

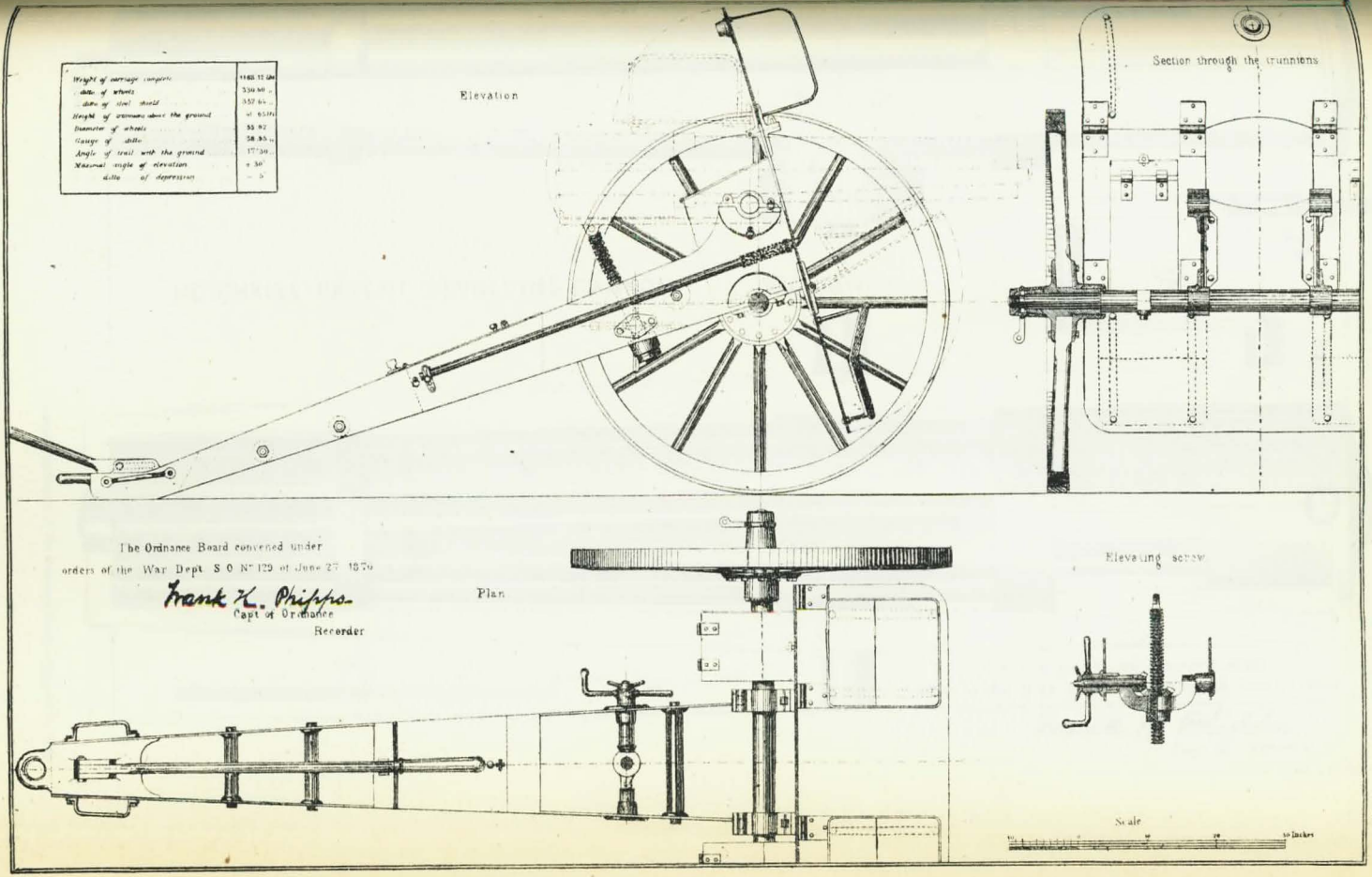
Signed—the secretary of state and minister of war.

Record of firing with caliber 1½-inch Hotchkiss revolving cannon, from September 11, 1876, to February 15, 1877, at Sandy Hook, New York Harbor.

Date.	Number of shots.		Charge.				Projectiles.				Mean observed velocities of the projectiles at 100 feet from the muzzle of the gun, as recorded by Le Boulenge chronograph.	Elevation.	Targets.					Condition of weather.					Remarks.
			Powder.		Cartridge-case.																		
	Preliminary.	Regular firing.	Kind.	Weight.	Length of powder space.	Diameter, exterior.	Kind.	Weight.	Length.	Diameter.			umber of targets.	Distance of first target from gun.	Size.	Distance apart.	Total number of hits.	Thermometer.	Barometer.	Humidity.	Direction of wind.	Strength of wind in miles per hour.	
1876-'77.				*Oz.*	*Inches.*	*Inches*		*Lb. oz.*	*Inches.*	*Inches*	*Feet.*	° ′		*Yards.*	*Feet.*	*Feet.*				*Pr. ct.*			
September 11	....	40	New mortar	4.23	3⅝	1.64	Hotchkiss shell	1 5.5	4.1	1.45	.....	.....	...	.....	.....	.....	.....	...	.....	.....	.....	.....	Fired to test working of gun.
September 12	....	3	....do	4.23	3⅝	1.64	.....do	1 5.5	4.1	1.45	1,294	.....	...	.....	.....	.....	.....	...	.....	.....	.....	.....	Fired to obtain velocities.
September 12	....	12	Musket	4.23	3⅝	1.64	.....do	1 5.5	4.1	1.45	1,572	.....	...	.....	.....	.....	.....	...	.....	.....	.....	.....	Do.
September 12 and 22	...	18	Old mortar	4.23	3⅝	1.64	.....do	1 5.5	4.1	1.45	1,458	.....	...	.....	.....	.....	.....	...	.....	.....	.....	.....	Do.
September 21	4	72	....do	4.23	3⅝	1.64	.....do	1 5.5	4.1	1.45	.....	2 15	4	1,000	11 by 26	125	312	64	30.141	64	L. to R	8	Target A.
September 22	7	51	... do	4.22	3⅝	1.64	.....do	1 5.5	4.1	1.45	.....	5 5	3	2,000	11 by 26	125	56	58	30.204	87	..do	21	Target B.
September 22	...	4	... do	4.23	3⅝	1.64	.....do	1 5.5	4.1	1.45	.....	.....	1	200	8 by 13	.....	38	..	.....	.....	.....	.....	o draught of target made.
September 22	...	26	...do	4.23	3⅝	1.64	Hotchkiss canister	1 9.4	4.56	1.44	.....	.....	1	200	8 by 13	.....	25	...	.....	.....	.....	.....	Do.
October 3	..	72	...do	4.23	3⅝	1.64	Hotchkiss shell	1 5.5	4.1	1.45	.....	.....	...	.....	.....	.....	.....	...	.....	.....	.....	.....	Fired to test working of gun.
ovember 23	14	101	....do	4.23	3⅝	1.64	.....do	1 5.5	4.1	1.45	.....	.....	...	.....	.....	.....	.....	...	.....	.....	.....	.....	No draught of target made; 1 miss-fire.
November 24	15	....	Musket	4.23	3⅝	1.64	.....do	1 5.5	4.1	1.45	.....	.....	...	.....	.....	.....	.....	...	.....	.....	.....	.....	Do.
December 2	7	143	...do	4.23	3⅝	1.64	.....do	1 5.5	4.1	1.45	.....	1 55	4	1,000	11 by 26	125	1,285	22	29.664	73	.....	22	Target C.
December 2	4	170	....do	4.23	3⅝	1.64	.....do	1 5.5	4.1	1.45	.....	4 50	4	2,000	11 by 26	125	963	22	29.664	73	.....	22	Target D; 3 miss-fires.
January 25	13	102	Old mortar	4.23	3⅝	1.64	.....do	1 5.5	4.1	1.45	.....	½	10	200	6 by 52	50	2,140	...	.....	.....	.....	.....	Target E.
January 25	2	100	....do	4.23	3⅝	1.64	.....do	1 5.5	4.1	1.45	.....	.....	2	200	11 by 52	75	1,045	..	.....	.....	.....	.....	Target F.
February 14	..	44	....do	4.23	3⅝	1 64	.....do	1 5.5	4.1	1.45	.....	.....	2	200	6 by 26	75	309	...	.....	.....	.....	.....	Target G.
February 15	12	100	....do	4.23	3⅝	1.64	.....do	1 5.5	4.1	1.45	.....	2 05	10	1,000	6 by 52	50	1,626	...	.....	.....	.....	.....	Target H.

NOTE.—ovember 23, 1876.—Twenty rounds fired in 14½ seconds. Fifty-one rounds fired in 48 seconds. December 2, 1876.—Forty rounds fired in 33 seconds. January 25, 1877.—Ten rounds (averaging) fired in 7½ seconds.

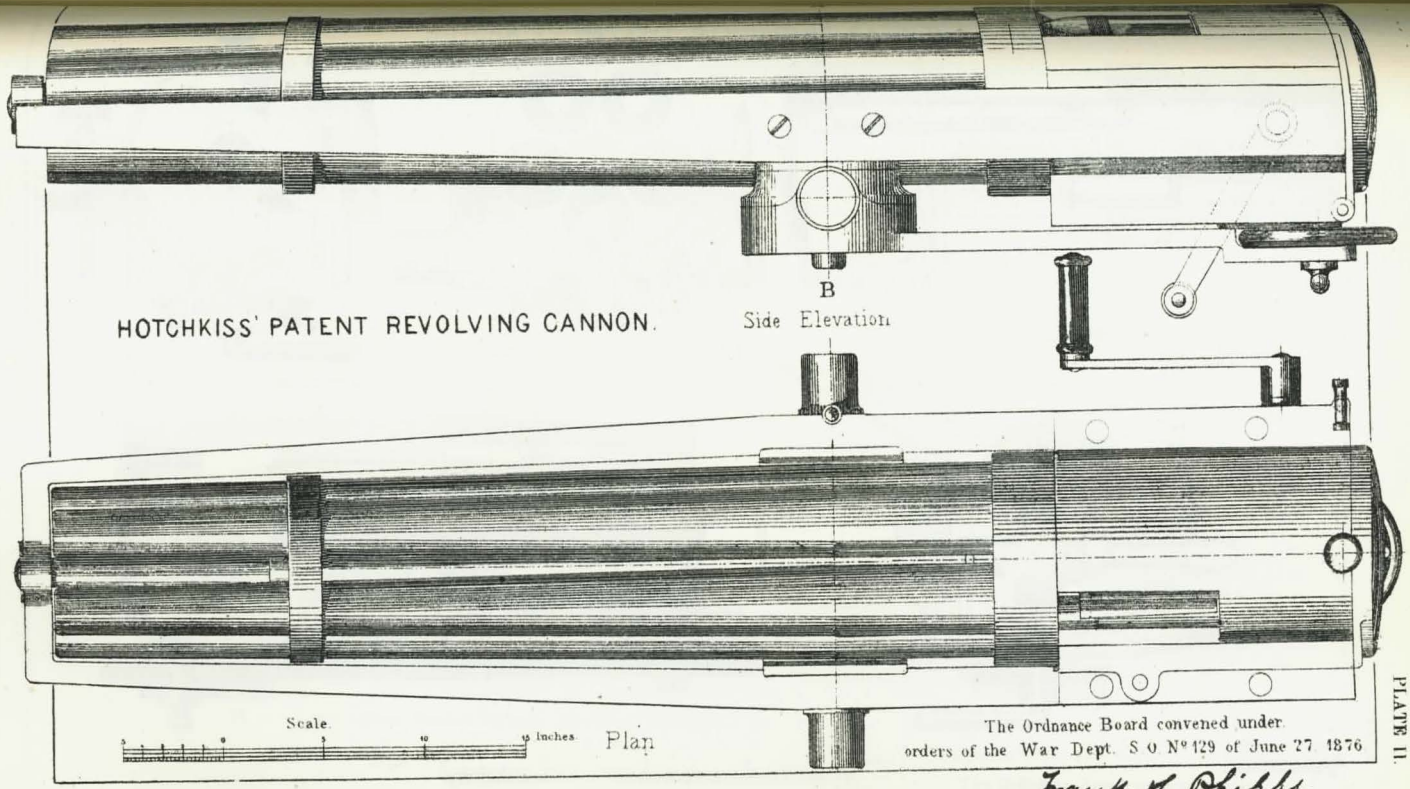
CARRIAGE FOR HOTCHKISS PATENT REVOLVING CANNON



Weight of carriage complete	1183.12 lbs
ditto of wheels	330.50 "
ditto of steel shield	357.64 "
Height of trunnions above the ground	41.65 in
Diameter of wheels	53.92 "
Gauge of ditto	58.35 "
Angle of trail with the ground	17°30'
Maximal angle of elevation	+ 30°
ditto of depression	− 5°

The Ordnance Board convened under orders of the War Dept. S.O. N° 129 of June 27 1879

Frank L. Phipps
Capt of Ordnance
Recorder

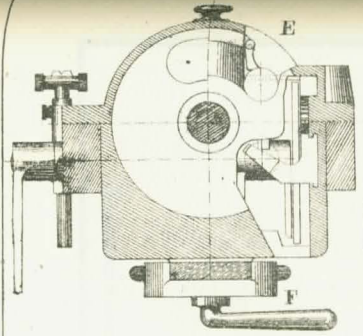


The Ordnance Board convened under orders of the War Dept. S O Nº 129 of June 27 1876

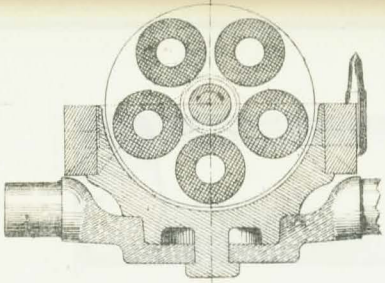
Frank H. Phifps.
Capt. of Ordnance.
Recorder

PLATE II.

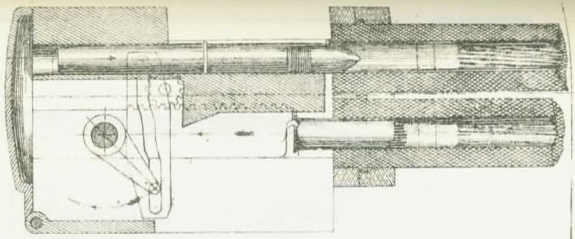
HOTCHKISS' PATENT REVOLVING CANNON



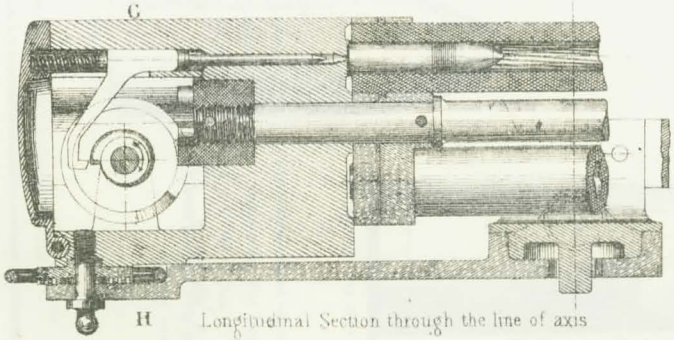
Front view of the breech



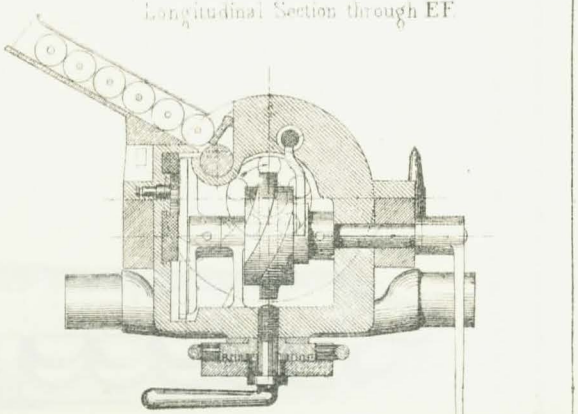
Vertical Section through AB.



Longitudinal Section through EF



Longitudinal Section through the line of axis



Vertical Section through GH.

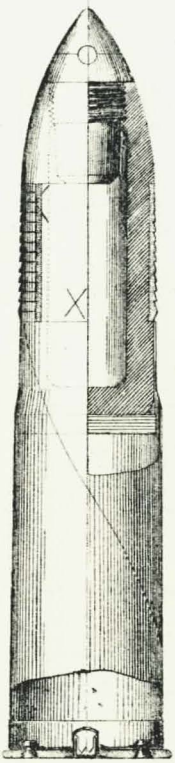
Scale

The Ordnance Board convened under orders of the War Dept. S.O. N° 129 of June 27 1876

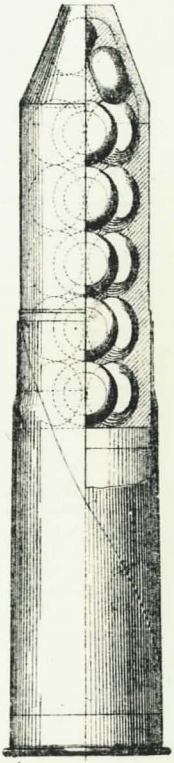
Frank H. Phillips

Capt of Ordnance, Recorder

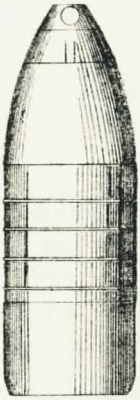
AMMUNITION FOR THE HOTCHKISS' REVOLVING CANNON.



Cartridge with explosive shell



Cartridge with case shot

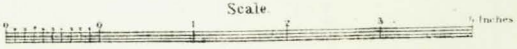


Improved shell

The Ordnance Board convened under orders of the War Dept S. O. N° 129 of June 27. 1876.

Frank H. Phipps
Capt. of Ordnance,
Recorder

Scale.



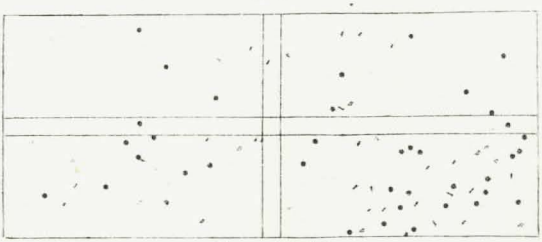
A.

Sept. 21st 1876.

Hotchkiss Revolving Cannon

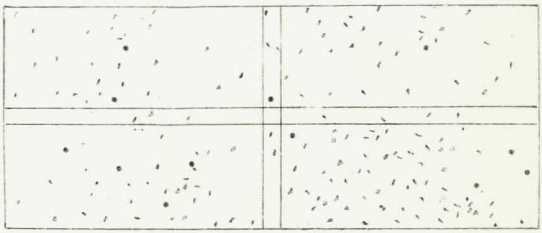
Target Record 1000 Yards.

No. 1.



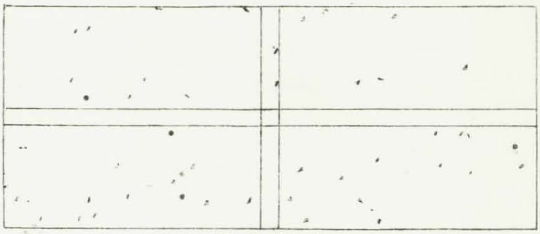
Number of Hits 77.

No. 2.



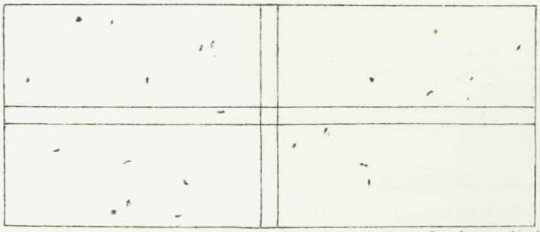
Number of Hits 171.

No. 3.



Number of Hits 45.

No. 4.



Number of Hits 19

The Ordnance Board convened under orders of the War Dept. S. O. No. 129 of June 27 1876

Legend.
- Target 11 feet by 28 feet.
- Distance between Target 12.5 feet.
- Total Number of hits 312.
- Number of shots fired. 72.

Frank H. Phelps.
Capt. of Ordnance.
Recorder

B.

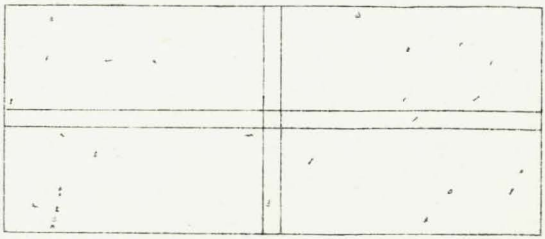
Sept. 22nd 1876.

PLATE VI.

Hotchkiss Revolving Cannon

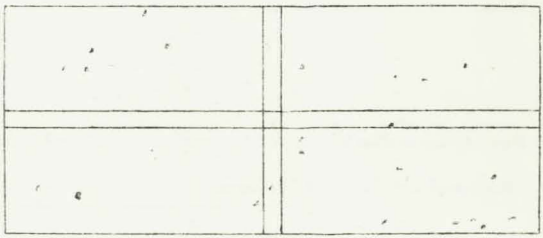
Target Record 2000 Yards.

No 1



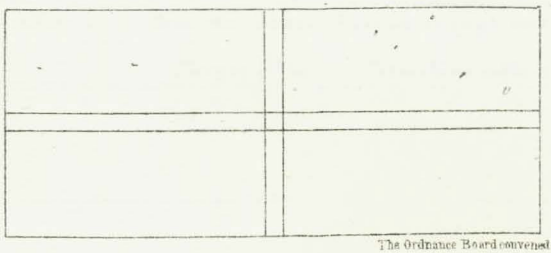
Number of Hits 28

No 2.



Number of Hits 21.

No 3.



Number of Hits 7.

Legend:
Target 11 feet by 28 feet
Distance between target 125 feet
Total Number of Hits 56.
Number of Shot fired 51.

The Ordnance Board convened under orders of the War Dept S O No 120 of June 27 1876

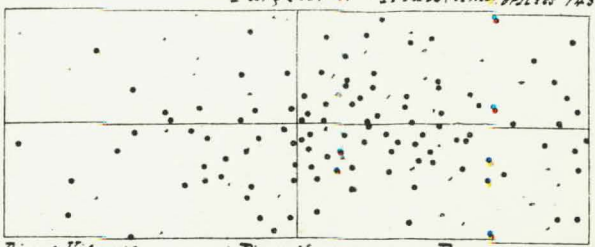
Frank L. Phillips
Capt. of Ordnance,
Recorder

C.

Hotchkiss Revolving Cannon Dec. 2nd 1876.

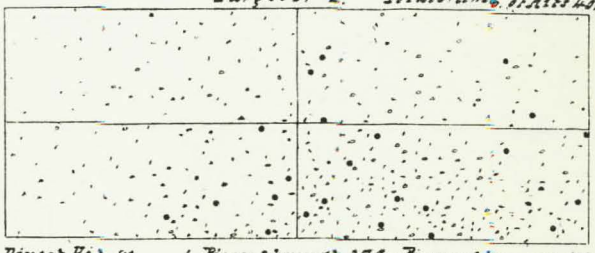
No. of Rounds fired 148 1½ Cal 1000 Yards.

Target No. 1. Total Number of Hits 145



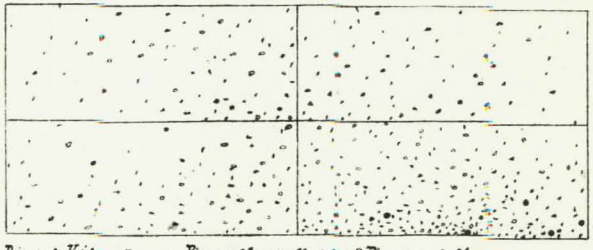
• Direct Hits 112. ▲ Pieces through 24. ▲ Pieces not through 9.

Target No. 2. Total Number of Hits 401.



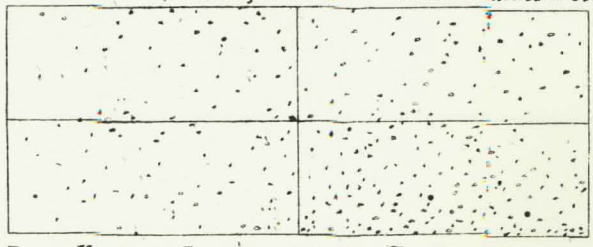
• Direct Hits 31. ▲ Pieces through 276. ▲ Pieces not through 102.

Target No. 3. Total Number of Hits 434



• Direct Hits 5. ▲ Pieces through 284. ▲ Pieces not through 145.

Target No. 4. Total Number of Hits 305.



• Direct Hits 2. ▲ Pieces through 194. ▲ Pieces not through 108.

Target 26 feet x 11 feet 125 feet apart The Ordnance Board convened under orders of the War Dept. S.O. No. 129, of June 27, 1876.

Frank A. Phillips

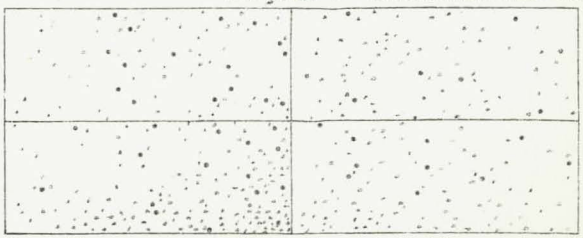
Capt. of Ordnance, Recorder

D.

Hotchkiss Revolving Cannon Dec 2nd 1876

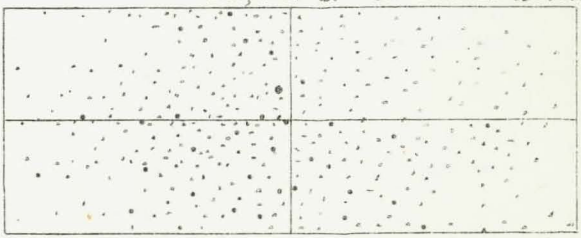
No of Rounds fired 176 1½ Cal. 2000 Yards

Target No 1 Total Numb of Hits 42.



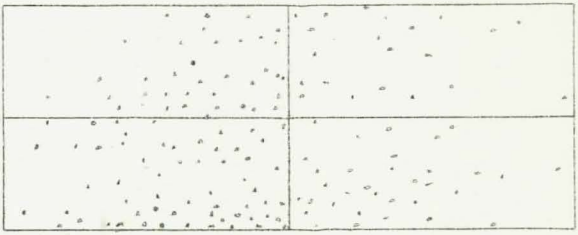
Direct Hits 50 Pieces through 182 Pieces not through 176.

Target No 2. Total Numb. of Hits 333.



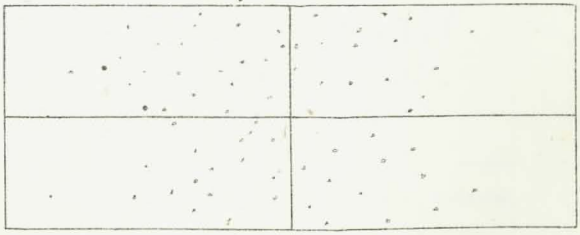
Direct Hits 31. Pieces through 126. Pieces not through 176

Target No 3. Total Numb of Hits 149



Direct Hits 4. Pieces through 64 Pieces not through 81.

Target No 4 Total Numb of Hits 69.



Direct Hits 2 Pieces through 25 Pieces not through 42.

Target 26 feet x 11 feet 125 feet apart.

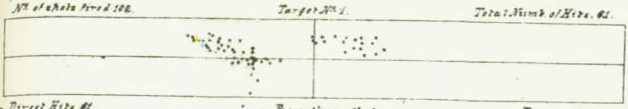
The Ordnance Board convened under orders of the War Dept. S. O. No 129 of June 27 1876.

Frank K. Phillips
Capt. of Ordnance
Recorder

E.

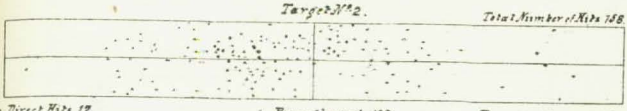
Target record of Hotchkiss Revolving Cannon at Sandy Hook N.J. January 25th 1877.
First Target 200 Yards from gun, Cal. 1½ inch, Total Number of Hits in 10 Targets 2140.

No. of shots fired 100. Target No. 1. Total Number of Hits. 61.



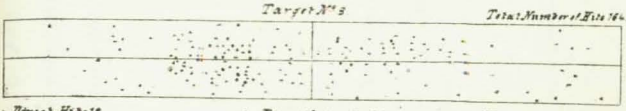
Direct Hits 61 — Pieces through 0 — Pieces not through 0

Target No. 2. Total Number of Hits 158.



Direct Hits 17 — Pieces through 128 — Pieces not through 13.

Target No. 3 Total Number of Hits 164.



Direct Hits 18. — Pieces through 129. — Pieces not through 17

Target No. 4. Total Number of Hits 234.

Direct Hits 12 — Pieces through 203 — Pieces not through 19.

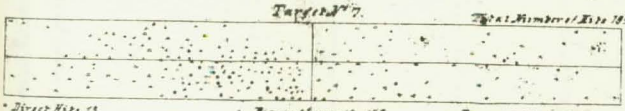
Target No. 5. Total Number of Hits 277

Direct Hits 5 — Pieces through 228 — Pieces not through 39

Target No. 6. Total Number of Hits 242

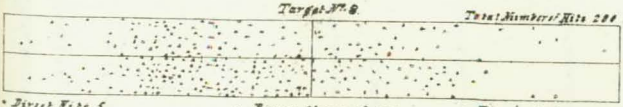
Direct Hits 12 — Pieces through 188 — Pieces not through 34

Target No. 7. Total Number of Hits 192



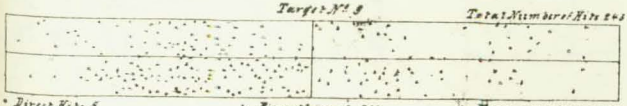
Direct Hits 13 — Pieces through 158 — Pieces not through 27

Target No. 8. Total Number of Hits 284



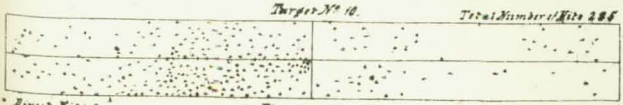
Direct Hits 5 — Pieces through 280 — Pieces not through 27

Target No. 9 Total Number of Hits 243



Direct Hits 5 — Pieces through 201 — Pieces not through 37

Target No. 10. Total Number of Hits 286



Direct Hits 9 — Pieces through 256 — Pieces not through 20.

Target 32 feet × 6 feet 36 feet square.

The Ordnance Board convened under orders of the War Dept. S.O. No. 179 of June 23 1876

David H. Phillips
Capt. of Ordnance,
Recorder.

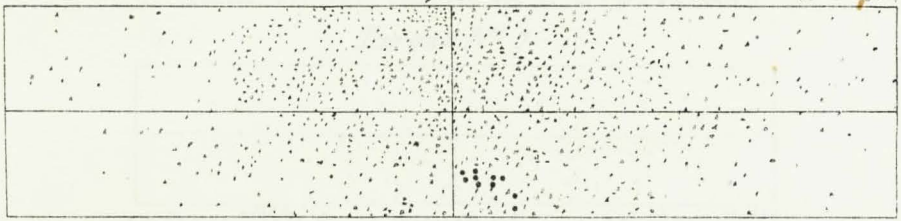
PLATE IX.

F.

Target record of Hotchkiss Rotating Cannon at Sandy Hook N.J. January 25th 1877.

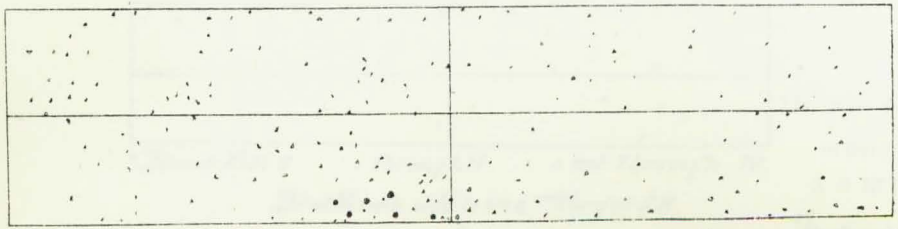
First Target 200 Yards from gun, Cal 1½ inc, Total Number of Hits in 2 Targets 1045.

No. of shots fired 100. Target No. 1 Total Numb. of Hits 884



• Direct Hits 11. ▲ Pieces through 838. ▫ Pieces not through 235.

Target No. 2. Total Number of Hits 161.



• Direct Hits 6. ▲ Pieces through 92 ▲ Pieces not through 63.

Targets 52 x 11 —— 75 apart.

The Ordnance Board convened under order of the War Dept. S.O. No. 129 of June 27 1876

Frank R. Phipps.

Capt. of Ordnance Recorder

PLATE X

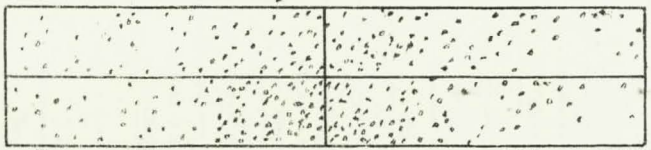
G.

Hotchkiss Revolving Cannon Cal. 1½ins Feb. 14th 1877. at Sandy Hook N.J.

First Target 200 Yards from Gun Number of Shots fired 44.

Total Number of Hits in 2 Targets 307.

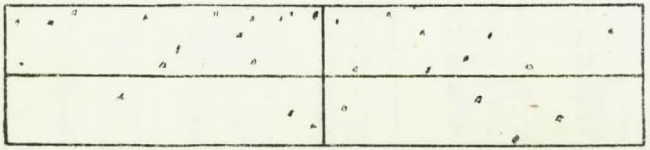
Target No 1.



• Direct Hits 0 ▲ through 128 ▲ not through 153

Total Numb. of Hits in 1st Target 281.

Target No 2.



• Direct Hits 0 ▲ through 11 ▲ not through 17.

Total Numb. of Hits in 2nd Target 28.

Target 26 feet x 6 feet 25 feet apart.

The Ordnance Board convened under orders of the War Dept. S. O. No 129 of June 27. 1876.

Frank H. Phelps.
Capt. of Ordnance,
Recorder

Hotchkiss Rev Common - Cal. 1¼ins Feb. 15th 1877 at Sandy Hook N. J.

First Target 1000 Yards from Gun Number of Shots fired 700

Total Number of Hits in 10 Targets 7626

Target No. 1

Direct Hits 33 through 67 not through 29.

Total Numb. of Hits in 1st Target 129

Target No. 2

Direct Hits 50 through 68 not through 68

Total Numb. of Hits in 2nd Target 186

Target No. 3

Direct Hits 39 through 132 not through 160

Total Numb. of Hits in 3rd Target 331

Target No. 4

Direct Hits 24 through 98 not through 200

Total Numb. of Hits in 4th Target 322

Target No. 5

Direct Hits 9 through 32 not through 191.

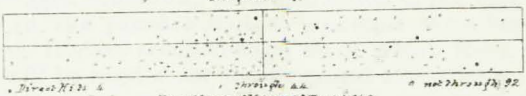
Total Numb. of Hits in 5th Target 232

Target No. 6.

Direct Hits 3 through 43 not through 126

Total Numb. of Hits in 6th Target 171

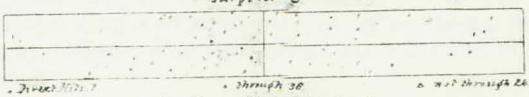
Target No. 7



Direct Hits 4 through 44 not through 92.

Total Numb. of Hits in 7th Target 140

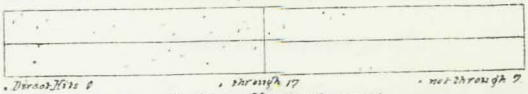
Target No. 8



Direct Hits 7 through 38 not through 24

Total Numb. of Hits in 8th Target 67

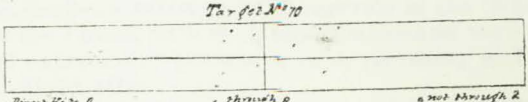
Target No. 9



Direct Hits 0 through 17 not through 7

Total Numb. of Hits in 9th Target 24

Target No. 10



Direct Hits 0 through 8 not through 2

Total Numb. of Hits in 10th Target 10

Target 7 - 52 ins x 6 ins ... 50 to square.

The Ordnance Board convened under orders of the War Dep. S.O. No. 129 of June 21, 1876.

Frank K. Phillips
Capt. of Ordnance & Recorder

Accompanying Report of The Ordnance Board—Appendix O, 1877.