

Notes
on
Lectures delivered,
at
U. S. Naval War College
September and October 1892.

Sept. 6.

Opening address by the President of the College and lectures by Naval Constructor J. J. Woodward and Captain A. T. Mahan.

Sept. 7

Captain A. T. Mahan on Naval Strategy. Campaigns of the armies and navy of the French Republic 1792-3. Naval Constructor J. J. Woodward. Construction and stability of ships of war.

General requirements.

- (1) Maximum speed S
- (2) Consumption of coal K at sustained speed of S .
- (3) Thickness of plates ϵ , thickness E and height H of armor belt.
- (4) Weight of batteries, ammunition, crew & stores π
- (5) Metacentric height
- (6) Displacement
- (7) Coefficient of fineness of ship's body $\alpha = \frac{V}{Lbd}$ referred to parallelepiped
- (8) Coefficient of fineness of ship's body $\beta = \frac{V}{mLd}$ " " cylinder
- (9) Coefficient of W.L. area to rectangle $\gamma = \frac{V}{\delta L}$

A and B are constants, obtained by comparisons with ships of similar characteristics. $A = \frac{m \times S_1^3}{P_1}$, $B = \frac{D^{7/3} \times S_1^3}{P_1}$

$p = IP$ developed per ton of similar machinery

$m =$ area midship section, $V =$ volume, $h =$ weight of hull &

fittings, \underline{m} of machinery, \underline{n} of coal supply, \underline{a} of armor. ^{required}

$\underline{P} = IP$ required for speed S , $\underline{C} =$ consumption of coal at ext. range

$$(a) D = h + m + n + a + \pi.$$

$$(b) h = D \times \delta,$$

$$(c) m = \frac{P}{p} = \frac{D^{7/3} S^3}{p}$$

$$(d) \frac{C}{2240} \times P_2 = \frac{C \times D^{7/3} \times S_2^3}{2240 B_2}, \quad n = \frac{C \times D^{7/3} \times S_2^3}{2240 B_2} + \frac{\gamma}{2240} \times \frac{K}{S_2}$$

(e) $a = a_1 + a_2$, $a_1 = \frac{41}{2240} \times 8 \times 7 \times I \times b \times q$, $q =$ coefficient of average thickness
 $a_2 = \frac{41}{2240} \times I \times H \times L \times f \times q$, $f =$ ratio length belt to deck

(f) $\pi =$ weight of battery + crew + provisions + etc

(g) $D =$ total displacement in tons

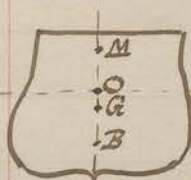
$$= D \times d + \frac{D^{2/3} S_1^3}{p \beta_1} + \left(\frac{C \times 10^3 \times S_2^3}{2240 \beta_2} + \frac{8K}{2240 S_2} \right) + \frac{41}{2240} (7B + 8q + HH + R) + \pi$$

(h) $D(1-d) = D^{2/3} \left(\frac{S_1^3}{p \beta_1} + \frac{C S_2^3}{2240 \beta_2} \right) + Z$, $V = 35D$, $D = \frac{V}{35} = \frac{24bd}{35}$

Putting in form of equation $x + ax^{2/3} + b = 0$, where x repr. D
 and solving for D we get

(i) $D =$ some known arithmetical quantity $= Z$

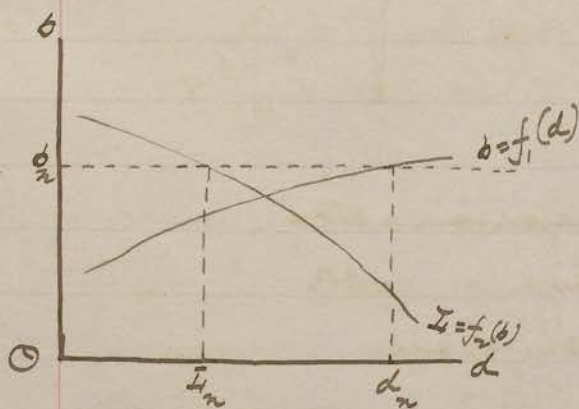
(k) $\frac{24bd}{35} = Z$, or $4bd = Z$, or $I = f(bd)$.



$b m = B m - B G$, $B = \frac{I}{V}$, $B O = \frac{d}{3} \left(\frac{1}{2} + \frac{d}{7} \right)$ normal.

$B m = (.008 + .07407^2) \frac{b^2}{d}$, $\therefore b = f(d)$

(1) $b = f_1(d)$, $I = f_2(b)$, $D = f_3(b)$, $\frac{I}{b} = f_4(b)$, $\frac{4}{d(1+d)} = f_5(b)$



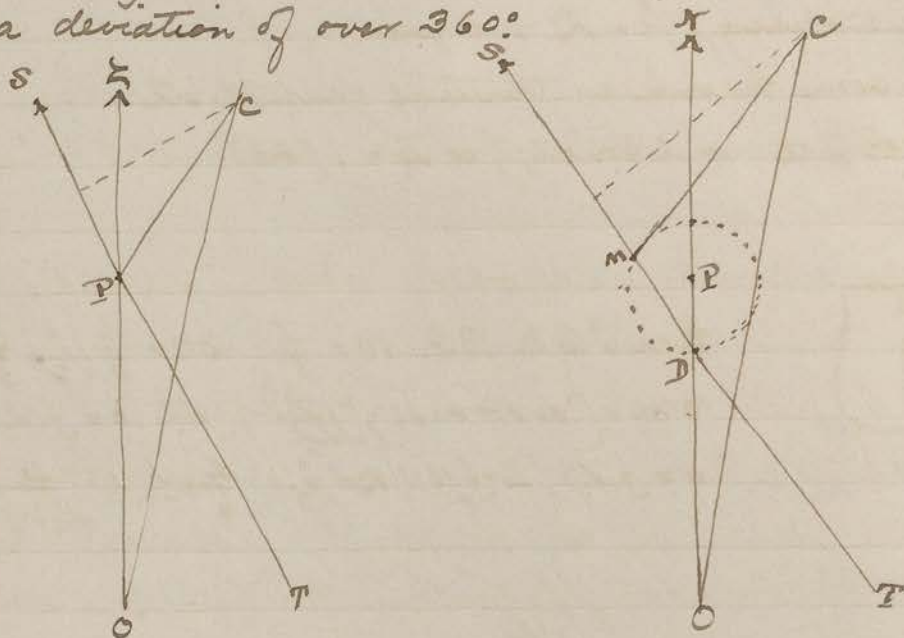
Sept. 8

Sept. 9.

Surgeon Chas. A. Siegfried, U. S. N. on Morbific influences affecting seamen. Description of cells of matter, and disease germs, their appearance, size, quantity, growth,

and destruction. Germs of disease found in almost every-
thing except substances heated to a considerable temper-
ature. In time of epidemics to avoid all raw and partly
cooked food especially fruit.

Lieutenant S. W. B. Diehl on "Magnetic variation and
deviation of compasses." Instanced the Baltimore with
conning tower so close to steering compass as to cause
a deviation of over 360°



H = Horizontal force earth's magnetism = $OP = 1$,

H' = " " earth's & ship's " = OC

ST = Magnetic direction of ship's keel

PD = Quadrantal force due to horizontal iron

Om = Semicircular deviation.

Practically reviews Wain's "Deviation of the Compass"

Sept. 12

Sept. 13

Sept. 14.

Captain A. T. Mahan, Naval Strategy, with particular application to the Caribbean Sea after completion of Inter-Oceanic Canal across Isthmus of Panama. The preeminence of Jamaica as a base in case of naval operations, flanking all lines of communication to the Isthmus. Value of Cuba to the United States in such a case with ports of Santiago de Cuba, & Cienfuegos controlling Windward passage, and Havana and Key West the Gulf Entrance. Secondary value of Puerto Rico and St. Thomas for control of Mona passage. Control of narrow passage on northern side of Cuba by torpedo boats working along coasts in shoals. Cuban railroads from Havana to the southern ports of great value. General study of ports and harbors of Caribbean.

Captain Mahan of the Army. Coast Defenses. General idea, and comparison of resources of different ports. New York of greatest importance. Its importance as flanking communications from Halifax to Bermuda in case of war with G.B. Its advantages of entrance and egress to our own and its difficulties for an enemy. Recommendations for defenses at Sandy Hook, Romers Shoal, West end of Long Island, Plum Island, & Fishers Island. Improbability of bombardment from Coney Island. Value of Gardiner's Bay and defense by torpedo boats. Use of Long Island Sound as drill ground - and last the difficulty for an enemy to guard both entrances, and corresponding advantages of exit for the United States. Use mines for coast defenses.

Sept. 15.

Sept. 16 Captain A. T. Mahan, U.S. Navy, Naval Strategy with particular application to Caribbean Sea.

To divide enemy's fleet and attack detachments
To destroy commerce. Value of Chiriqui Lagoon.

Sept. 19. Captain A. T. Mahan. Naval Strategy and Naval History.

Numerous entrances to Caribbean Sea, and difficulty to guard all. Consideration of Curacao.

Commercial stations and chief military stations, in islands and on Spanish main.

Commander P. H. Stockton on the Importance and Influence of an Inter-Oceanic canal. Consideration of the trade likely to pass through, and the importance of the numerous commercial stations.

Sept. 20

Sept. 21.

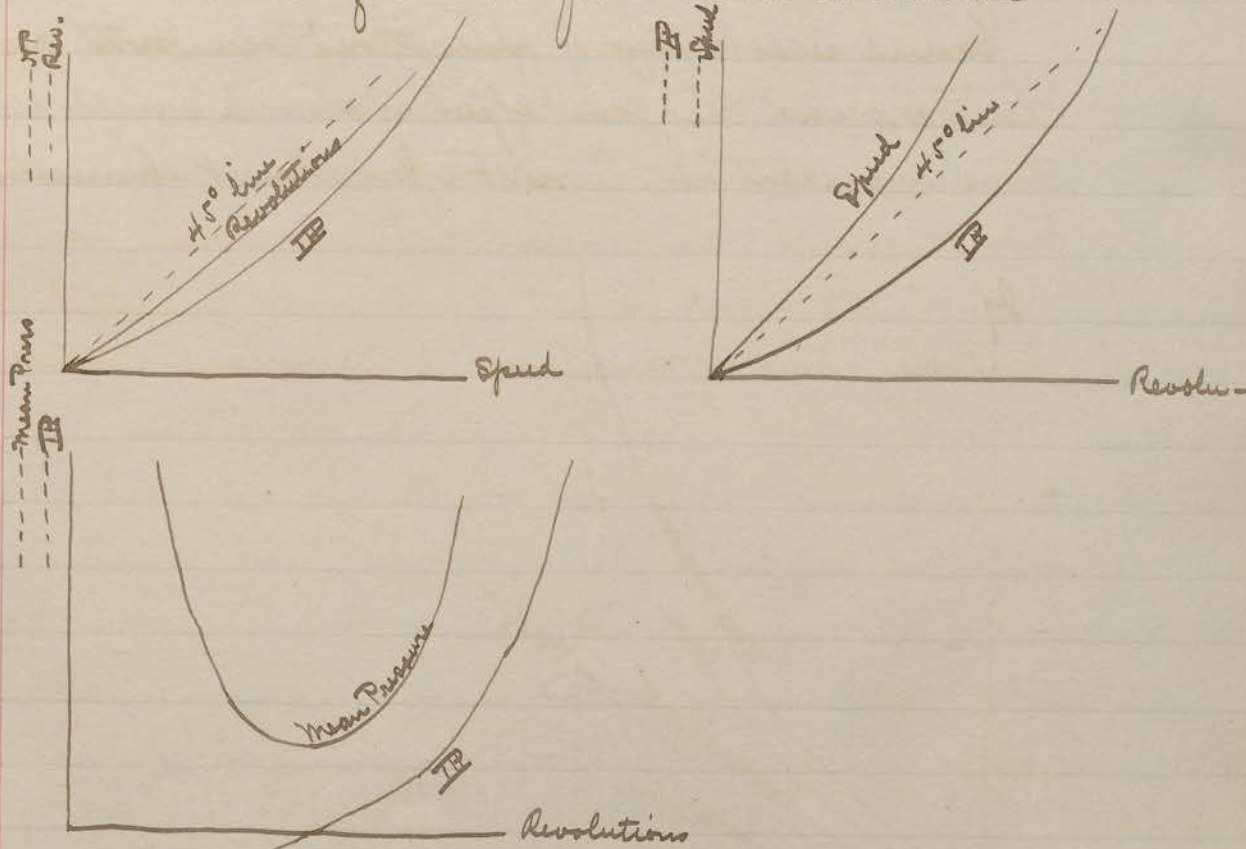
Sept. 22.

Commander C. H. Stockton. Importance and Influence of Inter Oceanic Canal across the Isthmus of Panama. General description of all the ports on Atlantic and Pacific sides, their size, imports & exports etc.

Assistant Naval Constructor S. W. Taylor - Speed trials of Ships of War.

Selection of body of water dependent on facility for marking terminals, current, depth, width, & to give room for turning at end of course.

Construction of curves from data obtained.



Curves of U.S.S. Yorktown

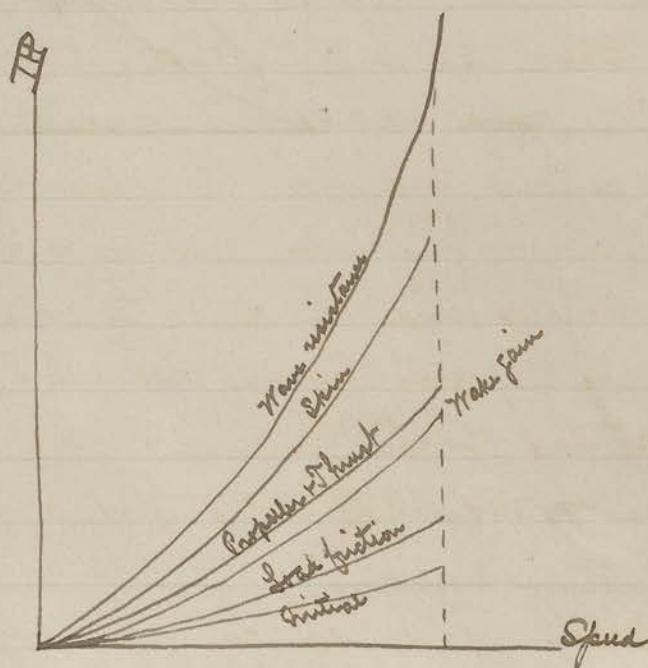
Sept. 23.

Commander C. H. Stockton, U.S. Navy. Examination of the effect on political situation of neighboring countries of the opening of a canal across the Isthmus of Panama.

Particular effect on the U.S. both as regards commercial relations, and responsibilities attaching to this as the only power able to hold and defend its neutrality against a belligerent. Multiplies our own interests and responsibilities.

Assistant Naval Constructor D. W. Taylor. Speed trials of modern ships of war.

General inaccuracy of observations taken with our ships Leutofore and the great effect of even a small error in time or revolutions. Current effect almost eliminated.



Sept. 26

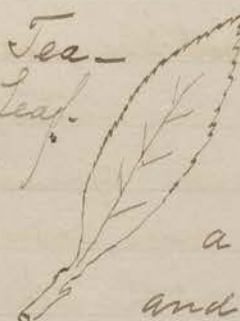
Sept. 27

Sept. 28

Sept. 29.

Medical Director R. C. Dean, U. S. Navy. Naval Hygiene

Tea-
Leaf.



Lanceolate, with serrated edges until very near stem, rays do not extend to edge of leaf. Good tea may be tested by spreading a leaf of good shape on a piece of paper and examining to see if it resembles description. Green tea is made by drying or roasting immediately after picking, and black tea by exposing to air for some time directly after picking allowing a kind of fermentation to take place, turning it constantly, then by drying or roasting, after this exposing again to air.

Changes of climate affect tea very much, for that reason the quickest traders formerly sold their cargoes at increased prices, and that tea brought by caravans across Siberia was more valuable.

Sept. 29

Medical Director Dean on Naval Hygiene Continued.

Component parts of tea are Steine, tannin, gluten, and its characteristic oil, the amount contained of the latter giving a brand of tea its peculiar value.

Tea stimulates, is a respiratory excitant, and assists in assimilation and transformation of food, but supplies no nutriment and no fuel, and does not promote digestion. Tea is not good to accompany a meal of animal food, or to go with starchy or farinaceous food. Best taken between meals, the custom of taking toast with tea a good one. Sugar and milk add nourishment.

Good tea can not be made from water kept in iron tanks, nor with water distilled, as this does not contain salts to dissolve the gluten, nor is distilled water good for the same reason, spring water being best. Tea diminishes action of the skin, cools the body when hot, and assists body to recover the abuse of alcoholic stimulants.

To make good tea use spring or running water. Boil in a pot of earthenware, porcelain, or Britannia metal, warm the pot in which the tea is placed, so that the water may be of a temperature of 212° after pouring on the tea; pour the boiling water on the tea, and boil for from five to ten minutes.

Tea is superior to wine or spirits in sustaining cold or exertion. To support privation, hunger etc. Opium in small doses is the best substance known in case of shipwreck etc.

Coffee in its general action and effects very much resembles tea. It causes more or less wake, agreeable excitement, assuages hunger, promotes perspiration, and does not interfere with digestion. As in tea its oil or the amount of it is the index of its value, and the good effects are due to it as much as to the caffeine.

To be roasted to 210° in tightly closed revolving cylinders, and ground as soon as it has attained its characteristic brown color, and aroma. The two operations to as nearly before the making as convenient, especially the grinding as when ground the volatile oil vaporizes very readily. Best pounded. Requires soft water of 212° heated in other than iron vessels, and a short time to remain in contact before serving. A small pinch of soda in the water prior to boiling precipitates salts and is more likely to make good coffee.

A cafetiere and iron stone mugs or cups are good ideas.

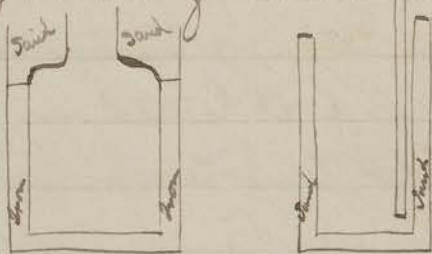
U.S. Navy Ration

Articles named by the Law	Articles Classified	Quantity	Articles named by the Law	Articles Classified	Quantity
Bread	Rolls	14 oz	Beans		1/2 pint
	Soft bread	1 lb		Pears		1/2 pint
Flour (as sub-stituted for bread)	Corn meal	1 lb or when issued with	Rice		8 oz
	Corn hominy	salt beef as	Dried fruit (any dried fruit not ordinarily used)		2 oz
	Oat meal	3 lb beef as	Butter		2 oz
Pork	Wheat	flour only 8 oz	Tomatoes		6 oz
	Salt	1 lb	Peas		1/2 oz
Beef	Salt	1 lb	Coffee or cocoa		2 oz
	Roast beef	12 oz	Sugar		4 oz
	Boiled mutton	12 oz	Pickles		1/2 pint
	Corned beef	12 oz	Molasses		1/2 pint
	Bacon	12 oz	Vinegar		1/2 pint
Prepared meat	Sausage	2 oz	Fresh meat	(Beef, mutton, veal, pork, poultry)	1/4 pounds
	Fish (any)	12 oz	Vegetables	Fresh ones such as can be had	1/4 pounds
			Canned Vegetables		6 oz

Sept. 29. Lieutenant-Commander A. R. Couder on "Armor"

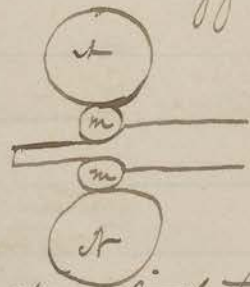
General description of armor and its purposes.

Peculiar advantages of hardened surface and tough backing, and superiority of Harvey method. Nickel armor superior in hardness and toughness, and when cracked the pieces hold together. At Bethlehem two processes used in making the steel, the acid and basic processes, the basic being cheaper and used for light plates protective decks etc. The molds for ingots at Bethlehem are of sand and iron, those at Carnegies are of sand alone. After 48 hours the ingot is



taken out, and puddle bar put in; the ingot is then hammered keeping a lookout for cracks which are chipped off as soon as seen. The drop of the hammer is about 10 feet and reduces the thickness of the ingot about 6" each blow when hot. Scale taken off by throwing salt on it.

At Carnegies the plate is rolled the heavy rollers N.R. giving support to the smaller ones M.M. which by being small exert greater force on plate. Plate is left a little thicker than required to allow for scale.



Before tempering the plate is bent, and when this is done it is annealed. It is heated first to about 1450° and put in an oil bath, oil jets playing over the surface of the plate, and water being thrown on to

fluent flame, a second tempering being gone through with, heating the plate to a less temperature.

When plate is finished pieces are taken from both ends and tested then the plates classified in groups.



Harvey system consists in keeping plates heated, and having a layer of carbon dust of some kind over upper face, the carbon being gradually absorbed, making upper face very hard. The percentage is usually .27% for $\frac{2}{3}$ the thickness of the plate, then doubtful, and in the last inch ranging from .35% to 1.1%. This carbonizing process continues for 5 or 6 days.

October 3

October 4. Lieutenant J. F. Meigs on the "Tactics of the Gun".

Commander P. F. Harrington on Tactics of the Ram.

Point of ram should be 7 to 8 feet below water-line, the ram should be pointed with squared edges to insure biting at small angles and it should be tempered. The best angle for ramming is 10° to 20° on the bow of an enemy, causing extensive ripping, change of lines of flotation and loss of

manoeuvring power. The ram of the Indiana is 4' below W. L., of the coast defense ram $1\frac{1}{2}$ feet below and of the Columbia 2' below. The most vulnerable points of attack for a ram, are the propellers, rudder, shaft and tubes.

October 5. - Commander P. F. Harrington "Study of Propellers" included Tactics of the Ram.

Lieutenant J. F. Meigs, on Gun Control.

In target practice exercise to be in picking up the range as well as in hitting target. Officers to set the sight bar. Value of a ship's fire depending on accuracy, number of shots in a given time, smashing effect, and mining power. Ranges to be determined.

Opening range = distance at which 4 shots will hit a target 12' by 30', probably about 2000 yds.

Tactical range = distance at which battery can be most effectively worked.

Dangerous range = dangerous space.

Extreme range = extreme range of battery as a whole.

Torpedo range = 400 yds.

Indicators should be used showing at any time of the action the range of the enemy to each gun station.

Use of 5" guns advocated, and Gatlings condemned on account of their sights being intermittently on target. Volley firing machine guns best.

October 6. Lieutenant J. F. Meigs on Gun Tactics.

Angles of bite of projectiles. Flat headed require $\frac{1}{6}$ more power to penetrate than a pointed projectile does.

Effect on angle of penetration of penetrability of impenetrability of target

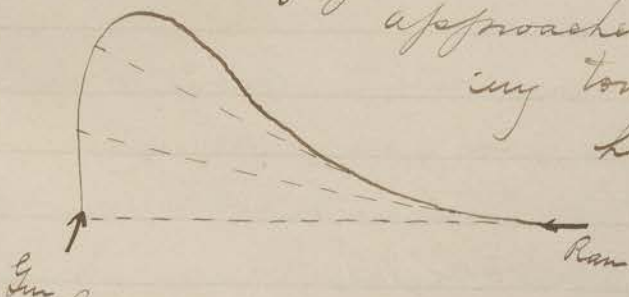
Commander P. F. Harrington on the "Ram"

Coast defense vessels recommended to have at least one heavy gun besides R.F. guns.

October 7. Lieutenant J. F. Meigs on Gun Tactics.

General principle to use your own special means as much as possible and to prevent the enemy using his. exemplified in combat of gun and ram

Tactics of gun and ram in combat. As ram approaches bring battery to bear turning toward ram and meet him bow on, as in example.



Commander P. F. Harrington on the Ram.

Agreeing in the same principle and in example cited. Exposition of tactics of two vessels in a ram combat. The vessel with slightly superior speed, and which follows the rules in tactics of the ram always wins.

October 10. Commander P. F. Harrington. Fleet tactics using the ram. The fleet maneuvering quickest wins. Example.

plan given of two fleets, Fleet A in column of single line ahead, fleet B in line steering to cut the line of A at right angles. If fleet B gets inside double tactical diameter of fleet A, the latter will surely be rammed if its speed is not greater than, or unless it has a superior manoeuvring power. Value of a cruiser and one torpedo boat as an adjunct to each battle ship.

Naval History, 1795-1800, Captain A. T. Mahan.

Importance of early concentration. Inability of commerce destroying to affect issue of a war, unless in particular circumstances - instance the wars between England & France during the Directory, Consulate & first Empire. With control of the sea its effect is more valuable.

October 11. Commander Charles H. Stockton. Naval preparations for war. All available knowledge of strength and disposition of enemy's forces, topography of enemy's coasts and country, climate, and weather will be valuable. All statistical information. Coal, trade, facility of docking, means of transportation, form and state of the enemy's government, and the temperament of the people.

In considering coast defence, that implies defence of the coasts, as well as that of the cities and harbors.

Basin to be chosen for operations intended, and their early possession necessary.

Lieutenant J. B. Murdock on the application of electricity to warships, and in war. Consideration of sub-

marine mines. Contact mines, simple. Electric contact mines, connected to shore stations. Testing of insulation of contact, and of dryness of gun cotton. Observation mines not good in the dark, or in foggy weather. Danger of induction currents in a number of wires collected together. Danger of leaks. Danger of grounding due to explosion of one torpedo of a group.

October 12. Lieutenant J. B. Furudock, on electric lights aboard ship. Compound dynamo is one wound with shunt and series coils, so making E. M. F. practically constant, making this kind of dynamo advantageous for working search lights.

In running dynamos, give them full power for which they have been designed. If designed for a certain number of revolutions run them at that number, at even a slightly greater number as then the dynamo will probably run cooler. As revolutions so with a dynamo designed for a certain number of volts E. M. F.

Of mirrors for search lights the German parabolic ground glass mirrors are best. Metallic mirrors are good but they tarnish and deform. Glass concave reflectors absorb too much light.

Captain A. T. Mahan on Naval History in the Mediterranean 1793-1800. In a war of commerce destroying it is an advantage for the weaker fleet

to separate, and so compel the enemy to do likewise. In case of decided or important operations the fleets must then concentrate.

October 13.

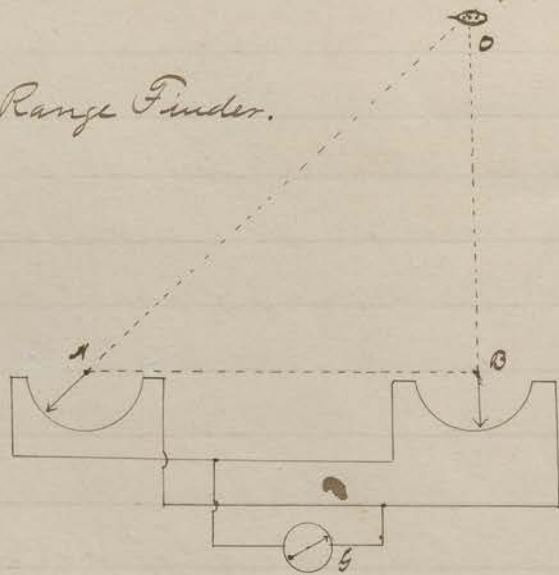
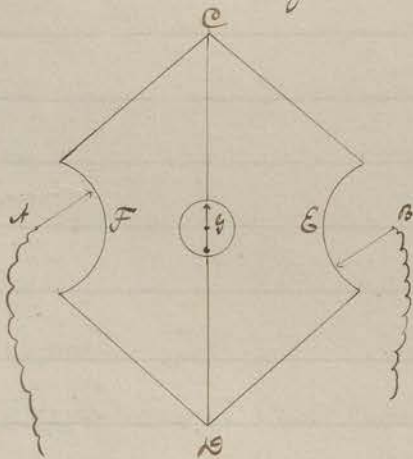
Captain A. T. Mahan, on Naval History 1796-99.

Never abandon an apparently forlorn hope unless you are sure not only that you cannot avoid injury to yourself, but that you can no longer effect any injury to the enemy. Instances, Rear Admiral Hanns abandonment of the Mediterranean fleet, and the abandonment of Forts Philip and Jackson by the Confederates.

Association of political condition with military operations

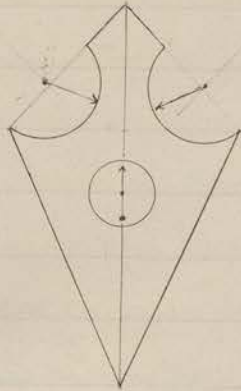
Lieutenant J. B. Murdock on Electrical Apparatus aboard ship.

Principle of Fiske's Range Finder.



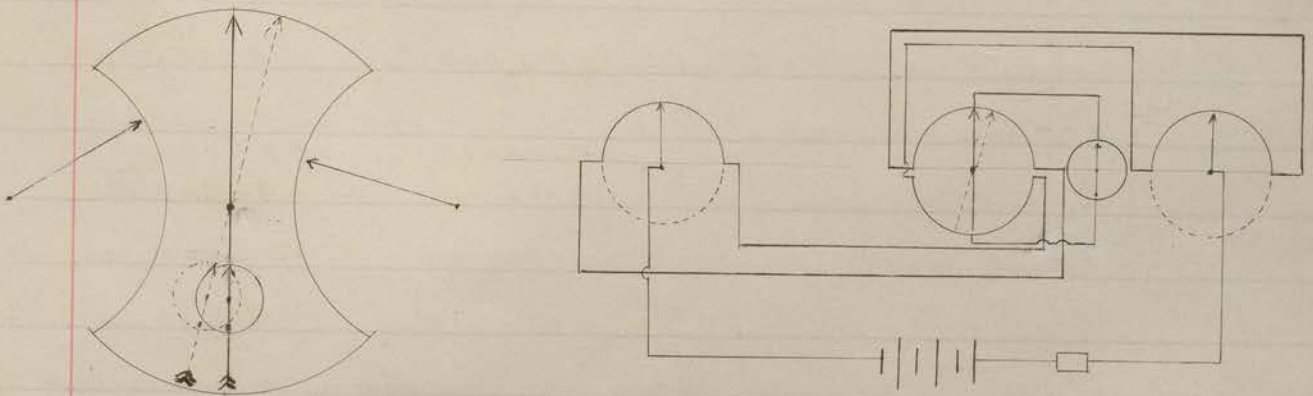
The principle is that of varying resistances in the Wheatstone bridge, and in case of different resistances, of measuring by the intercircuited galvanometer, the amount of the difference.

When the object draws nearly ahead or astern, on a fore and aft line of observation the current becomes so much reduced that the galvanometer does not record with accuracy. To remedy this an arrangement is made by



means of a short and long circuit, in which the current increases with the increased deflection of the two pointers. This principle is shown by the modified Wheatstone bridge, shown in the figure.

The range finder used in the Army depends on parallelism of the telescopes. When telescopes are at an angle with each other, intermittent currents cause induction in a movable coil connected to telephone at other end. So that by changing angle of coil at that end, the noise of the telephone may be made to cease, and you in this way find angle of bearing at opposite end.



Use of speaking tubes and auxiliary steam engines aboard ship condemned. Electric telegraph and automatic recommen-

ded. Signalling at sea by means of beams from electric search-lights projected upward, and experiments with signalling by means of induction currents. The great difficulty is that of calling ships at sea.

October 14. Captain A. T. Mahan, on Naval History. A review of the operations immediately precedent to, and of the Battle of the Nile.

Lieutenant W. S. Chambers on the Nicaragua Canal.

Distance ocean to ocean,	169.4 miles.	Summit level above S.L.	110 ft
Length of canal proper	26.8 miles	Maximum cut	288 ft
Lake river basin	142.6 miles	Number of locks	6.
Length summit level	153.2 miles		

	menocal.	Committee.
Cost of Eastern Division	23,686,000	34,649,800
Cost of S. Francisco	5,103,000	5,411,500
" Lake & River	5,700,000	6,600,000
" Western	17,520,000	20,231,000
Survey, Hospitals, & Contingents	13,016,800	6,250,000
Further allowance	65,084,000	1,4033,000
Interest on money	15,000,000	587800,000
Final cost	80,984,000	20,000,000
5% thereto	4,004,200	1,07,800,000
Operating expenses for one year (Same rate as San, & includes new works)		1,200,000
Revenues of 9,730,000 tons of shipping @ \$2.50 per ton		24,325,000
Net revenue for one year.		23,125,000
Net revenue for one year on 7,000,000 tons will pay at the interest of 5% -		\$ 3,250,000,000

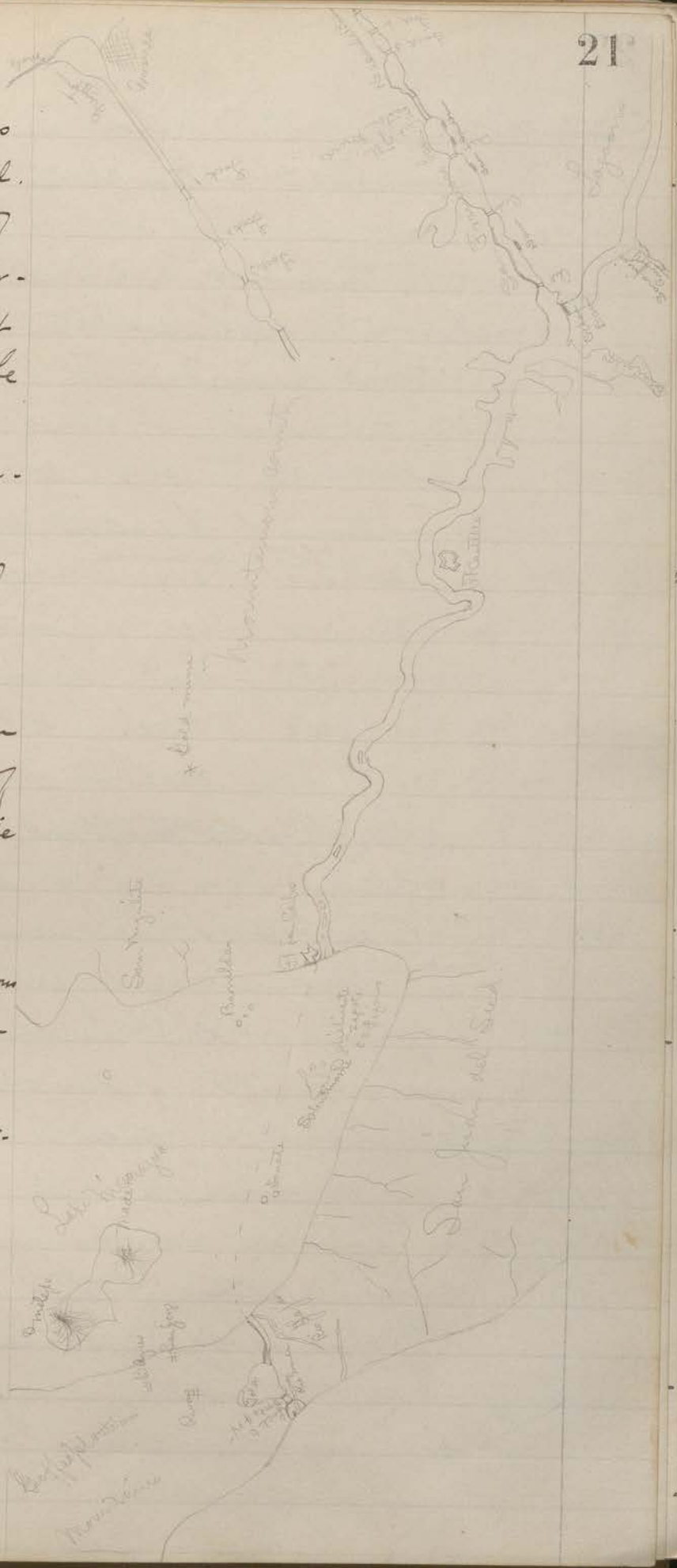
October 15. Lieutenant W.D. Chambers
on the Nicaragua Canal.

General review of
work done, its impor-
tance, and statement
belief that it will be
finished.

Greytown mole fin-
ished, or very nearly so
and a large amount of
canalling done.

Captain A.T. Mahan
on Naval History of
the Syrian and Baltic
expeditions in 1801.

Genius is able to
^{construct} draw general conclusions
from particular in-
stances, and who is
guided but not fet-
tered by rules.



October 17. Captain A. D. Mahan. Naval History. Operations prior
Bonaparte's contemplated invasion of England in 1804.

P. A. Engineer J. A. N. Halls, on the performance of naval
ships of war under steam.

Coal endurance - U. S. S. Charleston. Coal capacity 760 tons
Estimated endurance at 13 knots speed 4033 miles - actual endurance 2900
" " at 10 knots 7103 miles, actual endurance foul 2920 ⁽⁴⁴⁰⁰⁾ clean,

Endurance of "Charleston" after laying 3 or 4 months in Honolulu.				
	Speed	Rev. per hour	Endurance	
(1)	6.8	449	3509	Honolulu to Seattle, with bottom & screw foul
(2)	8.8	391	2995	Seattle to Honolulu, bottom foul, screw clean
(3)	10.0	392	3007	Honolulu to S. Francisco, bottom and screw clean
(4)	8.8	352	5293	S. Francisco to Iquique, clean and fair wind.
(5)	7.4	397	3701	S. Diego to Honolulu, strong headwind & sea

It is a good plan in steaming to set the number of
revolutions, and then to allow coal to make them.

The bottom and screws to be constantly kept clean.
The screws are very important their surface amounting to
 $\frac{1}{8}$ of the surface of the ship's bottom, immersed surface,
allowing for the greater speed of screw surface. Every ef-
fort should be made at every opportunity to clean as
much as possible of the ship's bottom. The screws should
be polished, not painted and their edges filed sharp.
Galvanic action of their surface much exaggerated.
The cruising speed should be about $\frac{4}{5}$ the maximum
speed of the ship, as engines designed for high velocity
and power work better at about $\frac{4}{5}$ their highest power
than at one-half which is Dept. requirement.

As an instance of time required to develop highest power from a position of say half-power, the case of the Charleston when a steamer was sighted supposed to be the Stata, the Charleston being in chase of that vessel. The vessel was sighted at 9 am. and one blower turned on running the speed up from 10, to 10.9 knots; at 10.40 and additional boiler gave her 12.2 knots, and at 12.45 all 3 additional boilers were, and the ship making 13.5 knots.

If water had been run up to steaming level, & kept hot by hydrogynetes, the time would have been much less. Banking fires is not a good idea, it being better on arriving in port to haul fires except in one boiler, and keep water hot by hydrogynetes, cleaning immediately the other furnaces, grates, and tubes.

A number of reasons combine to account for difference between actual and estimated coal endurance.

- (1) Calculations are made for normal draught when the actual draught is much greater.
- (2) Alteration of trim. Fire rooms should be used alternately at sea, cleaning up one while the other is being used. The Charleston filled water tight compartments in double bottom to restore trim when it was altered by the consumption of coal in some of the bunkers.
- (3) Different condition of bottom
- (4) Varying conditions of wind and weather.
- (5) The calculations based on trial trips.
- (6) Difference in quality of coal.
- (7) Consumption of coal by auxiliary engines for which

there is no allowance in calculations.

(8) Difference in H. required to drive the ship from that shown by speed of H. curves.

(9) Difference in firing.

(10) The effect of the size of the ship - the heaviest and longest having the advantage.

(11) The requirements for keeping flat station at sea.

The most economical speed is that at which one ton of coal will drive the ship farthest.

There exists for each ship a speed at which slip of screw is least - increasing or decreasing speed alike cause an increase of slip.

One reason for loss of efficiency in the engines of a naval vessel, is that caused by running a ship at a speed in which economy of boiler and machinery is not alike. Engines designed for high speed, when run at low speed, lose by extra condensation in cylinder, and proportionate ^{increase} loss of friction. Loss by smokepipe is greater at increased speeds but loss by radiation remains the same.

Captain A. T. Mahan, Conclusion of naval operations in the Mediterranean. Cruise of Admiral Boin from Brest to Toulon and back to Brest. Small results of this cruise due to the irresolution and indecision of the French Admiral, though very important results were possible, and their failure to occur very much to be regretted by the French.

October 18. P. A. Engineer J. H. N. Hollis. on Naval Ships of War under Steam.

Boiler scale. - consists usually of calcium carbonate, magnesium carbonate, and calcic sulphate.

Never subject boilers to sudden changes. Make smoke pipes higher by 40 feet or more.

Use fresh water as much as possible, carrying a double supply in double bottoms.

Use evaporator to replace water used.

Use salt feed as little as possible, so as not to carry over air and calcic sulphate.

Reduce quantity of cylinder oil used.

Inject a small quantity of caustic soda in condenser at intervals.

Avoid blowing off, and work and clean boiler regularly.

Let fires die out, pump out water when cold, clean and introduce water when cold, and heat by hydrogyn-ster.

Keep zinc in boilers.

Never use boilers for trimming ship.

Use salt water at first to ^{deposit} protecting layer of scale.

Do not allow salt water to remain in boilers at sea, ^{even} when cold.

Take an Intelligent interest in the Engineering Department.

Ash-pan forced draught system is faulty. It is de.

moralizing to the men, and there is a lack of communication to the fire room both by word or in person. It is also dangerous on account of heavy doors in protective deck, and is besides exceedingly uncomfortable.

Captain A. T. Mahan, on Naval History. The causes and results of Spanish declaration of war against Great Britain in 1804. Villeneuve's expedition to the West Indies. A great mistake for commanders to put themselves in the position of their opponents, and conduct their own operations in accordance with suppositions so formed.

October 19 Captain A. T. Mahan, U.S. Navy on Naval History. Operations immediately connected with the battle of Trafalgar, and the battle.

P. A. Engineer J. H. N. Hollis. Steam Engines on naval ships of war.

Advantages of vertical over horizontal engines.

Saves loss of H.P. by movement of reciprocating parts.

Better balanced, less lubrication, and occupy less room, so allowing double sets.

Facility for getting at parts for lifting, no lining.

Use better packing rings - no choss.

In casing for machinery do not use bladder valves for then the hot steam forces ends of condenser tubes out, causing leaks, and running risk of wrecking air and circulating pumps.

A satisfactory way of working engines is to hoist preparatory signals then to work engines backward & forward until signal of execution.

In using pumps for washing decks, have pumps stopped before closing valves.

Valve doors in double bottoms to be opened from deck above.

Doors to double bottoms to be opened well up from on side.

Hand bilge pumps to be fitted with lengths of hose to double bottom, as hand bilge pumps usually have great difficulty in creating suction.

Blowers for double bottoms.

Hand valve for safety valve to be available on ^{deck}

To give a ship high sustained ^{sea} speed do it by increasing height of smoke pipes, using the blowers only in emergencies for they get out of order very rapidly, and easily.

Double engines on one line of shafting is not a good idea, due to unequal lining up necessary, making risk of wrecking shaft.

October 20. P. A. Engineer J. H. N. Helle, on Coal for U. S. Ships.

Bituminous is best, the anthracite being especially bad

for gunboat boilers. Bituminous coal easily handled, it is more economical, & forms a solid clinker. The anthracite is difficult to handle, causes trouble with clinker, more costly, and is very hard to start burning. Besides the soot due to bituminous coal is more easily removed by the blower. The two coals require different methods of supplying air making different forms of grate and combustion chambers necessary. Coal must be free from sulphur, must be dry, and contain no iron pyrites. In hot weather especially, the coal should be kept dry, and should be used from bunkers nearest to boilers first. It seems to be the conclusion that side chutes are slower than the old method of over all.

Signals to the engine room should be unambiguous, and widely [distributed] separated. Speaking tubes good except from or to fire rooms in which forced draught is being used. There should be a gong to each compartment.

Accidents in fire room very demoralizing, and to be avoided at all costs.

Suggestions for government of engineer's force - more power to the engineer - extra pay to men doing extra work in engine or fire room - improve the condition of the Engineer's force - better accommodations to machinists, and make distinctions in granting privileges.

A ship with two steam launches should lay one off for repair & cleaning while other is used, & vice versa.

October 20 Surgeon C. A. Siegfried. Qualities of Water.

Analyses of all water used on board ship, for whatever purpose used. One of the most fruitful sources of deterioration of boilers, and of disease in the crew.

October 24. Lieutenant T. C. McLean. The Whitehead Torpedo.

General description. Use of oil to prevent leakage of air through steel cylinder reservoir. Pressure used 1350 lbs per square inch, giving velocity of about 29 knots. By means of spoon of torpedo discharge tubes the torpedo is made to fall flat on the water.

October 24. Surgeon C. A. Siegfried. Morbific influences affecting seamen.

Parasites, ringworm, trichinosis, syphilis, bowel affections, indigestion, gout, rheumatism. Precautions especially necessary for cruise in the tropics.

	Proteids	Fats	Carbo. Hydrates	Potential Energy
Navy ration	174	46	576	3515
Suggested (C.A.S)	176	150	564	4517.

In providing for "abandon ship" some of the most necessary articles of food are in order named; cheese, canned meats, hard tack, tobacco, coffee, opium, alcohol. Cheese is the most nourishing of all foods, and hard tack more so than soft leavened bread. Tobacco, coffee, & alcohol are good to keep withstand privation, & keep up spirits. In case of exhaustion of provisions, shut off the alcohol. Opium will keep a human body alive without food, longer than any other substance.

October 25. Lieutenant T. C. McLean. The Whitehead Torpedo.
Corrections for mechanical errors.

October 25. Commander C. A. Stockton. Strategic advantages of the Pacific coast.

October 26. Lieutenant F. J. Drake. The Howell Torpedo.
Size 10' 10", and 13" diameter weight 503 lbs charge of gun cotton 100 lbs.
Shell of hard brass, 89% copper, 9% zinc & rest lead.
Correct results obtained. Surprising accuracy of run.

Commander C. A. Stockton. Strategic importance of the Pacific Coast in time of war.

When the Inter-oceanic Canal is finished the value of the ports on the Pacific Coast will be greatly increased. San Francisco and Puget Sound being of the most importance. Strait of Juan de Fuca, Washington Sound, Gulf of Georgia, Burrard Inlet, and all the parts of Puget Sound will be valuable.

October 27. Commander C. A. Stockton. Strategic importance of points in the Pacific, Melanesia, Polynesia, Australasia, New Guinea, New Zealand etc.

Lieutenant F. J. Drake. The Howell Torpedo.
Resistance to horizontal deflection, and tendency

October 28. Lieutenant F. J. Drake. The Howell Torpedo.

It may be fired from a vessel going at any speed without suffering the deflection to which other torpedoes are liable.

Its principle of directive force, the flywheel has been adopted in the latest model of the Whitehead Systems of underwater launching tubes, and of disappearing mounts for torpedo discharge tubes on deck.

October 29. Commander T. F. Jewell. The Use of the Torpedo.

General remarks on value and use, consisting principally of quotations. Opposes their use on board cruisers, and believes use in daylight valueless except in special circumstances. About 95% of hits possible in a smooth sea at 400 yards. In a rough sea they are of very little value. Night is the best time, by far, for effective use.

The Ericson submarine gun does not compete with automobile torpedoes, it is to be used more as a detachable ram. It allows a ship to give another one the full effect of a blow by ramming without any dangerous consequences to itself.

It is 27 1/4" long 15" in diameter, weight 1500 lbs, and charge of powder used in firing it 27 lbs. It leaves the gun at a velocity of 110 knots, falls to 70 knots in the second hundred yards, and will run for 400 yds, though its use will probably be limited to 200 yds.

Oct. 29.

Lieutenant W. J. Chambers. G. sign Riblaet's lecture on signaling.

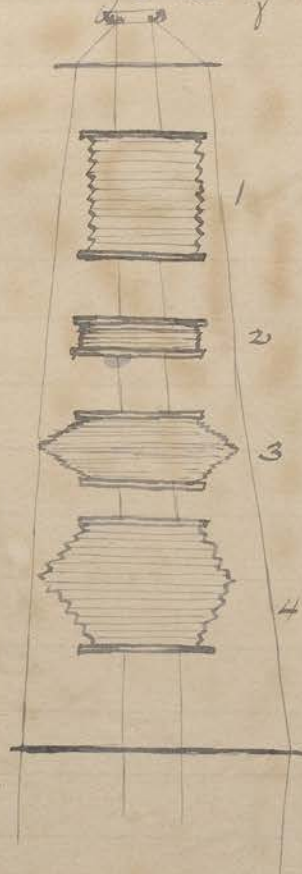
French Semaphore.

A B C D E F G H I J K L M N O P Q

R S T U V X Y Z ^{not used} ^{Numbers} ^{And} ^{Attention} ^{Answer}

0 1 2 3 4 5 6 7 8 9 ^{Thousand} ^{Answer} B.

System of distance signals proposed by Emign Riblaet



Any one of the shapes, which are black in color, may be made to assume all the shapes shown. No. 1 may be changed to No. 2, by merely crushing; No. 2 into No. 3, by springing out a wire in the middle of the shape; and No. 3 into 4 by expanding; No. 4 into No. 1 by compressing the wire ring in the middle. Expansion and contraction worked by wires from deck.

Size of shapes, 4 feet maximum length, 8 inches maximum, 3' 6" maximum diameter, 2 8" natural diameter.

It is computed that a signal could be read 6 to 8 miles, while flags would be indistinguishable within in shape or color.

Handley

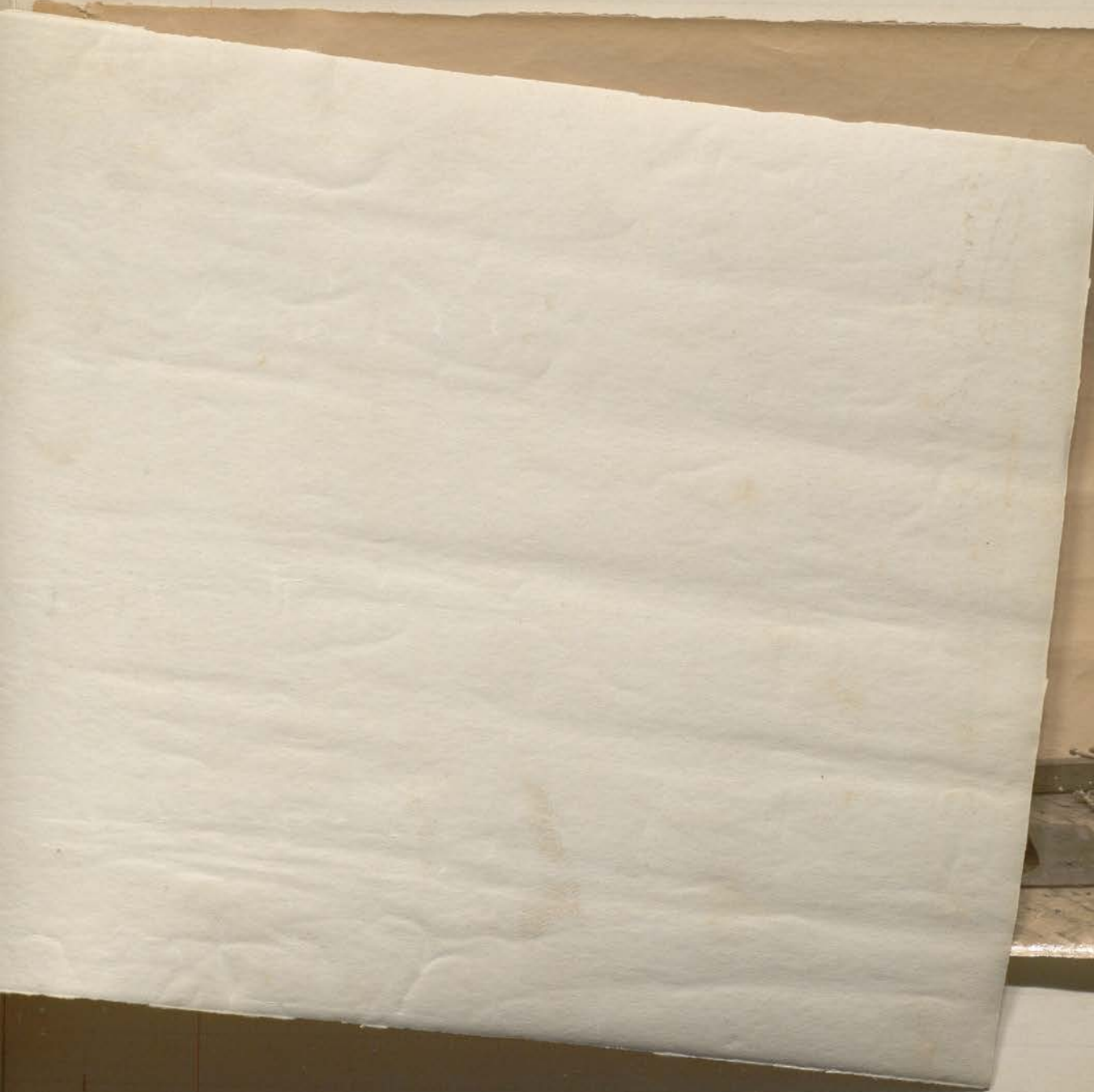
U. S. NAVAL B. L. GUNS.

Caliber.	Weight.	Weight.	Total Length.	Distance across Rimbases.	Greatest Diameter of Gun Body.	Total Length of Bore.	Length of Rifled Bore.	Twist of Rifling.	GROOVES.				CHAMBER.			Travel of Projectile.	Weight of Charge 1700 f. s. Velocity.	Weight of Projectile.	Fixed Ammunition.	Ratio of Projectile Weight to Weight of Gun.	Chamber Pressure.	Muzzle Velocity (Service).	REMAINING VELOCITY AT				Foot Tons.	Thickness of Steel which Shell will Penetrate at Muzzle.
									Number.	Width.	Depth.	Length.	Diameter.	Capacity.	Inches.								Inches.	Inches.	Tons.	Feet-Seconds.			1000 yds.	1500 yds.	2000 yds.	2500 yds.
4-in. B. L. R. Mark I	3380	1.5	13.7	13.0	157.29	130.29	Zero to 1 in 25	30	.279	.025	24.74	4.30	367	2037	132.50	12 to 14	33	58	1/102	15	2000	1651	1501	1384	1246	915	7.18	
4-in. R. F. Gun.	3400	1.5	13.7	13.0	157.50	128.12	"	30	.279	.025	25.38	4.44	329	1994	132.12	"	33	.....	1/103	"	2000	"	"	"	"	"	7.18
5-in. B. L. R. Mark I.	6190	2.8	13.5	21.0	18.0	150.27	129.75	1 in 180 to 1 in 30	.485	.05	27.07	6.5	899	3326	123.20	26 to 29	60	.....	1/103	"	2000	1697	1563	1439	1323	1690	8.67
5-in. R. F. Gun.	7000	3.1	17.4	16.5	191.50	164.40	Zero to 1 in 25	30	.349	.025	32.00	5.55	655	3965	168.00	28 to 30	50	95	1/140	"	2000	1547	1516	1374	1754	1754	9.00	
6-in. B. L. R. Mark I.	10775	4.8	15.8	25.0	21.5	176.0	136.65	1 in 180 to 1 in 30	.485	.05	36.85	7.0	1408	5880	139.15	50	100	.....	1/108	"	2000	1735	1616	1505	1402	2773	10.27
6-in. B. L. R. Mark II.	10900	4.9	16.1	25.5	21.5	180.08	144.85	"	.485	"	32.73	7.5	1410	5935	147.35	45 to 48	100	.....	1/109	"	2000	"	"	"	"	"	"
6-in. B. L. R. Mark III of 30 cal.	10800	4.8	16.3	24.0	20.5	183.75	147.26	Zero to 1 in 25	.415	"	33.99	7.0	1299	5552	149.76	44 to 47	100	.....	1/108	"	2000	"	"	"	"	"	"
6-in. B. L. R. Mark III of 35 cal.	11554	5.2	18.8	24.0	20.5	213.75	177.26	"	.415	"	33.99	7.0	1299	6404	179.76	"	100	.....	1/116	"	2080	1807	1680	1565	1458	2990	10.86
6-in. B. L. R. Mark III of 40 cal.	13370	6.0	21.3	24.0	21.0	243.75	207.26	"	.415	"	33.99	7.0	1299	7256	209.76	"	100	.....	1/124	"	2150	1865	1737	1618	1507	3204	11.38
*8-in. B. L. R. Mark I.	27600	12.3	21.5	33.8	30.0	239.91	195.16	1 in 180 to 1 in 30	.485	"	42.05	10.5	3569	13541	197.86	105 to 115	250	.....	1/110	"	2000	1808	1719	1634	1554	6932	14.51
8-in. B. L. R. Mark II.	29100	13.0	21.5	33.8	30.0	239.91	195.16	"	.485	"	42.05	10.5	3569	13541	197.86	"	250	.....	1/115	"	2000	"	"	"	"	"	"
8-in. B. L. R. Mark III of 35 cal.	29400	13.1	25.4	33.8	28.75	290.52	242.77	Zero to 1 in 25	.415	"	45.05	9.5	3176	15548	245.47	"	250	.....	1/118	"	2080	1880	1787	1700	1615	7498	15.61
8-in. B. L. R. Mark III of 40 cal.	34000	15.2	28.7	33.8	28.75	330.52	292.77	"	.415	"	45.05	9.5	3176	17564	285.47	"	250	.....	1/136	"	2150	1943	1848	1757	1670	8011	16.10
10-in. B. L. R. Mark I of 30 cal.	57500	25.7	27.4	.....	40.0	306.26	247.26	1 in 180 to 1 in 35	.455	"	57.17	12.5	6880	26639	250.43	225 to 240	500	.....	1/115	"	2000	1848	1777	1708	1642	13864	18.75
10-in. B. L. R. Mark I of 35 cal.	60660	27.1	30.5	.....	40.0	343.76	283.76	Zero to 1 in 25	.415	"	57.17	12.5	6880	29480	286.93	"	500	.....	1/121	"	2080	1922	1848	1777	1707	14996	19.83
10-in. B. L. R. Mark II of 30 cal.	56400	25.1	27.4	.....	39.0	307.26	247.26	1 in 26.8	.415	"	57.17	12.5	6881	26590	250.43	"	500	.....	1/126	"	2000	1848	1777	1708	1642	13864	18.75
10-in. B. L. R. Mark II of 35 cal.	61900	27.5	31.2	.....	39.0	354.91	294.91	Zero to 1 in 25	.415	"	57.17	12.5	6881	30350	298.08	"	500	.....	1/113	"	2000	1848	1777	1708	1642	13864	18.75
12-in. B. L. R. Mark I.	101300	45.2	36.8	.....	45.0	419.20	343.12	Zero to 1 in 25	.415	"	74.14	14.5	12043	51355	346.06	425	870	.....	1/124	"	2100	1940	1865	1793	1724	13285	20.10
13-in. B. L. R. Mark I.	155500	69.5	40.0	.....	49.0	454.46	370.46	Zero to 1 in 25	.415	"	80.88	15.5	15059	64857	373.08	550	1100	.....	1/119	"	2100	1964	1900	1837	1777	29885	24.16
13-in. B. L. R. Mark I.	155500	69.5	40.0	.....	49.0	454.46	370.46	"	.415	"	80.88	15.5	15059	64857	373.08	550	1100	.....	1/123	"	2100	1977	1918	1860	1805	33627	26.66

NATURE OF GUN.



*8" B. L. Rs. Nos. 1 and 3 are not hooped to the muzzle while Nos. 2 and 4 are.
 10" B. L. R. No. 3 differs in exterior from 10" B. L. R. No. 4 and is somewhat lighter in consequence.



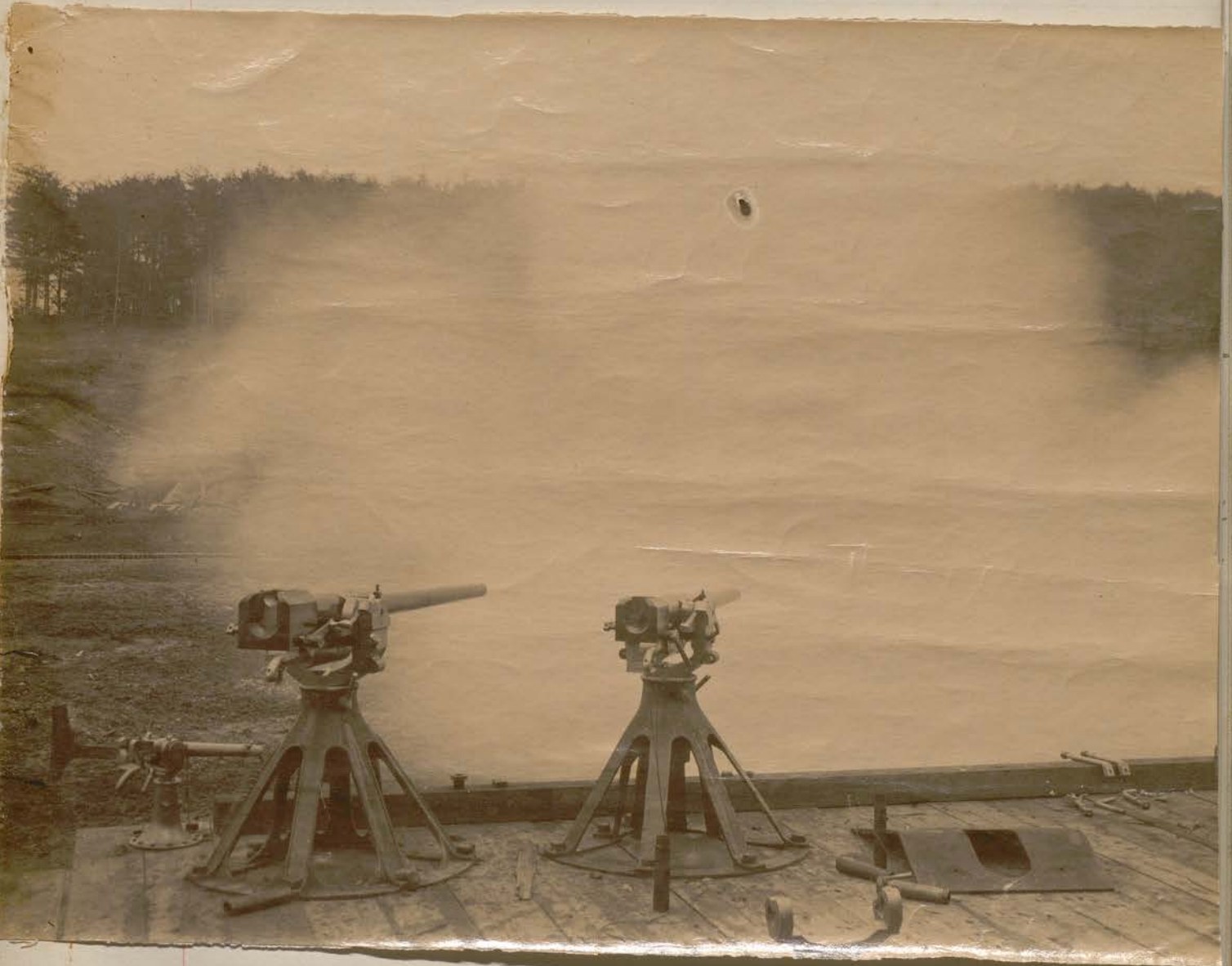


NATURE OF GUN.

	Caliber.	Weight.	REMAINING VELOCITY AT				Muzzle Energy.		Thickness of Steel	
			1000 yds.	1500 yds.	2000 yds.	2500 yds.	Foot Tons.	In.	Feet-Seconds.	In.
4-in. B. L. R. Mark I	4	3380	1000	1651	1501	1364	1246	915	7.18	7.18
4-in. R. F. Gun.	4	3400	1000	"	"	"	"	"	"	7.18
5-in. B. L. R. Mark I.	5	6130	1000	1697	1563	1439	1323	1690	8.67	8.67
5-in. R. F. Gun.	5	7000	1000	1847	1673	1516	1374	1754	9.00	9.00
6-in. B. L. R. Mark L.	6	10775	1000	1735	1616	1505	1402	2773	10.27	10.27
6-in. B. L. R. Mark II.	6	10900	1000	"	"	"	"	"	"	"
6-in. B. L. R. Mark III of 30 cal.	6	10800	1000	"	"	"	"	"	"	"
6-in. B. L. R. Mark III of 35 cal.	6	11654	1000	1807	1680	1565	1458	2990	10.86	10.86
6-in. B. L. R. Mark III of 40 cal.	6	13370	1000	1865	1737	1618	1507	3204	11.38	11.38
8-in. B. L. R. Mark I.	8	27600 28800	1000	1808	1719	1634	1554	6932	14.51	14.51
8-in. B. L. R. Mark II.	8	29400	1000	"	"	"	"	"	"	"
8-in. B. L. R. Mark III of 35 cal.	8	29400	1000	1880	1787	1700	1615	7498	15.61	15.61
8-in. B. L. R. Mark III of 40 cal.	8	34900	1000	1943	1848	1757	1670	8011	16.10	16.10
10-in. B. L. R. Mark I of 30 cal.	10	57000	1000	1848	1777	1708	1642	13864	18.75	18.75
10-in. B. L. R. Mark I of 35 cal.	10	60600 63100	1000	1922	1848	1777	1707	14966	19.83	19.83
10-in. B. L. R. Mark II of 30 cal.	10	56400	1000	1848	1777	1708	1642	13864	18.75	18.75
10-in. B. L. R. Mark II of 35 cal.	10	61900	1000	1940	1865	1793	1724	15285	20.10	20.10
12-in. B. L. R. Mark I.	12	101300	1000	1964	1900	1837	1777	25985	24.16	24.16
13-in. B. L. R. Mark I.	13	135500	1000	1977	1918	1860	1805	33627	26.66	26.66

*8" B. L. R. Nos. 1 and 3 are not hooped
 110" B. L. R. No. 3 differs in exterior from





November 1. Exploded one 4" shell, American Projectile Company, Lot 1, with $1\frac{1}{4}$ lbs macaroni smokeless as charge; 40 fragments shell and 7 pieces band, the base fuse intact. Stress seemed to be radial.

Exploded 2d shell after 3 trials, the fuse exploding once without exploding shell. The fourth time the shell exploded into very small fragments. Charge $1\frac{1}{4}$ lbs of fine smokeless powder. 92 fragments with a few very small chips.

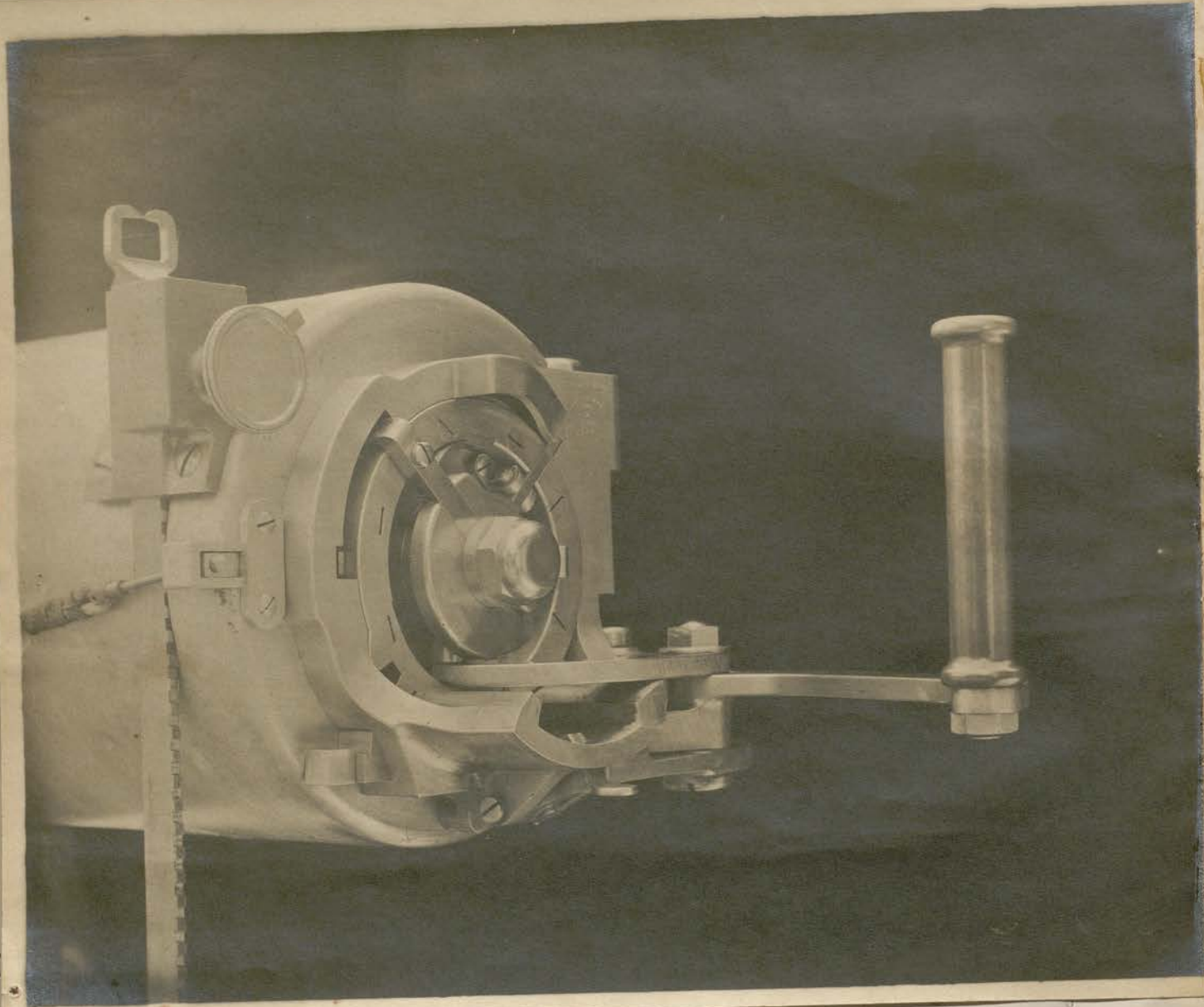
Fired one 4" shell, American Co., sand filled at five 1" iron plates, perforating shell entire. Fired 2 American Co. 4" shells, filled with M. N. 2, $1\frac{1}{4}$ lbs at six 1" iron plates. Shell perforated all six plates bursting beyond last plate. Both shells fitted with base plugs but no fuses. Found another one of the same kind of shell, perforating plates completely, & breaking into several large pieces after going through. Velocity 2000 f.s. in all cases.

November 2. Tested Carpenter A.P. shell, lot 7, by firing one of them No. 345, at an 8" steel plate, at a velocity of 1400 f.s. Plate was broken into numerous fragments, & left the backing completely. Shell was stopped in tunnels behind backing, having passed through the plate and 36" oak backing. Charge consisted of $\frac{63}{100}$ lbs of U.S. 17 weight of projectile 25.0 lbs. There were several ^{longitudinal} radial cracks around binnacle, and both binnacle and body were slightly bulged. A small piece chipped off shoulder of ogival.

4. 10 ^{shots} charges from wire wound gun on Howell car.

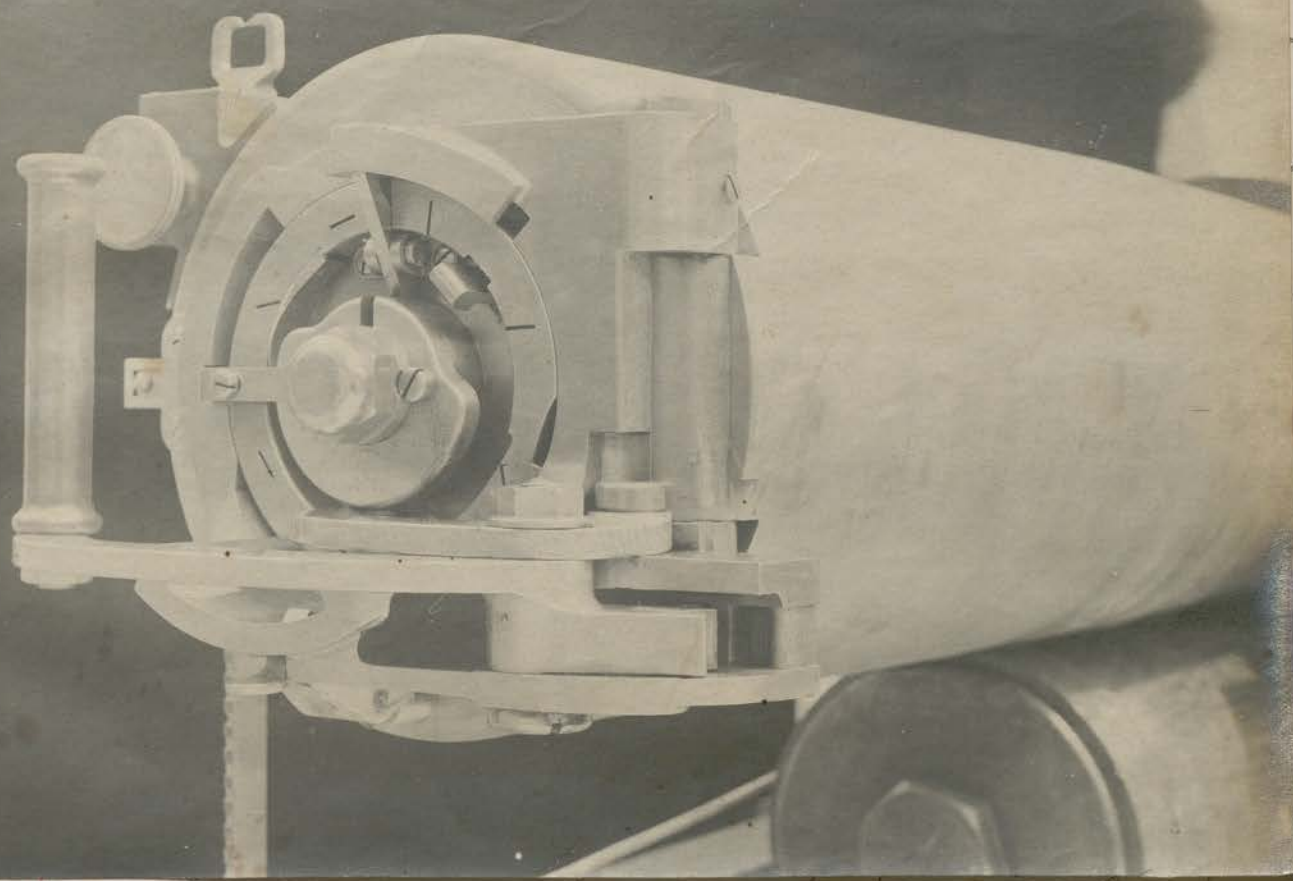
- (2) Charge $1\frac{1}{2}$ lb M.N.2, 42 pieces shell, 1 of band. Weight of largest piece $4\frac{1}{2}$ lb, of ten largest $17\frac{1}{2}$ pounds.
- (3) Charge $1\frac{1}{2}$ lb M.N.2, 31 pieces shell, 1 of band. Weight of largest piece 4 lb of ten largest 18 pounds.
- (4) Charge $2\frac{1}{4}$ lb small cubical grain smokeless powder, 157 pieces of shell, 17 of band. Weight of largest piece $1\frac{1}{2}$ lb, of ten largest 10 lb.
- (5) Charge $2\frac{3}{4}$ lb shell powder, 32 pieces shell, 4 of band, largest piece $3\frac{1}{4}$ lb, ten largest pieces 18 pounds.

November 1. Exploded one 4" shell American land to a



... out at an 8 steel plate, at a velocity of 1400 f.s.
 Plate was broken into numerous fragments, & left
 the backing com pletely. Shell was stopped in tun-
 nels behind backing, having passed throug h plate
 and 36" oak backing. Charge consisted of ^{63%} of U.T. 17
 weight of projectile 250 lbs. There were several ^{longitudinal} radial cracks
 around bounellet, and both bounellet and body were slight-
 ly bulged. A small piece chipped off shoulder of ogival.

November 2. Fired 10 ^{shots} [charges] from wire wound gun on Howell carriage. Shells loaded with Emmensate wooden plugs no



- Largest piece 2 $\frac{7}{16}$, of ten largest pieces 16 pounds.
- (2) Charge $1\frac{1}{2}$ $\frac{7}{16}$ MN2, 42 pieces shell, 8 of band. Weight of largest piece $4\frac{1}{2}$ $\frac{7}{16}$, of ten largest $17\frac{1}{2}$ pounds.
- (3) Charge $1\frac{1}{2}$ $\frac{7}{16}$ MN2, 31 pieces shell, 1 of band. Weight of largest piece 4 $\frac{7}{16}$ of ten largest 18 pounds.
- (4) Charge $2\frac{1}{4}$ $\frac{7}{16}$ small cubical grain smokeless powder. 157 pieces of shell, 17 of band. Weight of largest piece $1\frac{1}{2}$ $\frac{7}{16}$, of ten largest 10 $\frac{7}{16}$.
- (5) Charge $2\frac{3}{4}$ $\frac{7}{16}$ shell powder. 32 pieces shell, 4 of band, largest piece $3\frac{1}{4}$ $\frac{7}{16}$, ten largest pieces 18 pounds.

November 1

U.S. Army Ordnance Dept. Test Report

... at an 8 slab plate, at a velocity of 1400 f/s.
 Plate was broken into numerous fragments, & left
 the backing com pletely. Steel was stopped in tim-
 bers behind backing, having passed through 2 plate
 and 36" oak backing. Charge consisted of ^{63% of U.T. 17}
 weight of projectile 250 lbs. There were several ^{longitudinal} radial cracks
 around bouneslet, and both bouneslet and body were slight-
 ly bulged. A small piece chipped off shoulder of ogival.

November 2. Fired 10 ^{shots} [charges] from wire wound gun on Howell carriage. Shells loaded with Emmentite, wooden plugs, no fuzes, Charge 35th, propellant 100. Elevation of 10° used for all shots except last two which were fired at extreme elevation. Range of former about 2 miles, of latter about 3½ to 4 miles. Last shell exploded on striking water or apparently so, though it is difficult to state. Carriage put out of commission - from transom board in, near transom on which the buffers were was blown off, slides bent & yoke twisted. Due to weak framing, and insufficient means of controlling recoil of carriage.

Burst 6, American Co, 4" A.P. shell with 1¼th M.N. in each. Of the first shell there were 40 fragments of the second, 20, of the third 36, of the fourth, 54, of the fifth 35, of the sixth 45.

vs. 4.

- Burst 5 - 4" American Co. shell in explosion chamber
- (1) Charge 1th M.N. 2. 42 pieces shell, 6 of band. Weight of largest piece 2th, of ten largest pieces 16 pounds.
 - (2) Charge 1½th M.N. 2, 42 pieces shell, 8 of band. Weight of largest piece 4½th, of ten largest 17½ pounds.
 - (3) Charge 1½th M.N. 2, 31 pieces shell, 1 of band. Weight of largest piece 4th of ten largest 18 pounds.
 - (4) Charge 2¼th small cubical grain smokeless powder. 157 pieces of shell, 17 of band. Weight of largest piece 1½th, of ten largest 10.
 - (5) Charge 2¼th shell powder. 32 pieces shell, 4 of band, largest piece 3¼th, ten largest pieces 18 pounds.

November 4. Burst seven 4" American Co. shells, base fuze in explosion chamber

- (1) Charge $1\frac{1}{4}$ lbs M.N.2, 40 pieces of shell, 7 of band. Largest piece 3 lbs, ten largest pieces $18\frac{1}{4}$ lbs.
- (2) Charge $1\frac{1}{4}$ lbs M.N.2, 20 pieces of shell, 3 of band, largest piece $3\frac{3}{4}$ lbs, ten largest pieces $25\frac{1}{4}$ lbs.
- (3) Charge $1\frac{1}{4}$ lbs M.N.2, 36 pieces shell, 6 of band, largest piece ten largest pieces $20\frac{3}{4}$ lbs.
- (4) Charge $1\frac{1}{4}$ lbs M.N.2 - 54 fragments shell, 6 of band, largest piece $3\frac{1}{4}$ lbs, ten largest pieces $16\frac{1}{4}$ pounds.
- (5) Charge $1\frac{1}{4}$ M.N.2, 45 pieces shell, 8 of band, largest piece ten largest pieces $23\frac{1}{4}$ lbs.
- (6) Charge $1\frac{7}{8}$ shell powder, 42 pieces shell, 7 of band, largest piece 4 lbs, ten largest pieces $11\frac{1}{2}$ lbs.
- (7) Charge $1\frac{3}{4}$ lbs cubical fine grain smother powder, 92 pieces shell, 4 of band, largest $1\frac{3}{4}$, ten largest $11\frac{1}{2}$ pounds.

All shells exploded by means of service electric primer in a bag containing 30 grains musket powder.

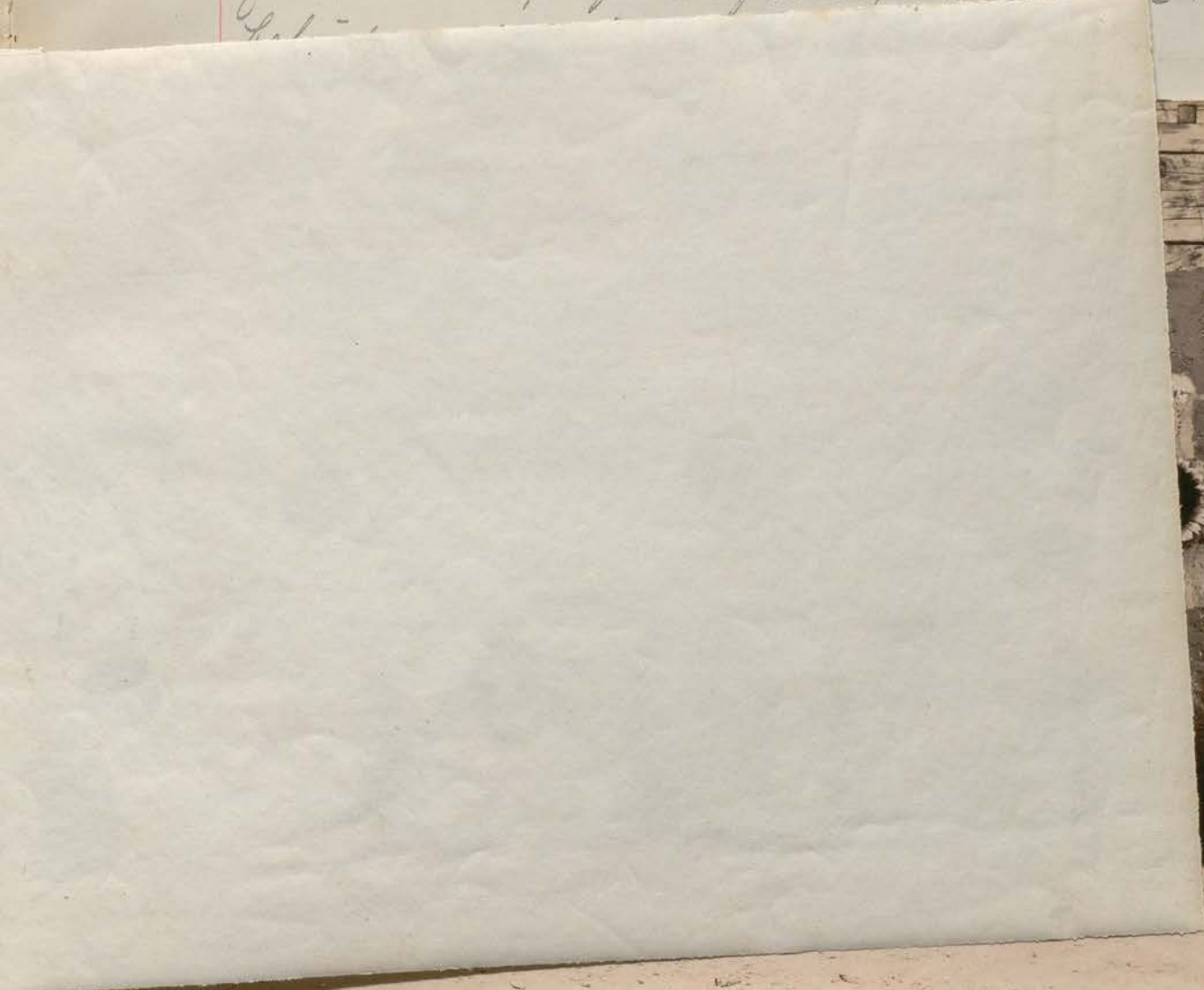
Rose plugs of iron were used in first 5 cases, & base plugs of brass in the later 7 cases. The screw threads were all stronger than shell walls.

One American Co. 4" shell sand filled was fired with full charge 2000 f.s. velocity at 5, 1" iron plates placed close together. Shell perforated plates without breaking up & struck water 300 yds beyond.

Two 4" shell of same kind, filled with $1\frac{1}{4}$ lbs M.N.2 were then fired with full service charge against 6, 1" iron

November 4. plates. Both shell perforated target & burst in the earth behind last plate, the explosion being very violent.

Another 4" shell of same kind was then sand filled & fired at the 6" plates passing through them & the earth



Barrel	7.94	7.96	7.95	7.95	8.18	7.94	8.00	7.95	8.00	7.95	8.00
Body ₁	7.91	8.18	7.91	7.91	8.24	7.91	8.23	7.91	8.01	7.91	8.49
Body ₂		8.82			8.36		8.80		8.08		8.63
Body ₃	7.91	8.06	7.91	7.91	7.95	7.91	8.07	7.91	7.92	7.91	8.00
Band	8.13		8.13	8.12		8.13		8.13		8.12	
Rear.	7.92	7.92	7.92	7.91	7.92	7.91	7.92	7.92	7.92	7.91	7.91

November 4. Burst seven 4" American Co. shells, base fuze in explosion chamber

(1) Charge $1\frac{1}{4}$ lbs M72, 40 pieces of shell, 7 of band. Largest piece 3 lbs, ten largest pieces $1\frac{3}{4}$ lbs

(2) Charge $1\frac{1}{4}$ lbs M72 20 pieces of shell 3 of band largest

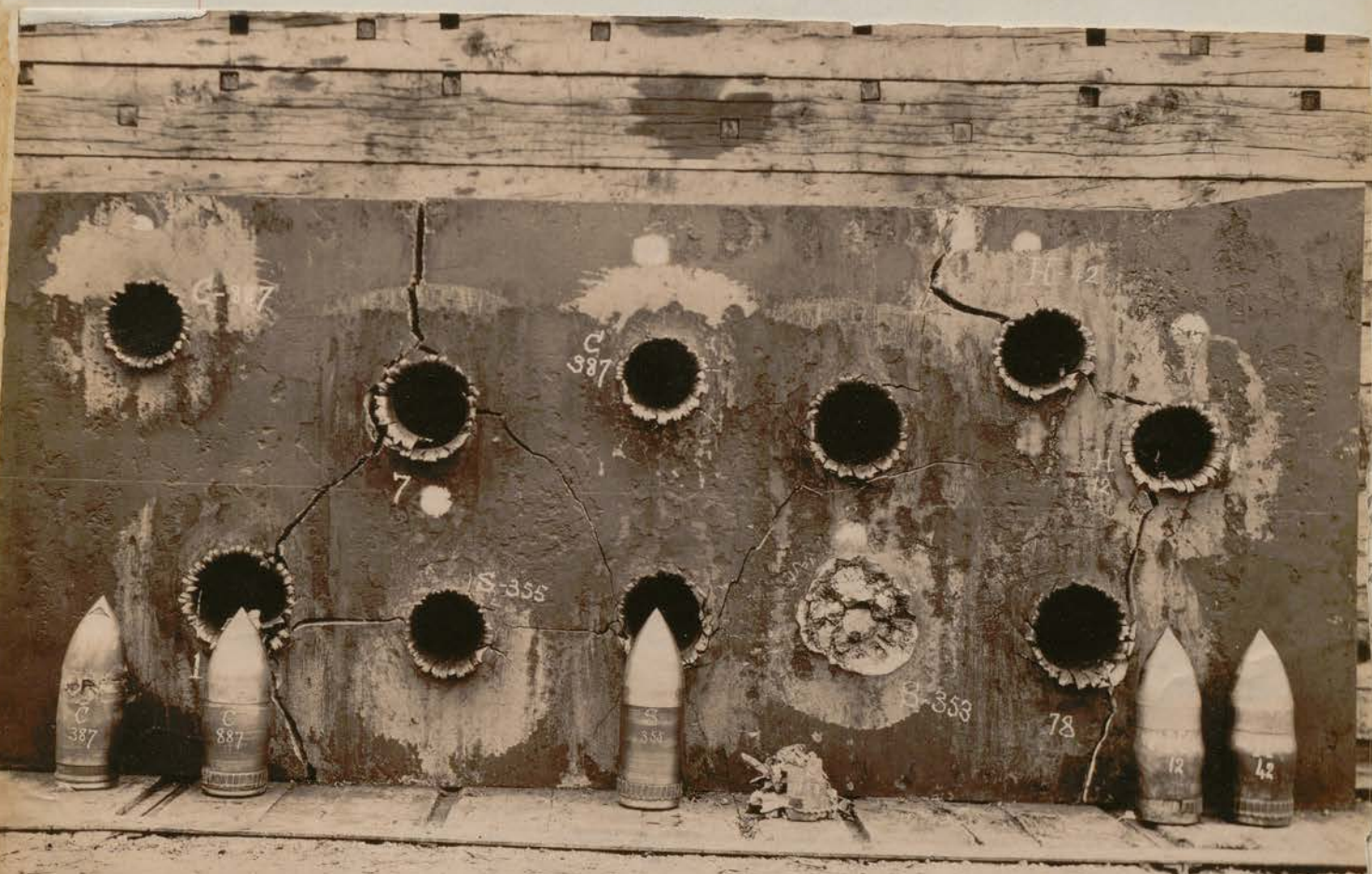


One American Co. 4" shell sand filled was fired with full charge 2000 f.s. velocity at 5, 1" iron plates placed close together. Shell perforated plates without breaking up & struck water 300 yds beyond.

Two 4" shells of same kind, filled with $1\frac{1}{4}$ lbs M72 were then fired with full service charge against 6, 1" iron

November 4. plates. Both shell perforated target & burst in the earth behind last plate, the explosion being very violent.

Another 4" shell of same kind was then sand filled & fired at the 6, 1" plates passing through them & the earth behind and on into the river



Bowndlet	7.94	7.96	7.90	7.90	8.18	7.97	8.00	7.90	8.00	7.90	8.00
Body ₁	7.91	8.18	7.91	7.91	8.24	7.91	8.23	7.91	8.01	7.91	8.49
Body ₂		8.82			8.36		8.80		8.08		8.63
Body ₃	7.91	8.06	7.91	7.91	7.95	7.91	8.07	7.91	7.92	7.91	8.00
Band	8.13		8.13	8.12		8.13		8.13		8.12	
Rear.	7.92	7.92	7.92	7.91	7.92	7.91	7.92	7.92	7.92	7.91	7.91

November 4. Burst seven 4" American Co. shell, base fuze in explosion chamber

① Charge $1\frac{1}{4}$ # M72, 40 pieces of shell, 7 of band - Largest
 ② Charge $1\frac{1}{4}$ # M72, 40 pieces of shell, 7 of band - Largest pieces $1\frac{1}{4}$ #

And American Co. 4" shell sand filled was fired with full charge 2000 f.s. velocity at 5, 1" iron plates placed close together. Shell perforated plates without breaking up & struck water 300 yds beyond.

Two 4" shell of same kind, filled with $1\frac{1}{4}$ # M72 were then fired with full service charge against 6, 1" iron

November 4. plates. Both shells perforated target & burst in the earth behind last plate, the explosion being very violent.

Another 4" shell of same kind was then sand filled & fired at the 6" plates passing through them & the earth behind and on into the river

November 4. Competitive trial of Hotzger, Sterling, and Carpenter armor piercing shells for the 5" gun, at 14" steel plate

No	Gun	Projectile	Powder	Charge	Stimulus Velocity	Company	
1	5" no 21	Con shell	U.T. 13	81.6	1724	C.P. No 16.	Fired to get velocity only. 1747 f.s. at muzzle
2	"	Hotzger no 12	U.T. 17	85	1700	"	Penetrated 12.9. Rebounded 100 feet to front.
3	"	Sterling 353	U.T. 17	85	1700	"	Broke up on impact.
4	"	Carp. 837	"	85	1700	"	Penetrated 13". Rebounded 75' to front right
5	"	Hotzger 42	U.T. 13	80	1700	"	Penetration 13". Rebd & carried to right of plate
6	"	Sterling 355	"	80	1700	"	Penetrated 14.2. Carried to right & rear of plate
7	"	Carp. 887	"	80	1700	"	Penetrated 13". Carried to right & rear of plate

Part measurements

Dimensions of shell before and after firing.

Part measurements	Hotzger No. 12		Sterling No 353		Carpenter No 837		Hotzger No. 42		Sterling 355		Carpenter 887	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Length	24.59	23.34	24.59	24.57	23.59	24.58	23.33	24.58	24.30	24.65	23.05	
Roundlet	7.94	7.96	7.95	7.95	8.18	7.94	8.00	7.95	8.04	7.95	8.28	
Body ₁	7.91	8.18	7.91	7.91	8.24	7.91	8.23	7.91	8.01	7.91	8.49	
Body ₂		8.82			8.36		8.80		8.08		8.63	
Body ₃	7.91	8.06	7.91	7.91	7.95	7.91	8.07	7.91	7.92	7.91	8.00	
Band	8.13		8.13	8.12		8.13		8.13		8.12		
Rear.	7.92	7.92	7.92	7.91	7.92	7.91	7.92	7.92	7.92	7.91	7.91	

November 4.

Competitive trial of 8" A.P. shell, continued.

All shells were fired at the 14" nickel steel plate of the "Massachusetts" which had already received five 10" in the acceptance test. Distance from gun to target was 390 feet. Each shell weighed 250 pounds.

Round 1. Common shell for velocity

Round 2. Hattys No. 12. Projectile rebounded entire, set up and band half off. Shell symmetrical, maximum diameter 10" from base.

Round 3. Sterling #353. Shot broke up on impact, lead welding in apparently.

Round 4. Carpenter 887. Rebounded in a damaged condition. Pieces scaled off ogival at shoulder, and off bourrelet. Longitudinal cracks in bourrelet and one beginning on ogival about $1\frac{1}{2}$ " from point, & continuing in plane parallel to axis. At vertex of crack a triangular piece chipped out. Point distorted .65" from point of symmetry. Maximum diameter 8"4 from base. Band stripped off.

Round 5. Hattys #42. Rebounded, set up, band on, symmetrical, no cracks. Maximum diameter 8"6 from base.

Round 6. Sterling #305. Rebounded entire, slightly set up, no cracks, symmetrical. Maximum diameter 12"8 from base.

Round 7. Carpenter 887, special. Rebounded entire set up. Band on, symmetrical in form. Crack 4" long in bourrelet. Hardening was unsymmetrical, extending farther back on two opposite sides than at point between these two.

Nov. 5.

Fired four charges as proof of 6" gun¹³¹ Mark III, 1892. The first charge was a reduced one of 40 lbs U.F., the three others with 46 lbs, S.M.A. 38, extreme elevation range about 5 miles. Weight of shell 100 lbs. Velocity (computed) Chanced bads after second round.



Shell of 500 lb used. Round 1, 11.0 tons pressure, 1708 f.s. at muzzle. Recoil 40"
 Round (2). 200 lb charge, 11.0 tons pressure, 1708 f.s. at muzzle. Recoil 40"

Nov. 5.

Fired four charges as proof of 6" gun¹³¹, Mark III, 1892. The first charge was a reduced one of 40 lbs U.F., the three others with 46 lbs, Sma 38, extreme elevation range about 5 miles. Weight of shell 100 lbs. Velocity (computed) Changed pads after second round.

Explosive 2 1/2" American Co. shell containing 1 lb 14 oz of



Shell of 500 lbs used. Round 1, 175 lbs, 8.8 tons pressure, 1600 f.s. at muzzle. Recoil 40"

Round (2). 200 lbs charge, 11.0 tons pressure, 1708 f.s. at muzzle. Recoil 40"

Nov. 5.

Fired four charges as proof of 6" gun¹³¹, Mark III, 1892. The first charge was a reduced one of 40 lbs U.F., the three others with 46 lbs, S.M.A. 38, extreme elevation range about 5 miles. Weight of shell 100 lbs. Velocity (computed) Changed pads after second round.

Exploded 2, 4" American Co. shell²⁰⁴, containing 1 lb 14 oz of ²⁰⁴ explosive Suge.

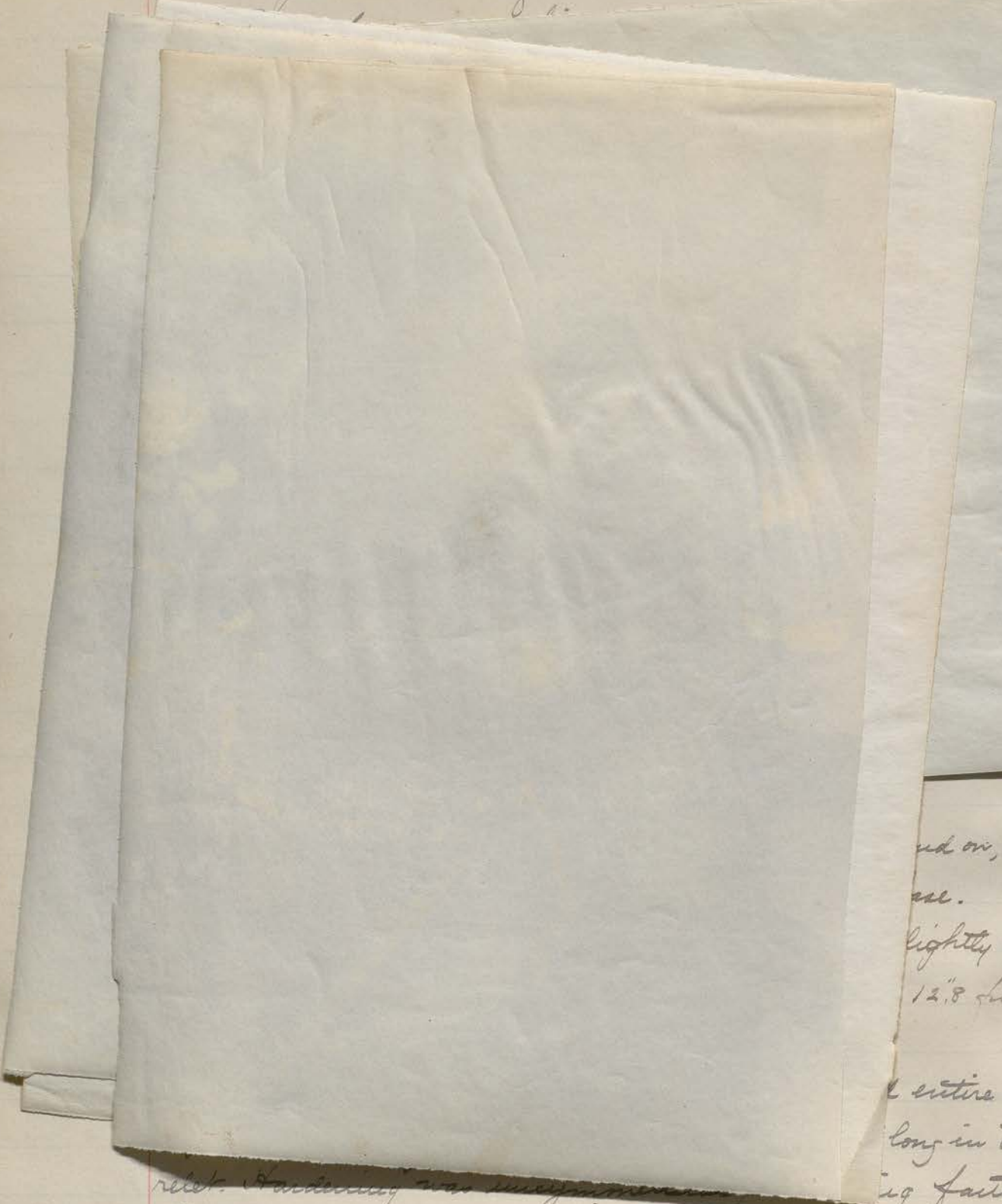


Used shell of 500 lbs used. Round 1, 125 lbs, 8.8 tons pressure, 1600 f.s. at muzzle. Recoil 40"

Round (2). 200 lbs charge, 11.0 tons pressure, 1700 f.s. at muzzle. Recoil 40"

November 4.

Competitive trial of 8" A.P. shell, continued.



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relet. Hardening was ~~unsuccessful~~
 back on two opposite sides than at point between
 these two.

Nov. 5.

Fired four charges as proof of 6" gun¹³¹ Mark III, 1892. The first charge was a reduced one of 40 lbs U.F., the three others with 46 lbs, Sma 38, extreme elevation range about 5 miles. Weight of shell 100 lbs. Velocity (computed) changed pads after second round.

Exploded 2, 4" American Co. shell²⁰⁴, containing 1 lb 14 oz of shell powder. Base plugs, + regulation electric fuse.

Weight of 1st shell^{subshell}, 3 1/2 lbs, no. pieces, 24, fuse, plug, + 6 pieces band

Weight of heaviest piece 7 1/2 lbs, ten heaviest 2 3/4 lbs, of all pieces 3 1/2

Weight of 2d shell 3 1/2 lbs, no. pieces 30, fuse, plug, + 5 pieces band

Weight heaviest piece 4 7/8 lbs, ten heaviest 2 4/5 lbs, of all pieces 3 1/5.

Proved 4" cartridge cases lots 48, 49, 50, 51. Brake extractor in withdrawing one of the cases of lot 49. Cases shortened in firing from .06" to .08". Gun 4", no. 12 Mark III, 1892.

(Oct. 25) Fired two shots from 10" B. L. R. No. 9, of Remnants U.F., 180 lbs first charge, giving muzzle velocity of 1751, with mean pressure of 12.0 tons. Round 2 - 220 lbs same powder, giving M.V. of 1873 f.s. and pressure of 14.9 lbs. Common shell used of 500 lbs weight.

Fired two shots from 10" B. L. R. No. 10, of U.F. 25: Common shell of 500 lbs used. Round 1, 175 lbs, 8.8 tons pressure, 1605 f.s. at muzzle. Recoil 40"

Round (2). 200 lbs charge, 11.0 tons pressure, 1708 f.s. at muzzle. Recoil 40"

November 7. Test of U.F. 20; Gun - 10" B.L.R. No. 10; Projectile common shell of 500 lbs weight; recoil 40".

- (1) Charge 225 lbs; pressure^(mean) 12.5; velocity at muzzle 1828 f.s.
 (2) Charge 240; pressure (mean) 14.5 tons; velocity at muzzle 1897 f.s.
 (3) Charge 248; pressure (mean) 14.9 tons; velocity at muzzle 1937 f.s.
 (4) Charge 249; pressure (mean) 14.9 tons; velocity at muzzle 1949 f.s.
 (5) Charge 251; pressure (mean) 15.1 tons; velocity at muzzle 1941 f.s.

Repetition of powder recommended, quantities blown out unburned.

Fired 10" shell No 213, lot 1, Carpenter Steel works at a steel plate; striking velocity 1400 f.s., using 140 lbs of U.F. 20. Shell passed through plate, 36" of Oak backing, & 12' into sand behind backing. Recovered entire, set up, two fine circular cracks about ogival about 5" x 8" from point. Shell shortened .58", bournelet increased .09", body just back of bournelet .16, about middle of its length .22", which was the maximum increase, and .01" just forward of the band. The plate was badly damaged so as not to be fit for further use.

November 11. Tested 6" B.L.R. # 130, regulation trial, passed successfully.

Tested U.F. 18 in 8" B.L.R. # 21. Common shell of 250 lbs.
 Round (1) 80 lbs - mean pressure 9.0 tons, M.V. 1722 - recoil 28 1/8"
 Round (2) 95 lbs - mean pressure 11.5 " - M.V. 1863 - recoil 29 1/2"
 Round (3) 105 lbs - " " 14.2 - M.V. 1980 - " 29 1/2"
 Round (4) 109 lbs - " " 15.0 - M.V. 2017 - " 29 1/2"
 Round (5) 109 lbs - " " 15.0 - M.V. 2019 - " 29 1/2"
 Repetition recommended as having failed to meet specifications.

November 13.

Instructions for preparing 4" and 5" Ammunition.

4" Ammunition.

The case is first primed care being taken to have the top of the primer and pocket flush with the head of the case. This should be tested with a straight edge. The primer pocket may be driven into its seat with a Hammer and Brass drift, the drift having a flat face about 1" to 1.5" in diameter. The inner end of the primer pocket is then examined by looking down inside the case, held to the light, to see that the road has not been displaced by driving the primer in. If this has occurred, a new primer must be put in. With new primers and proper cupping tools, this feature will not appear; but the above caution is given in case makeshift appliances have to be used.

The service charge of Register 100 is 12.92 pounds. It consists of 22 full layers of 7 grains each, and 2 grains on top of all. In making up a charge 21 layers are built up, 7 grains brown powder to a layer, and another layer placed on top consisting of 3 grains brown powder and 4 of black or ignition powder. A black grain is placed in the centre, and the 3 brown and other 3 black grouped around it alternating black with brown. The bag is then drawn down over the charge, the charge suspended, 2 brown grains placed on top, and the bag tied, after being drawn as tight as possible. It is then slipped into the case with the tie end next its mouth. When the charge is in, the tie is tucked neatly in around the upper end.

leaving an space 3.25 length to the top of the case. The body of the projectile in rear of the band is 2.98 long so that with this register of powder a wad .40" thick will be required to hold the charge snugly in place.

The wad, preferably of felt, having been pushed down firmly by hand, the case is stood on its base in the press, and the base of the projectile carefully entered in its mouth. The base of the projectile should be clean and dry. It is placed in position in the case and screwed home slowly, so as to allow air to escape. The screw should be stopped just as the lower edge of the band touches the mouth of the case. A greater insertion of the projectile will swell the mouth of the case, and make it tight in the gun. The space between the lip of the case and rear of band should be rubbed full of tallow about an hour after the shell is screwed home. Great care is required in working the press to keep the case and projectile exactly in line. A movable wooden centering disc is used. In loading point fuze or A. P. Shell, a brass cup to take on the ogival will be required to save the fuze or point. The complete charges should be tried either in a gauge or a gun of minimum tolerance before issue to service.

5" Ammunition.

The case is formed as described for the 4".

The charge of register 102 is 26.75 pounds. It consists of 33 layers of 19 grains each, and 13 grains on top of all. The layer at ignition end contains 12 grains of brown powder and 7 black or ignition grains, the 7 black one being in the centre grouped together the outer layer being composed of the 12 brown grains.

It is placed in a bag like the 4", and inserted similarly in the case leaving a space of 3.60 length between bag and lip of case. The base of the shell below the band is 2.40, leaving a space between charge and base of 1.20

It is recommended that this space be filled with one felt wad over the charge and a block of white pine about 3" square, & of such thickness that, with the wad, the charge will be held firmly in place when the shell is screwed home. This block is to have four holes pierced in it to increase air space, and make it break up on firing.

In all other respects the loading of 5" ammunition is the same as in the 4" already described.

The building up of these long charges will be facilitated if the grains are strung on wires properly arranged with one end of each held in a block the other end being free for stringing on the grains.

November 14. Fired 7 shots from Hotchkiss R. F. 3 Pdr. for velocities - using I.W.-10, and common shell of 3.3 pounds.

Round (1)	700	grammes,	mean pressure	14.3-	m.v.	2006-	record	3 1/2
Round (2)	705	"	"	14.2-	m.v.	1995-	"	3 1/2
Round (3)	690	"	"	13.4-	m.v.	1939-	"	3 1/2
Round (4)	700	"	"	13.9-	m.v.	1967-	"	3 1/2
Round (5)	700	"	"	13.7-	m.v.	1972	"	3 1/2
Round (6)	700	"	"	14.0-	m.v.	1976	"	3 1/2
Round (7)	700	"	"	13.3-	m.v.	1957	"	3 1/2

Acceptance recommended - charge fired at 705 grammes.

November 16. Test of fibro-graphite used on four 6" shell.

Round (1). Fired down range. Flew smoothly, and struck about 5000 yards from gun. Charge 30 pounds.

Round (2) Fired down range. Wobbled badly, the band evidently having slipped and struck at about $\frac{1}{4}$ the normal range. Charge 46 pounds.

Round (3) Fired into butt. Band slipped, shell wobbled and missed screens. Charge 46 pounds.

Round (4) Fired down the range at level. Velocity 1875 fs. Pressure 11.0 tons, a service shell under similar conditions would have registered 2000 fs., and 14.5-ton pressure with the charge used of 46 pounds. The band slipped off, the shell wobbled, cut the screens, struck the water and made one short ricochet then ruckled along the surface of the water in a straight line for fully 1500 yards roaring tremendously. The point was slightly elevated enough to counter balance the

weight, and as the course was straight it is probable that the shell did not rotate at all.

The effect of the fibro-graphite on the bore was very good, it appeared to polish the surface very nicely, but the cement used for sticking on the band was not strong enough to withstand the wrenching occasioned by firing a full charge.

Tested 200 electric primers with firing battery and attachments. Results as follows:-

Total number primers tested 192

Total number failing to fire 84

Causes of not firing.

Eight had neither gun cotton wisp nor powder.

Six had no gun cotton wisp.

Sixty-two had no contact between gun cotton ^{and} bridge.

Five had no bridges, or else the bridges were broken.

Three showed no cause for failing to fire.

Of the total number sixteen had no powder at all, and twelve a very small amount only. Two of the primers that exploded left a portion of the cotton in the primer, showing that it was probably in a decomposed state, or perhaps was not gun-cotton at all. Several of the primers had gun-cotton in a mealy condition so that it could be poured out.

Those that fired checked gas properly. Electrically considered the battery is satisfactory, but as an in-

to be issued to the service, it lacks many important features. Instead of being carried in the gun captain's belt, and an attachment for firing by means of a pedal grip arrangement to be pulled as a trigger or squeezed in the hand.

November 19.

Test of 10" nickel steel plate representing Barbette armor of the "New York." The plate was attacked with an 8" and Carpenter projectiles, charge 57.75 pounds, and striking velocity 1410 f.s.

Round (1) Carpenter shell # 819, lot 5; impact 26" from right hand edge and 77" from bottom; penetration 10.5". Hole 8.2 diameter at face of plate, burr 2.1 high, raised surface about 30" in diameter. The interior of the hole was smooth with a fine horizontal crack on its left side. The projectile broke up on impact, the pieces flying to the rear in every direction, some going into the water. The head seemed to have split just a little below the point, and the base to have broken off.

Round (2) Carpenter # 256, lot 7. Point of impact 2" from left edge and 63.5" from bottom. Penetration 10.5". Hole 8.3 diameter; burr, 2.1; raised surface 30" diameter. Interior of hole smooth, with a fine circular crack from bottom, and 4 fine longitudinal cracks from 3" to 6" in length. Shell broke up & flew to rear, most the lines of rupture being longitudinal, & breaking into 3 principal fragments.

Round (3) Carpenter shell special # 657. Point of im-



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24, 25, & 26. S M A-36-37-38, Index numbers 125-126-127. Charges
 varied by the amount of black ignition powder S X S
 that was contained. Shots were fired from 4" R.F.G. #15,
 atic,

November 19.



the lines of rupture being longitudinal, & breaking
into 3 principal fragments.

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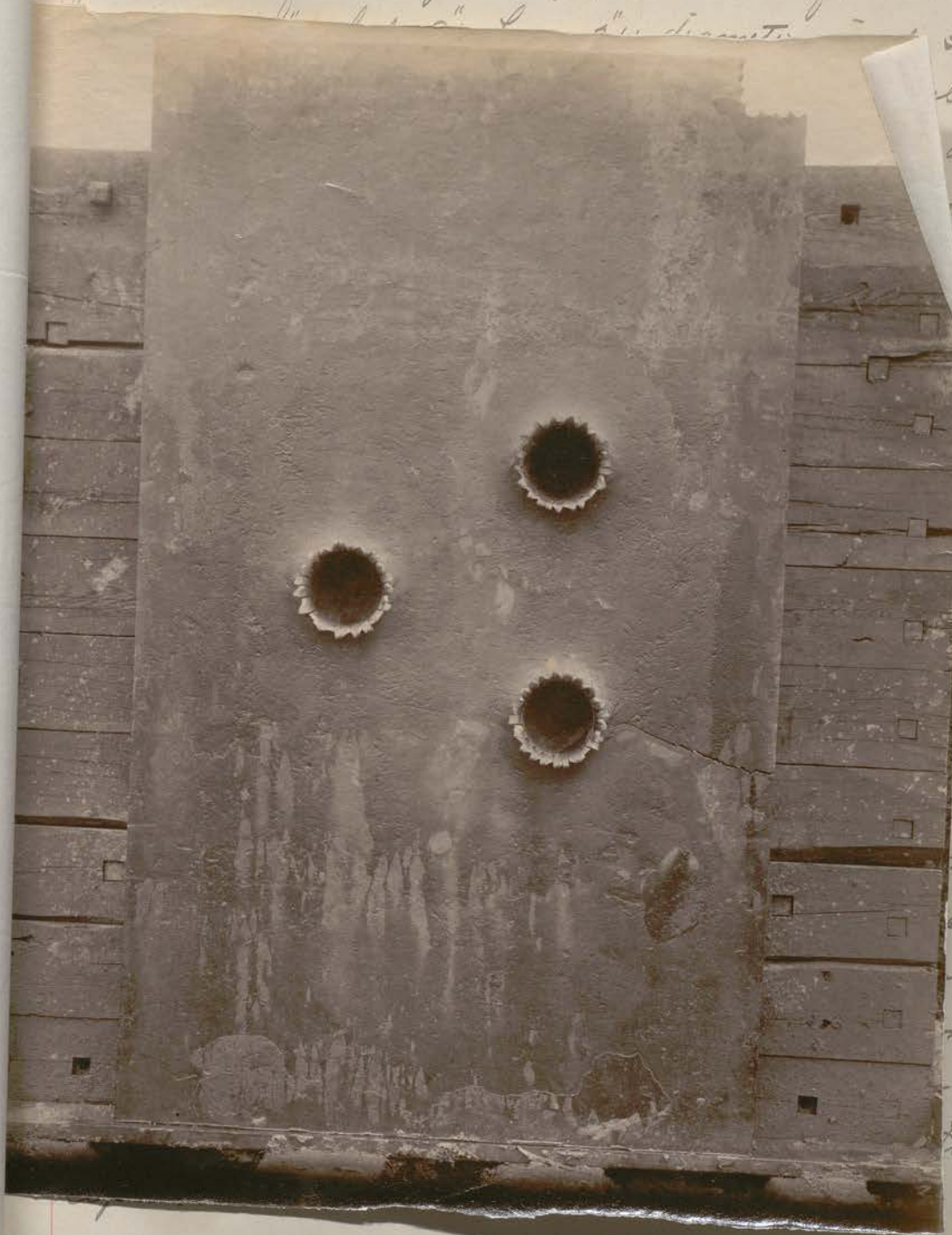
24, 25, & 26. S M A-36-37-38, Index numbers 125-126-127. Charges
 varied by the amount of black ignition powder S X G
 that was contained. Shots were fired from 4" R.F.C. #15,
 automatic,

November 19.

the lines of rupture being longitudinal, & breaking
into 3 principal fragments.

Round (3) Carpenter's shell special # 657. Point of un-

part 24" from right edge, and 49.0" from bottom. Pen-



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Experiments with 4" powder. Brown Prismatic,
SMA-36-37-38, Index numbers 125-126-127. Charges
varied by the amount of black ignition powder S.X.G
that was contained. Shots were fired from 4" R.F.G. #15,

November 19.

the lines of rupture being longitudinal, & breaking
into 3 principal fragments.

Round (3) Carpenter shell special # 657. Point of im-

part 24° from right edge, and 49.5° from bottom. Penetration 10.9 , hole 8.1 ; Burr 2.1 ; diameter raised surface about 30 ." A ^{line} small crack about 10 " long & inclined upward, ^{to left} about 2° , and a layer one 25 " long and inclined downward about 3° to the right & extending to edge of plate were developed. The latter was a through crack decreasing from $.3$ " at edge to $.1$ " at back and $.1$ " near hole. Interior of hole was very smooth. Projectile rebounded entire, shortened $.56$," borelet increased in diameter $.09$," body increased in diameter $.15$," the maximum, about 7.6 inches from base.

4 Test of Lot 3, Carpenter 6 " A.P. shell. Shell # 848 was fired against a 6 " steel plate with a striking velocity of about 1600 foot seconds. It passed through plate and 25 " backing & ricocheted over butt and was recovered at a distance of 100 yards. The shell was shortened $.1$," borelet increased in diameter $.02$," body increased $.04$ " maximum, rear of body $.03$ ". The shell was without a crack and symmetrical. It was fired in the muzzle of the gun and could be pushed as far as the rotation band. The lot was recommended to be accepted.

ber Experiments with 4 " powder. Brown frismatic, SMA-36-37-38, Index numbers 125-126-127. Charges varied by the amount of black ignition powder S X G that was contained. Shots were fired from 4 " R.F.C. # 15,

with common shell of 33 pounds, recoil being 8" in every case.

Sma 36 - 125				Sma 37 - 126				Sma 38 - 127			
No. grains	Height	Pressure tons	Velocity m/ft	No. grains	Height	Pressure tons	Velocity m/ft	No. grains	Height	Pressure tons	Velocity m/ft
4 lb. 107 B.	13.42	12.4	1944	4 lb. 107 B.	13.42	13.4	1940	4 lb. 107 B.	13.39	12.8	1928
7 lb. 104 B.	13.16	13.8	1944	7 lb. 104 B.	13.16	12.0	lost	7 lb. 104 B.	13.18	12.8	1948
11 lb. 100 B.	12.82	12.0	1925	11 lb. 100 B.	12.82	11.0	1929	11 lb. 100 B.	12.95	12.5	1936
4 lb. 102 B.	12.61	13.3	1948					4 lb. 102 B.	12.19	14.5	1998
4 lb. 143 B.	1.21	14.0	1985	4 lb. 143 B.	1.21	13.2	1944	4 lb. 143 B.	1.21	14.9	1969
4 lb. 243 B.	2.43	14.5	2015	4 lb. 243 B.	2.43	15.4	2040	4 lb. 243 B.	1.82	14.5	1970
4 lb. 29 B.	11.03	14.5	2015	4 lb. 29 B.	11.03	15.4	2040	4 lb. 29 B.	11.61	14.5	1970
4 lb. 243 B.	2.43	15.4	2035	4 lb. 243 B.	2.43	11.47	1906	4 lb. 243 B.	2.08	15.4	2024
4 lb. 134 B.	11.03	15.4	2035	4 lb. 134 B.	11.03	1.4	1906	4 lb. 134 B.	11.34	15.4	2024
4 lb. 30 B.	3.04	15.2	2038	4 lb. 30 B.	3.04	15.1	2014				
4 lb. 122 B.	10.43	15.2	2038	4 lb. 122 B.	10.43	15.1	2014				

November 26.

Burst in explosion chamber 2.4" American Co. shell, charged with $17\frac{1}{8}$ lbs shell powder. 1st shell $30\frac{1}{4}$ lbs, 2d. $30\frac{1}{2}$ lbs empty.

First shell exploded into 30 pieces, fuse, plug, & 5 pieces of band. Heaviest piece 5.5 lbs, 10 heaviest 2.5 lbs, all pieces 30.5 lbs.

Second shell. 33 pieces shell, fuse, plug, & 3 pieces of band. Heaviest piece $4\frac{1}{16}$ lbs, 10 heaviest $20\frac{3}{4}$ lbs, all pieces $30\frac{1}{4}$ lbs.

Fired 3 American Co. 4" shell through 3, 1" iron plates - successful.

Tested 2.4" and 4-6 Par. A.P. shell submitted by G. H. Blake of Boston, Mass. Fired 4" shell at a 4" steel plate

First shell penetrated plate & lodged in first tier of backing. Shell recovered badly bulged about equal to Courralet, point 5" inch from original axis, & shortened 1.06. ^{piece clipped out band.} Numerous cracks, &

Second shell penetrated plate and ^{24"} backing & broke up into about a dozen fragments.

The poor performance of the shell seemed due to the fact that the outside was soft, being soft to the file all over, and the inside hard, & under internal strains not drawn out in tempering.



Round (1). From right gun of pair. Charge 5075 - elevation 3° - recoil 22". Fired down range - about 3 miles.

Round (2). Fired pair of guns down range - charges 7075 - elevation 3°, recoil 26". Due to irregularity of pull, the left gun went off shortly ahead of the right, the projectiles flying very closely together however.

with common shell of 33 pounds, recoil being 8" in every case.

No. of rounds	Sma 36 - 125				Sma 37 - 126				Sma 38 - 127			
	Weight	Pressure tons	Velocity m.p.h.	Penetration	Weight	Pressure tons	Velocity m.p.h.	Penetration	Weight	Pressure tons	Velocity m.p.h.	Penetration
(1) 4 1/2	572								4 1/2			
(2) 7 1/2	542											
(3) 11 1/2	502											
(4) 4 1/2	472											
(5) 14 1/2	43											
(6) 2 1/2	24											
(7) 2 1/2	13											
(8) 3 1/2	12											

November 26.

Tested 2, 4 and 4-6 lbs. U.S. shell at
 Boston, Mass. Fired 4" shell at a 4" steel plate
 First shell penetrated plate & lodged in first tier of backing.
 Shell recovered badly bulged about equal to Bourrelet, point
 5" inch from original axis, & shortened 1.06. Numerous cracks, &
 Second shell penetrated plate and ^{24"}backing & broke up into
 about a dozen fragments.

The poor performance of the shell seemed due to the fact that the outside was soft, being soft to the file all over, and the inside hard, & under internal strains not drawn out in tempering.



Round (1) From right gun of pair. charge 50 lbs - elevation 3° recoil 22". Fired down range - about 3 miles.

Round (2). Fired pair of guns down range - charges 70 lbs - elevation 3°, recoil 26½". Due to irregularity of pull, the left gun went off shortly ahead of the right, the projectiles flying very closely together however.

with common shell of 33 pounds, recoil being 8" in every case.

Sma 36 - 125

Sma 37 - 126

Sma 38 - 127

No. of rounds	Weight	Pressure	Velocity	No. of rounds	Weight	Pressure	Velocity	No. of rounds	Weight	Pressure	Velocity
	4 lb.								4 lb.		
(1)	107 B.										
	7 lb.										
(2)	104 B.										
	11 lb.										
(3)	100 B.										
	4 lb.										
(4)	102 B.										
	4 lb.										
(5)	143 B.										
	2 1/2 lb.										
(6)	129 B.										
	2 1/4 lb.										
(7)	134 B.										
	3 1/2 lb.										
(8)	122 B.										

November 26.

Bois, ... shell at a ... shell plate

First shell penetrated plate & lodged in first tier of backing. Shell recovered badly bulged about equal to Courralet, point 5" inch from original axis, & shortened 1.06. Numerous cracks, ^{piece clipped out hand.}

Second shell penetrated plate and ^{24"} backing & broke up into about a dozen fragments.

The poor performance of the shell seemed due to the fact that the outside was soft, being soft to the file all over, and the inside hard, & under internal strains not drawn out in tempering.

The 6 Pdr. shell was fired at a 3" deck plate.

Round (1) shell soft to file all over, struck edge of plate and broke into many pieces

Round (2), shell hard to file all over, struck plate fairly but broke off a large fragment of latter so that penetration was nothing. Shell broke up into five pieces

Round (3). shell soft to file all over got its point just through the plate, head breaking off at coronet and rebounding. Body of shell broke into small pieces all hard, & with sharp edges.

Round (4) shell hard to file over head & coronet, soft to the rear, got its head and ring of coronet just through plate, a ring of the body and base struck in the plate, base in beyond surface of the latter.

All shell showed hard metal and internal strains

Nov 28, Tested turret mount for pair of 8" guns, designed for the "New York". Remnants of U.S. used common shell of 200 lbs.

Round (1) From right gun of pair. charge 50 lbs - elevation 8° recoil 22". Fired down range - about 3 miles.

Round (2). Fired pair of guns down range - charges 70 lbs - elevation 3°, recoil 26½". Due to irregularity of pull, the left gun went off shortly ahead of the right, the projectiles flying very closely together however.

Round (3). From right gun of pair - charge 80th - recoiled
elevation 3°. Fired down the range about 4 miles.

November 29. Continued test of New York turret mount.

Round (4) Fired pair of guns simultaneously - charge 90th
elevation 3°, recoil 27". Projectiles flew together & struck
together but separated somewhat after ricochet. Mount re-
ceived recoil with strains, behaving well. Greater eleva-
tion than 3° could not be obtained with left gun as
to edge of rim base bringing up against edge of forward
transom.

Round (5). Right gun of pair - charge 100th, elevation
13° (maximum), recoil 27". Flight regular, & projectile
struck water between 6 & 7 miles from Station.

November

Burst in explosion chamber with ^{the} electric detonator
the point; one American Co., 6" steel point fuze common
shell (slightly deformed). Charge 7¹/₈ th shell powder. Weight
of empty projectile 91 pounds.

No pieces shell 56, 6 pieces band, the fuze, & plug.
Weight heaviest 11³/₄ th, 10 heaviest 4⁸/₄, of all pieces 8

December 2.

Burst in explosion a 2d, American Co., 6" steel point
fuze common shell. Electric detonator in point, & charge
7¹/₈ pounds of shell powder. Weight empty shell 91 pounds.

No pieces shell - 67, pieces band 6, fuze & plug.

Weight heaviest 5 pounds, of 10 heaviest 33³/₄ pounds
& of all pieces 91 pounds.

cc. 2. Fired 3, 6" American Co. steel point fuse common shell in-
to butt.

Round (1) Shell not hardened, entered butt and was dug

...
... and broke
... more or less ex-
... was recovered
... low barrel.
... broke up.

4" R.F.G. Shell

Struck plate and
... ation 1.4
... plate and broke
... ting in plate.

sand filled
shell, soft. Shell
... with it a
... thick.

shell sand-filled.
... in diameter, cony-
... point was

Round (2) ... consisting charge of M.N.-2
Penetrated plate & exploded behind with great violence, cracking
plate & throwing earth in all directions.

Round (3). From right gun of pair - charge 80 lbs - recoil elevation 3°. Fired down the range about 4 miles.

November 29. Conti

Round
elevation
together
secured
from
to edge
transo.

Round
13° (m
struck

But
the pa
shell
of emp
7

December 2.

But
fuse c
7 1/8 pound

No. of pieces - 67, pieces band, fuse & plug.
Weight least 5 pounds, of 10 least 33 3/4 pounds
& of all pieces 91 pounds.



Dec. 2.

Fired 3, 6" American Co. steel point fuzee common shell in - 604
to butt.

Round (1) Shell not hardened, entered butt and was dug
out undeformed. Could be reentered in gun.

Round (2) Shell hardened. Entered butt and broke
up. Pieces of walls showed bulging to more or less ex-
tent

Round (3) Shell hardened. Entered and was recovered
whole but with irregular bulge just below chamber.
A cast iron shell also fired into butt broke up.

Test of Harveized American Co. shell, for the 4" R.F.G. Shell
fired at 4" steel plate, velocity 2000 f.s.

Round (1) Common shell, ^{untreated} sand-filled. Struck plate and
broke off fragment. Shell broke up, penetration 1.4"

Round (2) Hard Harveized shell, ^{sand filled} Struck plate and broke
off fragment. Shell broke up, lead welding in plate.
Then fired at 2" steel ^{deck} plate.

Round (3) American Co. steel Harveized shell, ^{sand filled} soft. Shell
penetrated plate & about 5 feet of earth carrying with it a
circular portion 14" in diameter, and 1.5" thick.

Round (4). Untreated American Co. shell, sand-filled. ^{with}
Penetrated plate making ragged hole about 6" in diameter, carry-
ing away a fragment of plate in which point was
welded

Round (5). Soft Harveized shell, bursting charge of M.N.-2 ^{ed.}
Penetrated plate & exploded behind with great violence, cracking ^{thirds}
plate & throwing earth in all directions.

Round (6). Hard Haverized shell. Luning charge of 1⁷/₈ M.N.-2. Shell penetrated plate carrying with a piece about 1.5" thick and 8" diameter, cracking plate badly, and burst in earth beyond.

Round (7). Untreated shell Luning charge 1⁷/₈ M.N.-2. Shell exploded on face of plate, head welding in & body breaking up. No part of the shell got through.

Two untreated shell were then fired at the Massachusetts 14" plate. Penetration 1.75" and 2" respectively.

A Haverized shell, soft to file all over, was then fired giving a penetration of 1.5".

A Haverized shell, hard to file, was then fired at same plate, giving penetration of 2³/₈". All shell broke up.

December 6.

Fired 5 common shell into butt, from 40 caliber 6" B.L.R. Charge 46⁷/₈ S.M.A.-37-38. Weight of shell 100⁷/₈.

Round (1) Cast iron shell, pressure 13.4 tons, muzzle velocity 2145 f.s.

Round (2) Steel shell, not hardened " 14.7 " " " 2110 "

Round (3) " " Hardened " 14.6 " " " 2124 "

Round (4) Cast iron shell " 13.4 " " " 2121 "

Round (5) Steel shell, Hardened " 13.4 " " " 2126 "

The cast iron shell broke up in butt. Steel shell No. 2, not hardened was recovered entire, practically unchanged and was reentered in gun. Steel shell, No. 3, hardened was broken up in butt, pieces showing evidence of having bulged, but without signs of having struck anything. Shell No. 5, Hardened, recovered

entire, but with a bulge just below base, irreg-
diameter being 6.025604
It was found to be
American Company, Lar-

SPECIFICATIONS

FOR

Forged-Steel 4-in., 5-in., and 6-in. Shells.

The shells must be of forged steel and must be finished to the dimensions shown on the accompanying blue prints, numbered 4"-2589, 5"-2591, and 6"-2561, within the limit of tolerance stated thereon. Where no tolerances are mentioned they must be as near to standard dimensions as careful machining will make them. The fuse holes must be tapped, but the shell need not be banded nor the band scores cut.

They must be sound and free from cracks, blow holes, and all other defects seriously affecting their resistance and value for the purpose for which they are intended. This condition to be determined by the Government inspectors.

They are to be subject to inspection by the Government inspectors during all the processes of their manufacture, and to inspection and tests before acceptance, and the contractors shall furnish the inspectors with full facilities for such inspection and tests. The shell of each caliber are to be presented for acceptance in lots not less than 200 ~~not more than~~ 500 in number.

The acceptance tests may consist of any or all of the following:

Each shell may be submitted to an internal water pressure of 200 pounds per square inch, and no leakage through the metal must result therefrom.

Tensile specimens may be taken from as many shell as desired, not to exceed one per cent. of the number offered for acceptance, and these must show, on two-inch specimens, a tensile strength of at least 70,000 pounds per square inch.

A number of shells, not to exceed five from any lot, brought up to service weight with sand or salt, may be fired, with the service charge and velocity, over a range or into a butt of sand or earth, and no shell so fired shall set up or break in the gun or afterwards.

In case any shell selected for test fails to meet the requirements of the above-mentioned tests, the lot from which it was selected may be rejected, and no shell from a lot thus rejected shall be added to any new lot.

All firing tests will be at the Department's expense, but the expense of all other inspections and tests before acceptance must be borne by the contractors. Shells will be paid for by lots upon acceptance; the price per shell being that fixed by the contract. Ten per cent. will be reserved from each payment made the contractor until the completion of the contract.

Accepted lots must be delivered f. o. b. cars, at the contractor's works, suitably protected against injury from weather or other causes during transportation.

WM. M. FOLGER,

Chief of the Bureau of Ordnance.

NAVY DEPARTMENT,
BUREAU OF ORDNANCE,

August 4, 1892.

5" gun No. 17, using
To each.

muzzle velocity	2310 f.s.
"	" 2290 "
"	" 2301 "
"	" 2279 "
"	" 2311 "
"	" 2262 "

pressure, and 30 f.s.,

service charge of Registered
can pressure 15.3 tons,
probably to slight
become somewhat

Pdr. R.F.G. Fired with
deck plate.

within 1" of lead, &
to completely, lead &

Part of base getting through. Point undeformed.
Round (2). Shell soft to fill all over. First two-thirds

Round (6). Hard Haweyized shell. Existing charge of
17th M7-2. Shell penetrated
about 1.5" thick and
and burst in earth

Round (7). Untreated
Shell exploded on
body breaking up.

Two untreated shells
Chusitto 14" plate.

A Haweyized shell
fired giving a pen

A Haweyized shell
same plate, giving
broke up.

December 6.

Fired 5 common
B.L.R. Charge #678 S

Round (1) Cast iron shell

Round (2) Steel shell, not

Round (3) " " Lard

Round (4) Cast iron shell

Round (5) Steel shell, L

The cast iron shell
No. 2, not hardened
changed and was
hardened was broken

of having bulged, but without signs of having
struck anything. Shell No. 5, Lardened, recovered

entire, but with a bulge just below bournelet, irregu-
 diameter being 6.02 to 6.04
 he was found to be
 American Company, Har-

SPECIFICATIONS

FOR

WROUGHT-STEEL 4-INCH AND 5-INCH SHELLS.

The shell must be of wrought steel and must be finished to the dimensions shown on the accompanying blue prints, numbered 4793 and 4794, within the limit of tolerance stated thereon. Where no tolerances are mentioned they must be as near to standard dimensions as careful machining will make them. The fuse holes must be tapped and the shell banded.

The electric weld joining the head to the body must be as far to the rear as is found practicable; this position being determined by further experiment, and fixed to the Department's satisfaction.

The shell must be of steel, containing at least 0.35 per cent. carbon, and they must be hardened by tempering in oil or in some other suitable manner.

They must be sound and free from cracks, blow holes, and all other defects seriously affecting their resistance and value for the purpose for which they are intended. This condition to be determined by the Government inspectors.

They are to be subject to inspection by the Government inspectors during all the processes of their manufacture, and to inspection and tests before acceptance, and the contractors shall furnish the inspectors with all facilities for such inspection and tests. The shell of each caliber are to be presented for acceptance in lots not less than 500 in number.

The acceptance tests may consist of any or all of the following:

Each shell may be submitted to an internal water pressure of 200 pounds per square inch, and no leakage through the metal must result therefrom.

A number of shells, not to exceed five from any lot, brought up to service weight with sand or salt, may be fired, with the service charge and velocity, over a range or into a butt of sand or earth, and no shell so fired shall set up or break in the gun or afterwards.

One or more shell from each lot may be fired with the service velocity normally against a plate of ordinary ship steel of a thickness equal to one-half the caliber of the shell, and must pass through the plate without breaking up.

In case any shell selected for test fails to meet the requirements of the above-mentioned tests, the lot from which it was selected may be rejected, and no shell from a lot thus rejected shall be added to any new lot.

All firing tests will be at the Department's expense, but the expense of all other inspections and tests before acceptance must be borne by the contractors. Shells will be paid for by lots upon acceptance, the price per shell being that fixed by the contract. Ten per cent. will be reserved from each payment made the contractor until the completion of the contract.

Before final acceptance the interior of each shell shall be thoroughly covered with a suitable lacquer.

Accepted lots must be delivered f. o. b. cars, at the contractor's works, suitably protected against injury from weather or other causes during transportation.

WM. M. FOLGER,
 Chief of Bureau of Ordnance.

DECEMBER 1, 1892.

in 5" gun No. 17, using
 To each.

muzzle velocity 2310 f.s.

" " 2290 "

" " 2301 "

" " 2279 "

" " 2311 "

" " 2262 "

pressure, and 30 f.s.,

service charge of Registered
 can pressure 15.3 tons,
 probably to slight
 become somewhat

Pdr. R.F.G. Fired with
 deck plate.

within 1" of lead, &
 to completely lead &

Part of bournelet getting through. Point undeformed.
 Round (2). Shell soft to file all over. First two-thirds

Round (6). Hard Haverized shell. Linsting charge of
1⁷/₈ M.N.-2. Shell penetrated
about 1.5" thick and
and burst in earth to

Round (7). Untreated
Shell exploded on face
body breaking up. No

Two untreated shells
Chusette 14" plate. Pen

A Haverized shell
fired giving a pen

A Haverized shell
same plate, giving
broke up.

December 6.

Fired 5 common shells
B.L.R. Charge 46⁷/₈ S.

Round (1) Cast iron shell

Round (2) Steel shell, not

Round (3) " " Lard

Round (4) Cast iron shell

Round (5) Steel shell, Lard

The cast iron shell
No. 2, not hardened
charged and was re
hardened was broken

of having bulged, but without signs of having
struck anything. Shell No. 5, Lardened, recovered

entire, but with a ledge just below bournelet, irregu-
 diameter being 6.02 to 6.04
 he was found to be
 erican Company, Lar-

SPECIFICATIONS

FOR

WROUGHT-STEEL

8-INCH, 10-INCH, AND 12-INCH SHELLS.

The shell must be of wrought steel and must be finished to the dimensions shown on blue prints to be furnished by the Bureau of Ordnance within the limit of tolerance stated thereon. Where no tolerances are mentioned they must be as near to standard dimensions as careful machining will make them. The fuse holes must be tapped and the shell banded.

The electric weld joining the head to the body must be as far to the rear as is found practicable; this position being determined by further experiment, and fixed to the Department's satisfaction.

The shell must be of steel, containing at least 0.35 per cent. carbon, and they must be hardened by tempering in oil or in some other suitable manner.

They must be sound and free from cracks, blow holes, and all other defects seriously affecting their resistance and value for the purpose for which they are intended. This condition to be determined by the Government inspectors.

They are to be subject to inspection by the Government inspectors during all the processes of their manufacture, and to inspection and tests before acceptance, and the contractors shall furnish the inspectors with all facilities for such inspection and tests. The shell are to be presented for acceptance in lots of 250 for the 8-inch and of 50 each for the 10-inch and 12-inch.

The acceptance tests may consist of any or all of the following: Each shell may be submitted to an internal water pressure of 200 pounds per square inch, and no leakage through the metal must result therefrom.

A number of shells, not to exceed five from any lot, brought up to service weight with sand or salt, may be fired, with the service charge and velocity, over a range or into a butt of sand or earth, and no shell so fired shall set up or break in the gun or afterwards.

One or more shell from each lot may be fired with the service velocity normally against a plate of ordinary ship steel of a thickness equal to one-half the caliber of the shell, and must pass through the plate without breaking up.

In case any shell selected for test fails to meet the requirements of the above-mentioned tests, the lot from which it was selected may be rejected, and no shell from a lot thus rejected shall be added to any new lot.

All firing tests will be at the Department's expense, but the expense of all other inspections and tests before acceptance must be borne by the contractors. Shells will be paid for by lots upon acceptance, the price per pound being that fixed by the contract. Ten per cent. will be reserved from each payment made the contractor until the completion of the contract.

Before final acceptance the interior of each shell shall be thoroughly covered with a suitable lacquer.

Accepted lots must be delivered f. o. b. cars, at the contractor's works, suitably protected against injury from weather or other causes during transportation.

WM. M. FOLGER,
 Chief of Bureau of Ordnance.

DECEMBER 30, 1892.

on 5" gun No. 12, using
 To each.

muzzle velocity	2310 f.s.
" "	2290 "
" "	2301 "
" "	2279 "
" "	2311 "
" "	2262 "

pressure, and 30 f.s.,

service charge of Registered
 can pressure 15.3 tons,
 probably to slight
 become somewhat

Pdr R.F.G. Fired with
 desk plate.

within 1" of lead, &
 to completely, lead &

Part of bournelet getting through. Point undeformed.
 Round (2). Shell soft to fill all over. First two-thirds

Round (6). Hard Haverized shell. Limiting charge of
175 M.N.-2. Shell penetrated
about 1.5" thick and 8"
and burst in earth below.

Round (7). Untreated
Shell exploded on face
body breaking up. No

Two untreated shell
Chusitto 14" plate. Penetrated

A Haverized shell
fired giving a penetration

A Haverized shell
same plate, giving 7"
broke up.

December 6.

Fired 5 common shells
B.L.R. Charge #678 S.M.

Round (1) Cast iron shell

Round (2) Steel shell, not hardened

Round (3) " " Lardened

Round (4) Cast iron shell

Round (5) Steel shell, Lardened

The cast iron shell
No. 2, not Lardened was
changed and was re-
Lardened was broken up

of having bulged, but without signs of having
struck anything. Shell No. 5, Lardened, recovered

entire, but with a bulge just below bournelet, irregu-
 diameter being 6.02604
 he was found to be
 erican Company, Har-

SPECIFICATIONS

FOR

10-INCH AND 12-INCH CAST-STEEL COMMON SHELL

(HADFIELD).

1. The shell are to be of domestic manufacture and made in accordance with drawings approved by the Bureau of Ordnance, and are to conform thereto within the tolerances marked thereon.
2. They must be made of the best quality of steel, and must be sound and free from cracks, blowholes, and all other defects seriously affecting their resistance and value for the purpose for which they are intended; this condition to be determined by the Government inspectors.
3. They are to be subject to inspection by the Government inspectors during all the processes of their manufacture, and to inspection and tests before acceptance, and the contractors shall furnish the inspectors with full facilities for such inspection and tests.
4. The castings must be suitably annealed so as to remove all strains and give a tough material. They must be carefully and thoroughly cleaned.
5. At the specified distance from the base a groove is to be turned for the driving band with the necessary roughening to prevent the band from turning on the shell. The driving bands must be of a good quality of copper; must be properly pressed into the before-mentioned grooves, preferably by hydraulic pressure, and must then be finished to the dimensions shown on the drawings.
6. The nose of the shell, after being properly machined, is to receive a gun-metal bushing of dimensions to take the fuse, as shown on the drawings. The base plug is to be so fitted, either by a lead ring or otherwise, as to make a gas-tight joint.
7. Each shell may be subjected to an internal water pressure of 200 pounds per square inch, and no leakage through the metal must result therefrom. To aid manufacture, the Government inspector will make a preliminary examination and apply this water pressure to the shell before they are machined, or otherwise finished, except as regards dressing and cleaning.
8. The shell must be carefully lined with a suitable lacquer.

in 5" gun No. 17, using
 To each.

muzzle velocity 2310 f.s.

" " 2290 "

" " 2301 "

" " 2279 "

" " 2311 "

" " 2262 "

pressure, and 30 f.s.,

erwise charge of Registered
 can pressure 15.3 tons,
 probably to slight
 become somewhat

Dr. R.F.G. Fired with
 deck plate.

within 1" of Lead, &

beyond that hard. - - - - - plate completely, Lead &
 part of bournelet getting through. Point undeformed.
 Round (2). Shell soft to fill all over. First two-thirds

Round (6). Hard Haweyized shell. Limiting charge of
1⁷/₈ M N-2. Shell penetrated
about 1.5" thick and
and burst in earth

Round (7). Untreated
Shell exploded on face
body breaking up. No

Two untreated shells
burst 14" plate. No

A Haweyized shell
fired giving a pen

A Haweyized shell
same plate, giving
broke up.

December 6.

Fired 5 common &
B.L.R. Charge #678 S

Round (1) Cast iron shell

Round (2) Steel shell, not

Round (3) " " Lard

Round (4) Cast iron shell

Round (5) Steel shell, L

The cast iron shell
No. 2, not hardened &
charged and was
hardened was broken

of having bulged, but without signs of having
struck anything. Shell No. 5, Lardened, recovered

2

9. The shell must be presented for acceptance in lots 100 in number, and from each lot not more than 5 shell may be selected for test.

10. The acceptance tests will be the following:

The shell shall be brought up to standard weight by filling with sand, salt, or other suitable non-explosive material, and shall then be fired, with the service charge and velocity, over a range or into a butt of sand or earth, and no shell so fired shall set up or break in the gun or afterwards. In case any shell selected for test fails to meet the above requirements, the lot from which it was selected may be rejected, and no shell from a lot thus rejected shall be added to any new lot.

11. In case the Government inspector so directs, one shell from any lot may be selected for physical tests, and the specimens taken from such shell must show on 2-inch specimen a tensile strength of from 63,000 to 76,000 pounds per square inch.

12. All firing tests will be at the Department's expense, but the expense of all the inspection and tests before acceptance must be borne by the contractor.

13. Shell will be paid for by lots on acceptance, the price per shell being that fixed by the contract. Ten per cent. will be reserved from each payment made the contractor until the completion of the contract.

14. Accepted shell must be delivered f. o. b. cars at the contractor's works, suitably protected against injury from weather or other causes during transportation.

15. Before the current manufacture of either caliber of shell is begun a small lot of ten (10) of that caliber shall be furnished to the Department for trial for the purpose of determining whether any changes in form or dimensions are desirable or necessary.

WM. M. FOLGER,
Chief Bureau Ordnance.

MARCH 22, 1892.

entire, but with a bulge just below bournelet, irregular in form, of about .98", the diameter being 6.52 to 6.64. In the last round the jump angle was found to be -10' 30". The steel shell were from American Company, hardened by Harvey process.

umber 7. Fired 6 rounds of common shell from 5" gun No. 12, using 26.75 lbs YZ-3. Height of all shell 50 lbs each.

Round (1) Cast-iron,	pressure	15.2 tons,	muzzle velocity	2310 f.s.
Round (2) Bliss, nose fuze	"	15.8 "	" "	2290 "
Round (3) Cast iron	"	15.4 "	" "	2301 "
Round (4) Bliss, nose fuze,	"	15.4 "	" "	2279 "
Round (5) Cast iron	"	15.3 "	" "	2311 "
Round (6) Bliss nose fuze	"	16.0 "	" "	2262 "

The mean gives .43 ton higher pressure, and 30 f.s., lower velocity for the Bliss shell.

umber 8. Fired 3 rounds from 5" gun, full service charge of Registered 152, & common cast-iron shell. Mean pressure 15.3 tons, mean velocity 2307 f.s. Due probably to slight change in powder it having become somewhat quicker.

umber 12. Test of Blake A.P. shell for the 6 Pdr. R.F.G. Fired with full service charge at a 3" steel deck plate.

Round (1). Shell soft to file to within 1" of lead, & beyond that hard. Penetrated plate completely, lead & part of bournelet getting through. Point undeformed.

Round (2). Shell soft to file all over. First two-thirds

of the projectile got through all right, but not all of base, part of a ring near base striking in plate. Round (3). Shell hard to greater distance back of Courrellet than first shell. Probably broke in gun as its fragments struck butt & hill-side in several places.

All shell showed internal strains not to be detected by file.

December 13. Tested 5" cases lots 2 and 3, cases passing successfully the tests to which they were subjected of 6 rounds each.

December 15. Test of Hotchkiss 10 Pdr. field gun - French design.

December 17. Test of first curved Hawey nickel steel 10" plate. Seams firmly to curved backing 3/8" thickness, bolts entered and set up hard.

Round (1). Hattys A.P. shell No. 46, 250 lbs, striking velocity 1800 foot seconds. Aimed and struck centre of plate smashing up, and head welding in. Core was opened out in plate from top to bottom, 1/2" in width at top, and 2" at bottom and passing tangent to impact. No signs of flaws in the metal or anything abnormal in the fracture, the cleavage

However being very irregular.

Round (2) Hattger A.P. shell, No 61, 250 $\frac{7}{8}$, striking ve-
locity 1900 f.s. Point of impact 18" from top, and 33"

from left. Projectile smashed on the plate
fragments, the head remaining

2. A through crack opened
of the plate, maximum width 1/2
direction.

No 51, 250 $\frac{7}{8}$, striking velocity 1900
bottom, and 26" from left

Projectile smashed on the plate
in. The upper left hand
thrown off laterally from
its origin in the crack de-
ing thence obliquely down
crack 3 on its upper left
not detached from the

the bolts; the lower left
off in a piece about 10"
24" high by 30" long
below point of impact,
led to the backing by one
diagonally downwards and

roughness of the metal in the interior as well
as hardness on the surface. A wide through crack was
also developed from impact 2, extending vertically down-
wards to the bottom of the plate, of a maximum width

of the projectile got through all right, but not all of base, part of a ring near base sticking in plate.

Round (3). Shell had to greater distance back of Courrellet than its fragments in places.

All shell protected by file.

December 13. Tested 5" case fully the tests each.

December 15. Test of Stotch

December 17. Test of first firmly to curve set up hard.

Round (1). Velocity 1800 ft plate smashed was opened out in width at top, and 2" at bottom and passing tangent to impact. No signs of flaws in the metal or anything abnormal in the fracture, the cleavage

However being very irregular.

Round (2) Hattzer A.P. shell, No 61, 250 $\frac{7}{8}$, striking velocity 1900 f.s. Point of impact 18" from top, and 33" from left edge of plate. Projectile smashed on the plate going into very small fragments, the head remaining welded in. Penetration 5.2. A through crack opened from the impact to top of the plate, maximum width 1/2" in an irregular or zigzag direction.

Round 3. Hattzer A.P. No 51, 250 $\frac{7}{8}$, striking velocity 1900 Point of impact 23" from bottom, and 26" from left edge of plate. The projectile smashed on the plate the head remaining welded in. The upper left hand corner of the plate was thrown off laterally from impact, the break taking its origin in the crack developed by round 2, passing thence obliquely down to the left tangent to impact 3 on its upper left hand side. This piece was not detached from the backing being still held by the bolts; the lower left hand corner was broken off in a piece about 10" square. A triangular piece 24" high by 30" long was broken off immediately below point of impact, but still remaining attached to the backing by one bolt, the fracture running diagonally downwards and back wards from the surface of the plate showing great toughness of the metal in the interior as well as hardness on the surface. A wide through crack was also developed from impact 2, extending vertically downwards to the bottom of the plate, of a maximum width

of 2". A crack $\frac{1}{4}$ " wide was opened between 1st & 2nd shot holes, whether through or not is impossible to say. The head of projectile of round 2 was shaken out of its hole.

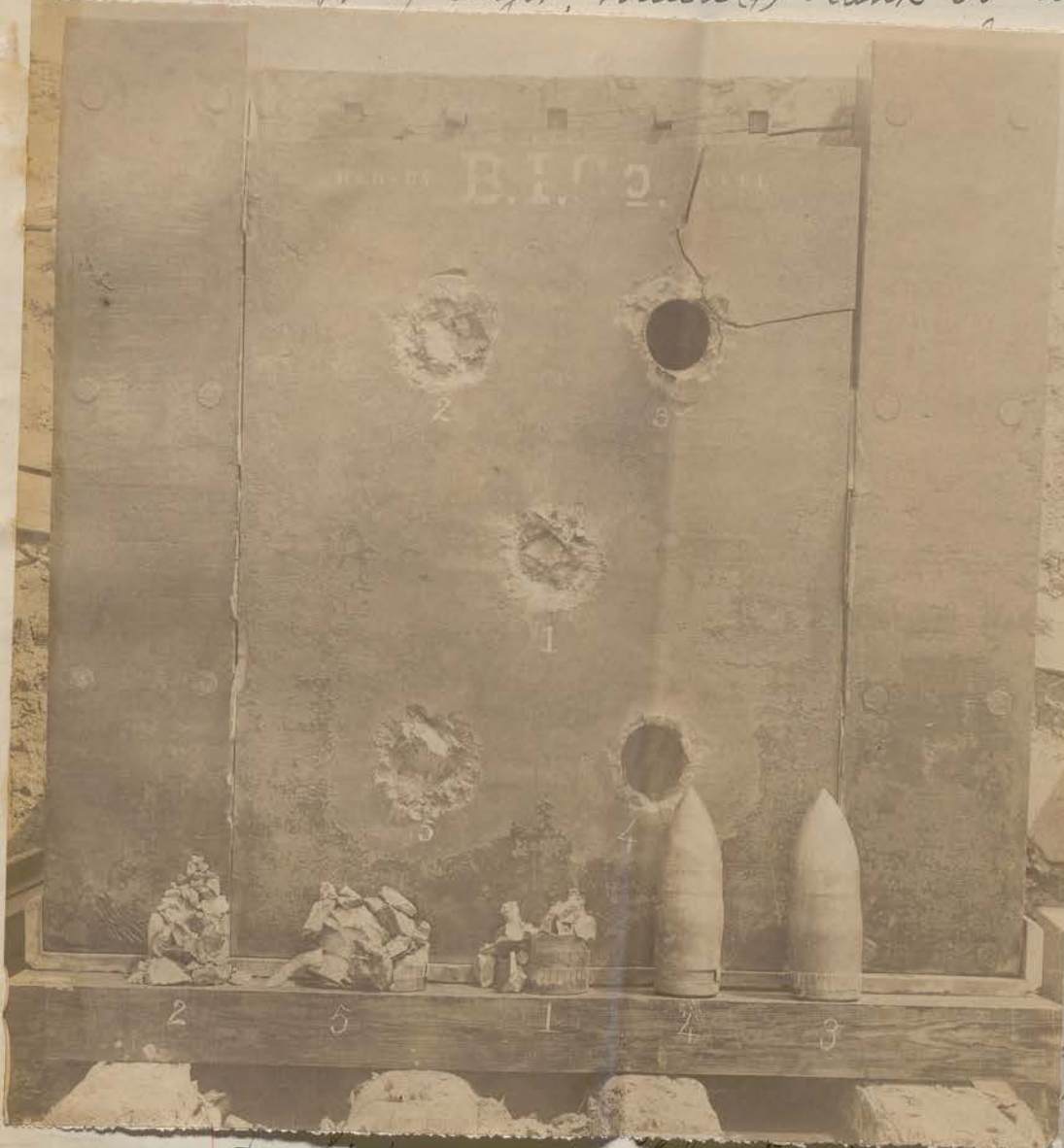
Round 4. Carpenter A.P. Special, 952-A, striking velocity 1900 f.s. Point of impact on middle line of plate 20" from right hand edge, projectile striking a slightly oblique blow & breaking up, depth of impact 6". A crack 1" wide was opened horizontally through right hand end of plate, passing through last impact, this end being moved bodily 1" to the right, but still remaining attached to backing. No fringe or bulge formed on front of the plate in any of the shots, the full Harvey effect being shown in each case.

The head of the second projectile as well as of the Carpenter were recovered, points entirely gone, and surface being changed to a rude hemisphere. Weight of recovered head of No. 2 was 28⁷⁵ of the Carpenter 63⁷⁵. The Carpenter was subjected to greater racking strains, striking more obliquely, but seems to have preserved its shape a little better, with a slightly greater penetration.

The backing was somewhat defective in that it had little longitudinal strength to resist lateral motion of the plate. The total striking directed against plate was 24417 foot tons, and it is considered that the plate did well to keep out all the shot successfully, which it did, badly as it was hammered.

Dec. 19. Test of Fletcher mount for 5" guns. Loading from either side.

(1) Fired 5 rounds - round (1) aimed shot at target 1500yds, round (2) blank 30° to left of target, round (3) blank 60° to left of target, round (4) blank 30° to left of target, round (5) blank firing from the left.



licated, loading

eded, to load,
g from left, 6

right, time - 22^s.
left - 22^s, delayed

price trained
ist 70° degrees be -

of 140° covered in

move 140°, & clamp
nds.

in elevation due

to firing caused by shifting of centre of gravity during recoil, & shock on front buffers in counter recoil. The "lost motion" in training gear prevents stopping short on target, but may in certain circumstances assist in giving final adjustment.

of 2". A crack $\frac{1}{4}$ " wide was opened between 1st & 2nd shot holes, whether through or not is impossible to say. The head of projectile of round 2 was shaken out of its hole.

Round 4. Carpenter A.P. Special, 952-A, striking velocity 1900 f.s. Point of impact on plate 20" from a slightly oblique impact 6". A crack through right hand last impact, this right, but still no fringe or bulge of any of the shots, shown in each case.

The head of the Carpenter gone, and surface hemisphere. Weight of the Carpenter 63 lbs greater racking strength but seems to have better, with a slight

The backing ~~was not~~ defective in that it had little longitudinal strength to resist lateral motion of the plate. The total striking directed against plate was 24417 foot tons, and it is considered that the plate did well to keep out all the shot successfully, which it did, badly as it was hammered.

Dec. 19. Test of Fletcher mount for 5" guns. Loading from either side.

(1) Fired 5 rounds - round (1) aimed shot at target 1500 yds. round (2) blank 30° to left of target, round (3) blank 60° to left of target, round (4) blank 30° to left of target, round (5) aimed shot at target. Loading from the left. Time of 5 rounds - 45 seconds.

(2) The above named rounds were duplicated, loading from the right - time 52 seconds

(3) Gun laid 20° to left of target, unloaded, to load, train & aim on target and fire - loading from left, time 20 seconds.

(4) Same as (3) but loading from right, time - 22.5.

(5) Three aimed rounds, loading from left - 22", delayed 8 to 10 seconds by smoke.

By means of hand training wheel, piece trained through arc of 140° in 23 seconds, the first 70° degrees being covered in 10 seconds.

Friction discs unclamped, an arc of 140° covered in 10 seconds.

Friction discs clamped, to unclamp, move 140°, & clamp again ready for hand wheel - 22 seconds.

An alteration of from -20' to +18' in elevation due to firing caused by shifting of centre of gravity during recoil, & shock on front buffers in counter recoil.

The "lost motion" in training gear prevents stopping short on target, but may in certain circumstances assist in giving final adjustment.

Time gained in use of friction discs not of sufficient importance to give them practical value. If they are to be retained, a longer lever with single motion for throwing in and out of gear would be preferable. See note 1.

Centre lifting bolt exercises no appreciable influence on facility of training unless screwed up so as to bind hard. Gun being loaded 20 seconds time were required to change from extreme elevation to extreme depression.

No change in in number of revolutions of hand wheels is desirable.

Dec. 24 Test of Carpenter 10", A.P. shell lot 2

The sample shell # 294, was fired was fired at a 10" steel plate with a striking velocity of about 1320 f.s. Projectile passed through plate and stopped in backing. It was recovered entire entire, shortened .37", maximum increase of body .12". Two fine cracks in shoulder of ogival.

Dec. 27. Tested 5" cases lot 4, representative passing satisfactorily, shortening .18" after 6 rounds.

Dec. 28. Finished test of "New York" turret mount, guns Nos. 20 and 21 being used. Twenty rounds in all were fired from it, nine from the left hand, and eleven from the right hand side, angles of elevation varying from level to 13°. Recoil, ^{counter} always smooth and easy. Maximum re-

coil 27" for left carriage and 27 1/4 for right. Both guns were fired simultaneously four times, twice at elevations



12° 30' each, the mounting or vibration of any together and strike to great elevation. Provisional guides while gun is in the hole should be bored carriage, to allow the reached

for velocity & pressure. Press down the range at an m of pair.

587 f.s.	recoil 25 1/2"
46 f.s.	" 26 3/4"
92 f.s.	" 27 1/4"
1034 f.s.	" 27 1/4"
ditions, with 8" B.L.R. # 21,	
ns, m.v. 1709 f.s.	recoil 26 3/4"
" " 1902 f.s.	" 26 3/4"
" " 1974 f.s.	" 27"

Dec. 29. Tested VZ-4, in 5" R.F.G. # 10, common shell of 5-0 75, elevation 1°, recoil 9 1/2".

Round (1). 20 75, pressure 11.4, tons, m.v. 2033 f.s.
Round (2). 23 75 " 13.6 " " 2143 "

Time gained in use of friction discs not of sufficient importance to give them practical value. If they are to be retained, a longer lever with simple motion for throwing ~~be~~ preferable. See note

Centre lifting bolt and facility of training in gun being loaded change from extreme to no change in in wheels is desirable.

Dec. 24 Test of Carpenter 10"

The sample shell, a 10" steel plate with 1320 f.s. Projectile passed in backing. It was rec .37", maximum increase in shoulder of ogival.

Dec. 27. Tested 5" cases lot 4, ~~re~~ only, shortening .18" after

Dec. 28. Finished test of "New York" and 21 being used. Twenty rounds in all were fired from it, nine from the left hand, and eleven from the right hand side, angles of elevation varying from level to 13°. Record ^{counter} always smooth and easy. Maximum re-

coil 27" for left carriage and 27 $\frac{1}{4}$ " for right. Both guns were fired simultaneously four times, twice at elevations of 3°, and twice at elevations of 12°30' each, the mount standing the strain with yielding or vibration of any kind. Projectiles appeared to fly together and strike together whether at small or great elevation. Provision should be made for filling cylinders while gun is run out. To this end a suitable hole should be bored in the rear transom of the top carriage, to allow the filling hole and its plug to be reached.

28. Tested U.S.-19, in 8" gun, No. 20 for velocity & pressure. Projectile, common shell, 250 $\overline{\text{lb}}$, firing down the range at an elevation of 1°. Mounted as right gun of pair.

Round (1) 75 $\overline{\text{lb}}$, pressure 8.5 tons, m.v. 1687 f.s., recoil 25 $\frac{1}{2}$ "

Round (2) 90 $\overline{\text{lb}}$, " 11.1 tons, " 1846 f.s., " 26 $\frac{3}{4}$ "

Round (3) 103 $\overline{\text{lb}}$, " 14.3 " , " 1992 f.s. " 27 $\frac{1}{4}$ "

Round (4) 106 $\overline{\text{lb}}$, " 16.0 " , " 2034 f.s. " 27 $\frac{1}{4}$ "

Tested U.F. 20, under same conditions, with 8" B.L.R. # 21, mounted as left gun of pair.

Round (1) 75 $\overline{\text{lb}}$, [mean] pressure 9.0 tons, m.v. 1709 f.s., recoil 26 $\frac{3}{4}$ "

Round (2) 90 $\overline{\text{lb}}$, " " 13.5 " , " 1902 f.s., " 26 $\frac{3}{4}$ "

Round (3) 98 $\overline{\text{lb}}$, " " 14.4 " " 1974 f.s., " 27"

Dec. 29. Tested VZ-4, in 5" R.F.G. # 15, common shell of 50 $\overline{\text{lb}}$, elevation 1°, recoil 9 $\frac{1}{2}$ ".

Round (1). 20 $\overline{\text{lb}}$, pressure 11.4, tons, m.v. 2033 f.s.

Round (2). 23 $\overline{\text{lb}}$ " 13.6 " , " 2143 "

Dec. 29.

Test of V2-4, continued.

Round (3), 26 lb , pressure 14.8 - Band Strip & missed screwRound (4), 26 lb , " 14.8 tons, M.V., 2304.Round (5) 26 lb " 15.0 tons, M.V. 2309.

Lot recommended to be accepted and charge fixed at 26 lb .

Dec. 29.

Test of Carpenter 10" A.P. shell, lot 3, # 338. Fired at same plate as used in test of lot 2. Struck and wrecked plate and backing, & found about $\frac{1}{4}$ mile beyond. Striking velocity 1350 f.s. Shortened .54", bournet increased .12", body .10". Two fine longitudinal cracks developed down ogival to bournet, & about 2"-3" apart, & 6" long.

Dec. 29.

Exploded 2-4" American Projectile Co Shrapnel, lot 1, in explosion chamber using charge of 100 grammes smokeless powder M.N-2. Both heads blown off & broken into pieces balls scattering well. Electric V.S. primers & dry battery used.

Dec. 31

Continued test of 6 Pdr. breech-block firing 25 rounds of old ammunition, three of the primers being weakened so that blow backs should occur. Block worked well, $8\frac{3}{4}$ " spring & $\frac{1}{2}$ " liner. No misfires.

Jan. 3, 93

Fired 9 rounds, common shell, 460 grammes charge of

mn-2, 3 primer weakened for blow-back. Block

SPECIFICATIONS

FOR

ARMOR-PIERCING PROJECTILES

FOR THE

UNITED STATES NAVY.

The projectiles and their base plugs must be of forged steel and must be finished to the dimensions shown on the accompanying blue prints, within the limits of tolerance stated thereon. The cavities must be concentric with the exteriors.

The band scores and extractor scores must be cut, but the projectiles are not to be banded.

The right is reserved to alter the shape of projectiles, not in course of manufacture, from time to time, as the Department may desire, provided the new forms be not materially more difficult to make than the present ones. These changes in form are not to increase the cost of the projectiles.

The Department also reserves the right to alter the number of projectiles of each caliber by exchanging projectiles of one caliber, when not in course of manufacture, for those of another caliber, at the contract prices, provided the total value of projectiles delivered be not lessened by such exchanges.

The shells must be sound and free from cracks, blowholes, and all other defects seriously affecting their resistance and value for the purpose intended. This condition to be determined by the Government inspectors. A water test may be used for this purpose.

Lots for the firing test will consist of two hundred (200) 4-inch, two hundred (200) 5-inch, two hundred (200) 6-inch, one hundred and fifty (150) 8-inch, one hundred (100) 10-inch, seventy-five (75) 12-inch, or fifty (50) 13-inch.

On the completion of each lot two shells will be selected from the lot by the Government inspector for the firing test; the shells chosen being those which, in the opinion of the inspector, are least likely to pass the required test.

The target used in the firing test will in each case consist of a steel armor plate properly bolted and secured to an oak backing of suitable thickness and the whole properly supported. The thickness of the steel plates used in testing 4-inch, 5-inch, 6-inch,

*Stekiss field gun to
Charge 1 1/4 pounds*

*ix field gun, charge
Carriage.*

*number 2-4" American
base fuze & U.S.
shell powder.*

- Shell 61*
- " 6*
- " 2 1/2*
- " 16 1/2*
- " 29 1/4.*

*Stekiss R. F. G.
very satisfactory and
Difficulty in ex-
but remedied by
al of cushion spring
benefit to the block.
fire with [Block]
Block rapidly a*

*number of tubes functioning well in all cir-
cumstances # Note No. 2.*

Dec. 29.

Test of V2-4, continued.

Round (3), 26

Round (4), 26

Round (5) 26

Lot recom

at 26 ~~ft~~.

Dec. 29.

Test of Bay
same plate as
wicked plate
beyond. Striking
let increased.
developed down
part, 4 6" long

Dec. 29.

Exploded 2-4
in explosion
smokeless powder
& broken in
the V.S. journal

Dec. 31

Continued test
rounds of old
being weaker
Block worked
fired.

Jan. 3, 93

Fired 9 rounds, common shell, 460 gramme charge of

2

8-inch, 10-inch, 12-inch, and 13-inch shell, will be respectively 5-inch, 6-inch, 7-inch, 9-inch, 11 $\frac{1}{2}$ -inch, 13 $\frac{1}{2}$ -inch, and 14 $\frac{1}{2}$ -inch.

PRIMARY TEST.

One or both of the shells selected from each lot, weighted to 33 pounds for the 4-inch, 50 pounds for the 5-inch, 100 pounds for the 6-inch, 250 pounds for the 8-inch, 500 pounds for the 10-inch, 850 pounds for the 12-inch, and 1,100 pounds for the 13-inch, will be fired against the proper target, with a striking velocity of 1,800 f. s. for the 4-inch, 1,925 f. s. for the 5-inch, 1,725 f. s. for the 6-inch, 1,575 f. s. for the 8-inch, 1,525 f. s. for the 10-inch, 1,500 f. s. for the 12-inch, and 1,475 f. s. for the 13-inch, and at an angle with the plate as nearly corresponding with the normal as conveniently practicable. The velocities given are supposed to be fully sufficient for perforation of the target if the shell is of good quality, the backing being 36 inches thick.

If it be found that the velocity be too low for an uninjured projectile to pass through plate and backing, then the Department may increase the velocity. If it be found that the velocity be too great, the projectile causing damage beyond the target, the Department may then reduce the velocity. If it be found that the thickness of backing (the projectile having passed through the plate), does not add to the severity of the test, the Department may, if it so desires, reduce the thickness of the backing.

If the first shell fired passes through the target unbroken and without serious distortion or cracks, the lot from which that shell was selected will be provisionally accepted. (The expression, "provisionally accepted," grants to the Department the right to call upon, within three months, the contractors to replace a lot of projectiles if subsequent to their acceptance it be found in experimental or test firing at plates that they lack uniformity of quality.)

If the first shell is broken or seriously distorted or cracked, but all parts of it, exclusive of expansion band, pass through the target, then the second shell from the lot will be fired, and if this shell passes unbroken and without serious distortion or cracks through the target the lot will be provisionally accepted. (Provisionally-accepted projectiles mentioned in this paragraph will be under the conditions as to acceptance named in the preceding paragraph.) But if it fails to do so the lot will be rejected, or upon application subjected to the secondary test.

If the first shell breaks on impact and any part thereof fails to pass through the plate and its backing, or if the shell so fails without breaking, then the lot will be rejected, or, upon application, subjected to the secondary test.

mn-2, 3 fuses weakened for blow-back. Block

3

SECONDARY TEST.

If upon primary test a lot of projectiles should fail to pass, the contractor shall have the right to demand a secondary test in all respects similar as to method of selection and firing details to the primary test. If a lot of projectiles should fail upon secondary test, their rejection shall be final.

The importance of distortion or cracks will be judged solely by the Government inspectors.

The steel plates to be used in the tests above mentioned will be of the most suitable quality of simple steel armor plate oil tempered and annealed.

Lots of projectiles rejected by the aforementioned tests are condemned, and no projectiles from rejected lots will be added to new lots.

Trial projectiles selected by the Government inspector from the different lots will be shipped at the expense of the Department to the Naval Proving Ground, at Indian Head, Md., for test. The Department will have these projectiles submitted to the proper ballistic test within thirty days from their arrival at the Proving Ground. Trial projectiles, which pass the required test, will be paid for with the lots to which they belong, provided the lot is accepted on the successful trial of one projectile, but when, as specified in the ballistic test above mentioned, the trial of a second shell is necessary, but one trial projectile will be paid for with the accepted lot.

The lots of projectiles will not be finally accepted until a month has elapsed from the date of their completion, and only such projectiles will be paid for as are in good condition at this time.

Trial projectiles, which in the ballistic test do not cause the acceptance of their respective lots, will not be paid for.

Accepted lots of projectiles will be delivered f. o. b. cars at the contractor's works.

Projectiles will be paid for by lots upon acceptance. The price paid will be at the rate fixed by the contract for the caliber. Ten per cent. will be reserved from each payment made the contractor until the completion of the contract.

The contractor will be allowed two months from the date of notification of the rejection of any lot within which to replace it.

WM. M. FOLGER,

Chief of Bureau of Ordnance.

NAVY DEPARTMENT,

WASHINGTON, D. C.,

November 19, 1892.

*Stehkiss field gun &
Charge 1 1/4 pounds*

*for field gun, charge
Carriage.*

*number 2-4" American
base fuze & U.S.
shell powder.*

shell 61

" 6

" 2 1/2

" 16 1/2

" 29 1/4.

Stehkiss R. F. G.

*very satisfactory and
difficulty in ex-
but remedied by*

*al of cushion spring.
benefit to the block.*

fire with [block]

Block rapidly a

*number of tubes functioning well in all cir-
cumstances. # Note No. 2.*

Dec. 29. Test of V2-4, continued.

Round (3), 26

Round (4), 26

Round (5) 26

Lot recom

at 26 $\frac{7}{8}$.

Dec. 29.

Test of Cap,
same plate
wicked plate
beyond. Striking
let increased.
developed do
part, 7 6" long

Dec. 29.

Exploded 2-
in explosion
smokeless pow
& broken in
the V.S. pr

Dec. 31

Continued to
rounds of o
being weak
Block work
fired.

Jan. 3, 93

Fired 9 rounds, common shell, 460 gramme charge of

mn-2, 3 joints weakened for blow. back. Block

SPECIFICATIONS
FOR THE MANUFACTURE OF
ONE-POUNDER R. F. GUN MOUNTS.

Hydraulic Top Carriages and Adapters.—To be made of bronze of the best quality.

The hydraulic cylinder, when machined and ready for issue, must stand a water test of 2,000 pounds per square inch without weeping.

Springs.—To be made of steel. Outside diameter of coil not greater than 2.15 inches; inside diameter of coil not less than 1.30 inches. When compressed to 8.50 inches in length must exert a pressure of about 100 pounds and be capable of standing a further sudden compression to 5.25 inches in length without a permanent set.

Cage Stands and Deck Circles.—To be made of cast steel and must possess the following physical characteristics: Tensile strength, 70,000 pounds per square inch; elastic limit, 30,000 pounds per square inch; elongation, 15 per cent.; reduction of area, 20 per cent.

Appendages.—To be made as per drawings, and of the best quality of material.

The recoil cylinder must not show any appearance of binding or wedging.

The gun, when screwed into the sleeve, must be a snug fit, and the axis of the gun and the axis of the recoil cylinder must be in the same vertical plane.

The sleeve must fit the slides of the oscillating bed snugly.

The axis of the trunnions must be at right angles to the axis of the pivot.

The slides of the oscillating bed must be parallel and in the same plane; and the trunnions must fit snugly in their seats.

Drawings.—The Hotchkiss Ordnance Company will prepare and submit to the Bureau of Ordnance complete designs or drawings of the several parts of the mounts. The Bureau may suggest modifications in these designs, and the company will accept the modifications, provided the essential features of the system and its proper working will not, in the opinion of the company, be unfavorably affected thereby. Standard drawings must be approved by the Bureau of Ordnance, with any modifications as above, and must be accepted by the company before manufacture affecting the proposed modifications is commenced.

Hotchkiss field gun &
Charge 1 1/4 pounds

Hotchkiss field gun, charge
Carriage.

Number 2-4" American
base fuze & U.S.
shell powder.

Shell 61

" 6

" 2 1/2

" 16 1/2

" 29 1/4.

Hotchkiss R. F. G.

very satisfactory and
Difficulty in ex-
but remedied by

al of cushion spring.
benefit to the block.

file with [Block]

Block rapidly a

number of trials functioning well in all cir-
cumstances # Note No. 2.

Dec. 29.

Test of V2-4, continued.

Round (3), 26

Round (4), 26

Round (5) 26

Lot recom

at 26 ~~75~~.

Dec. 29.

Test of Cas

same plate

wrecked plate

beyond. Strike

let increased.

developed do

part, 7 6" long

Dec. 29.

Exploded 2-

in explosion

smokeless po

r broken in

the V.S. pu

Dec. 31

Continued to

rounds of

being weak

Block work

fired.

Jan. 3, 93

Fired 9 rounds, common shell, 460 gramme charge of

Inspectors, &c.—The Department shall have the right to keep agents or inspectors at the works where material is produced and where the mounts are built, and at the proving ground who shall have free access to all parts thereof and who will be permitted to examine freely the raw material, to witness all the processes of manufacture, and to examine all the contractor's records with reference to such matters.

A statement of work and contractor's tests, to be commenced and in progress each day, must be furnished to the chief inspector.

All information and reports, written or verbal, concerning material, tests, processes, etc., and all assistance that the inspectors may require from the contractor or his employes, shall be rendered free of charge to the Department.

The inspectors will be supplied, free, with suitable office room at the various works and with such plain office furniture as may be necessary to the proper transaction of their business as agents of the Department.

If the chief inspector present considers that any of the work is not in accordance with the contract, he will so inform the contractor at once, and immediately thereafter give his reasons for so doing in writing, both to the Department and to the contractor. Any work done by the contractor on the material in question, after the verbal notification, shall be at his own risk.

Except as hereinafter provided, all tests, measurements, etc., shall be made at the expense of the contractor, under the observation and supervision of the inspectors, and with the contractor's gauges and instruments. The inspector has the right to verify all testing or gauging instruments at any time during which they may be in use by him for "receiving inspections" of work or material.

Inspections shall be made at any time or times that the inspectors shall see fit, and without notice being given; but the inspectors must use discretion and not interfere unnecessarily with the progress or control of work.

The obligation is upon the contractor to satisfy the inspector as to the correctness of everything and its accordance with the terms of the contract.

All machined work must be examined by the agents of the contractor for workmanship and material and found to be up to the contract standard before it is submitted to the inspector.

The contractor has the right to submit machined work to the inspector at such times and in such lots as shall be most convenient to him. If, however, the inspector considers that work ready for

mn-2, 3 frames weakened for blow-back. Block

3

inspection is allowed by the contractor to accumulate in inconvenient quantities before being presented for inspection, he will have the right to require that said work be presented for inspection in such lots and at such times as he may find convenient.

Lots of machined work shall be submitted with the gauges and instruments used in the contractor's inspection; and if these are not satisfactory, the Department may provide (at its own expense) and use any others it may see fit.

Material or work, as condemned by the inspectors, shall not be embodied in the articles to be furnished the Department.

The company shall at all times render such assistance to the inspectors as the latter may require in the prosecution of their duties as they understand them.

The inspector is to decide, in the first instance, as to the results of all official tests, but if he is in doubt he may refer the matter to the Department.

Manufacture and Inspection.—The material used in and about the mounts, other than that already specified, shall be of the best quality for the various purposes, and shall be free from cracks, flaws, blow holes, and all other defects, and must be of domestic production.

Whenever, during the manufacture of the mounts, there shall be any departure from the standard drawings submitted to the Bureau, arising either from correction of errors or for manufacturing reasons, correct drawings which truly represent the mounts as actually produced shall be made by the contractor as soon as practicable, and be furnished to the Bureau.

During the progress of the work the material of all kinds will be subjected to inspection for defects of material and workmanship, and finished articles will be rigidly inspected for defects of any sort in material, workmanship, and proper working of mechanism and fit of the mechanism.

Interchangeability of Parts.—All similar parts of mounts must be interchangeable one with another, and it is the duty of the contractor to demonstrate this to the satisfaction of the inspector.

Marks on Mounts.—The following marks will be made on each mount:

Top mount—

On top of the cylinder:

No. —
(Place of manufacture.)
(Anchor.)
(Date.)

Attkiss field gun to
Charge 1 1/4 pounds

ix field gun, charge
Carriage.

umber 2-4" American
e, base fuze & U.S.
shell powder.

shell 61

" 6

" 2 1/2

" 16 1/2

" 29 1/4.

Attkiss R. F. G.

very satisfactory and
Difficulty in ex-
but remedied by

al of cushion spring.
benefit to the block.
file with [block]

Block rapidly a

number of tubes functioning well in all cir-
cumstances # Note No. 2.

Dec. 29. Test of V2-4, continued.

Round (3), 20

Round (4), 20

Round (5) 20

Lot recom

at 26 $\frac{1}{2}$.

Dec. 29.

Test of Car

same plate

wrecked plate

beyond. Strike

let increased.

developed do

part, 7 6" long

Dec. 29.

Exploded 2-

in explosion

smokeless po

r broken in

the V.S. pm

Dec. 31

Continued to

rounds of o

being weak

Block work

fires.

Jan. 3, 93

Fired 9 rounds, common shell, 460 gramme charge of

4

On left-hand side of pivot saddle:

No. —

(Place of manufacture.)

(Anchor.)

(Date.)

(Inspector's initial.)

(One-pounder mark —.)

Cage stands—

On the "bell" below the fillet:

No. — Wt., — lbs.

(Place of manufacture.)

(Anchor.)

(Date.)

(Inspector's initials.)

Deck circles—

On upper side of circle:

No. — Wt., — lbs.

(Place of manufacture.)

(Anchor.)

(Date.)

The Bureau will supply the information as to the serial numbers and mark of the mounts; and also as to the size of the letters and marks to be used.

The proof firing shall consist of five shots with service ammunition.

Previous to final acceptance by the Department, the company is to give a written guarantee of the efficient performance of all material, and is to make good any defects or failures clearly and solely due to imperfect material or workmanship furnished by the company that may occur within one year of the time when any article may have been first put on board ship for service.

During the year referred to the Department may institute any tests and proofs that it may think necessary to show clearly that the strength, endurance, efficiency, and accuracy of manufacture of the mounts and accessories are amply sufficient for all the requirements of service and that all articles furnished are of the best quality.

The Department may waive any tests that it pleases.

If any objects, operations, machines, or methods employed by the contractor for this manufacture, production, etc., are protected by caveats, patents, or otherwise, the contractor is to save the Department harmless against all claims of patentees, or others, with regard to such matters.

No action of the Department, as described herein, shall be construed as in any way relieving the company from the responsibility of producing thoroughly efficient and satisfactory mounts and articles pertaining thereto.

WM. M. FOLGER,

Chief of Bureau of Ordnance.

DECEMBER 31, 1892.

mn-2, 3 primers weakened for blow. Backs. Block functioned well, no misfires.

January 3. Fired 20 rounds 10 Pdr. Hatchkiss field gun to test carriage and mechanism. Charge $1\frac{1}{4}$ pounds U.D-6.

Jan. 4. Fired 10 rounds 10 Pdr. Hatchkiss field gun, charge $1\frac{1}{4}$ to U.D-6, testing gun & carriage.

Burst in explosion chamber 2-4" American Company common steel shell, base fuze & U.S. electric primer. Charge $1\frac{7}{8}$ to shell powder.

No. pieces 1st shell 59, 2d shell 61

No " band " 4, " " 6

Weight heaviest " $2\frac{1}{4}$, " " $2\frac{1}{2}$

" 10 " " $15\frac{5}{8}$ " " $16\frac{1}{2}$

" all pieces " $29\frac{1}{4}$ " " $29\frac{1}{4}$.

Jan. 11. Report on 6 Pdr. Block for Hatchkiss R. F. G.

The action of the block very satisfactory and preferable to the old form. Difficulty in exploding primers at first but remedied by stronger spring and removal of cushion spring. The latter probably of little benefit to the block. Tested with deliberate & rapid fire with [Block] blow-backs, & by working block rapidly a number of times functioning well in all circumstances. # Note No. 2.

Jan. 12.

Report of Hatchkiss 10 Pdr. Field gun.

Gun and carriage satisfactory, light, strong, smooth flight for projectile, and good velocity about 1180 feet with chamber pressure of 8 tons & charge of 1.25 lb powder.

Breech mechanism not at all satisfactory. Safe & strong but hard to work on account of its low position & the horizontal push necessary. Loaders hand in danger of being nipped. Extractor weak. Separate primer a disadvantage making another motion necessary to loading, and the gas check not efficient. Sights not satisfactory, awkward to work & having unnecessary parts. The rope breaks awkward & requiring too much time to manipulate. Drag ropes good & convenient. On hard ground piece shoots well, on soft ground trail buries & shot flies high. Limber & boxes strong & satisfactory. Pioneer's axe, pick & shovel, & rammer & sponge carried on limber.

Recommendations: The breech mechanism to be fitted on the slotted screws principle, with a firing pin. The sight bar to slide up & down without gearing & fixed by ^{friction} clamp on breech, working with one motion, drift angle to be allowed for without milled head for wind allowance. The cartridge cases to be solid drawn & fitted with percussion primer. Brakes fitted to carriage.

instead of check ropes. The ammunition boxes to be
 of sheet metal instead of wood. The keys for boxes
 of wheels, and to be
 Use of shafts not
 as superior to any

Mr McCully

SPECIFICATIONS

FOR

Wrought-steel 4-inch, 5-inch, and 6-inch Shrapnel.

WASHINGTON, D. C., August 28, 1893.

The body of the shrapnel must be of wrought steel and the powder tube of cast iron, and must be finished to the dimensions shown on the accompanying blue prints numbered 5464, 6915, and 5463, within the limit of tolerances stated thereon.

Where no tolerances are mentioned they must be as near to standard dimensions as careful machining will make them, or as the requirements of the parts warrant. This to be determined by the Bureau of Ordnance or its representative.

The fuse holes must be tapped, unless otherwise arranged, and the shrapnel banded.

The steel used must be of the same quality and grade as that used for the wrought-steel shell.

The castings for the powder tubes must be of good quality, free from defects, and as smooth on the interior as the best iron castings, and rejection for such defects shall be final.

The bullets must be uniform in size within tolerances determined by the inspector, and none are to exceed in diameter the dimensions shown on the prints.

The shrapnel and all parts, including hidden threads, are to be subject to inspection by the Government inspectors during all the processes of manufacture, and to inspection and tests before acceptance; and the contractors shall furnish the inspectors with all facilities for such inspection and tests.

The shrapnel of each caliber are to be presented for acceptance in lots of 500.

One per cent. of each lot presented, to be selected by the inspector, to be tested as follows for acceptance for the lot:

One shrapnel to be burst in explosion chamber, to observe character and completeness of burst.

Two to be blind loaded and fired with service charges. The shell to be recovered to observe action in the gun and action of band. The body must show no signs of taking the rifling and the bands must remain intact and not slip.

Catchkiss R. F. G. Tests
 k, and generally
 on the old style # note 2.

ell lot 4, fired at a
 ing velocity of 1300 f/s.

No. 379 fired. Shortened
 body, 24". Shell without
 only set up. The shell
 In the gun, striking
 e to get home.

o. Shrapnel, 2 of lot
 st lot 1, & of lot 2 was
 iter of black shell
 shrapnel were blown
 t screw thread leaving
 reventing issue of balls,
 tested much deformed
 shell of lot 1, charge 130

grammes shell powder was set up well, effected all
 balls scattering them well.

Jan. 12.

Report of Hatchkiss 10 Pdr. Field gun.
 Gun and carriage satisfactory light stroke
 smooth fly
 about 1180
 + charge of
 Breech -
 Safe & strong
 of its low
 necessary. I
 nipped. Extra
 disadvantage
 to loading,
 Sights not
 unnecessary
 requiring to
 ropes good &
 shoots well,
 shot flies
 factory. Pion
 sponge carri
 Reconnen
 fitted on the
 firing pin
 without gear
 ing with on
 for without
 The cartridge cases to be solid drawn & filled
 with percussion primer. Brakes fitted to carriage

2

Two to be loaded and fused, and fired with service charges through wood or metal-resistance targets to observe character of burst and cone of dispersion.

These tests must in all cases come up to the standard set by the experimental lots, and the number of shrapnel selected for test may be increased or decreased, or the tests discontinued, as the Department may determine.

All firing tests to be at the Department's expense, but the expense of all other inspections and tests before acceptance must be borne by the contractors.

Payment and shipment will be as per contract, and in lots as herein specified.

All fuse holes must be plugged with a satisfactory wood or metal plug before shipment.

Powder chamber to be suitably lacquered, and the shrapnel must be protected against injury from weather or other causes during transportation.

All changes in design or dimensions must obtain the Department's approval before embodiment in the projectile.

Approved:

W. T. SAMPSON,
 Chief of Bureau of Ordnance.

Accepted lots must be delivered f. o. b. cars, at the contractor's works, suitably protected against injury from weather or other causes during transportation.

W. T. SAMPSON,
 Chief of Bureau of Ordnance.

instead of check ropes. The ammunition boxes to be of sheet metal instead of wood. The keys for boxes on limber to be placed clear of wheels, and to be made as short as possible. Use of shafts not recommended. Recommended as superior to any service gun of the type.

m. 14. Report on block for 1 Pdr. Hatchkiss R. F. G. Tests resembling that of 6 Pdr. block, and generally same findings. Improvement on the old style # note 2.

m. 24. Test of Carpenter 10" A.P. shell lot 4, fired at a 10" steel plate with a striking velocity of 1300 ft. s. Penetrating plate & backing. No. 379 fired. Shortened .52", bownelet increased .16" body, 24". Shell without cracks, symmetrical & uniformly set up. The shell was very difficult to load in the gun, striking at origin of rifling & hard to get home.

Exploded 3, 4" American Co. Shrapnel, 2 of lot 1, and 1 of lot 2. Charge of 1st lot 1, & of lot 2 was 110 grammes m. n. 2, with igniter of black shell powder. The heads of these shrapnel were blown off, separating from rest at screw thread leaving the latter in the walls, so preventing issue of balls, about half of which were ejected much deformed through the small opening. 2d shell of lot 1, charge 130 grammes shell powder broke head up well, ejected all balls scattering them well.

m.P. = 12.1

" not obs.

" " "

" " "

" 11.8

" 17.5"

" 11.1

" not obs.

" " "

m.P. 12.7

m.P. not obs.

" 10.5"

7 130 grammes

re. A

deck

inch.

ugh

A

A larger

shell

Jan. 30. Test of 10" Carpenter A.P. shell lot 5 fired at the same plate as lot 4. Plate was badly cracked & very weak. Charge 70⁷⁸ U.F. 20, striking velocity very low probably 800 or 900 f.s. Penetrated plate & backing, breaking plate up badly. Shell recovered entire, & symmetrical, shortened .08", increased in diameter .03"

Fired one 5" blunt point, American Co. Common shell at 2-3" ^{steel deck} plates backed by about 8' of earth, striking velocity 2250 f.s. Struck plates & passed through earth backing & picked up 20' beyond, rolled up into a ball on account of softness. Plates broken up into numerous pieces, due to inferiority of quality of metal.

Jan. 31. Exploded 2-4" American Co. Common shell in explosion chamber charge 17⁷⁸ shell powder.

No. pieces	1st shell	21	2d shell	30
Weight heaviest	"	7 ³ / ₄	"	4
" 10 "	"	23 ³ / ₄	"	22
" all pieces	"	30 ³ / ₈	"	31 ⁷ / ₈

Feb. 1. Exploded in explosion chamber 2-6" American Co. Common shell, charge 7⁷⁸ shell powder

No. pieces	1st shell	42	second shell	50
Weight heaviest piece		13 ¹ / ₂	"	11
" 10 "	"	58,	"	50
" all pieces		89,	"	86 ¹ / ₂

Feb. 3.

Test of YZ-5, for 5" R.F.G.

Round (1), 2075, pressure 15.0, muzzle velocity 2103

" (2) 2075 " 15.0, " " 2092

Rejection of lot recommended.

Feb. 12, 3,

Test of YRA-3, in Hotchkiss 1 Pdr. R.F.G.

3 rounds 125 gr. each Loading shell 510 gr. M.V. = 1552 f.s. M.P. = 12.1

1 " 125 gr. Common " 454 " " 1689, " not obs.

1 " 130 gr. " " 454 " " 1685, " " "

5 " 135 " " " 455 " " 1717, " " "

1 " 130 " Loading " 455 " " 1610, " 11.8

1 " 135 " " " 455 " " lost " 17.5"

1 " 135 " " " 455 " " 1522 " 11.1

1 " 140 " Common " 455 " " 1690 " not obs.

2 " 145 " " " 455 " " 1743 " " "

1 " 145 " Loading " 455 " " lost M.P. 12.7

4 " 150 " Common " 455 " " 1767 M.P. not obs.

1 " 150 " Loading " 455 " " not obs. " 10.5"

On January 31, in firing the 1 Pdr. charge of 135 grams the muzzle sight was by accident left in the bore. A pressure of 17.5 tons was developed in the piece, deck bolts pulled out & the muzzle swelled .05" of an inch. The sight weight nearly a pound.

In the recommendation of this powder, though judged irregular, the acceptance was urged, with a charge of 145 grammes, giving an M.V. of 1700 f.s. A larger charge though could have been used if the shell would have held it.

Jan.

Feb. 11, '93.

Test of 14-inch, nickel steel, Harveized plate.

Tested with 10-inch gun No. 10, and Holtzer A.P. projectiles, weighing 500 lbs each. Plate secured to 36-inch oak backing 8' x 10', by 16-2.8" bolts. Rubber washers & cups used on ends of armor bolts, set up as hard as possible. Plate measured 9' x 7' x 14".

Round (1) Striking velocity 1472 f.s. Holtzer # 10. Impact 38" from right edge & 32" from bottom. Projectile smashed on face, point of ogival welding in, rest of shell breaking into small pieces & flying to the rear several hundred yards, some of them. Surface of plate mottled. Plate cool, fragments of shell hot. Estimated penetration 2". Plate & backing entire. Largest fragment of shell, 25 lbs.

Jan.

Round (2). Striking velocity 1859 f.s. Holtzer # 9. Impact 35" from left edge & 33" from top. Shell broke up, leaving head welded in plate. Surface of plate scaled off $\frac{1}{4}$ " to $\frac{1}{2}$ " in a rough circle about impact. A through crack, $\frac{1}{2}$ inch wide opened out from impact to left edge and another fine crack running downward tangent to impact (1), & to about 14" below it. Structure set back elastically 1"; & plate dished about 1". Close to impact plate was warm, fragments of shell hot. Penetration estimated 5" (?). Largest fragment of shell weighed 63 lbs.

Feb.

Round (3) Striking velocity 1959 f.s. Holtzer # 12. Struck plate 34" from right hand edge, and 25" from top, & broke up, leaving head welded in. Same circum-

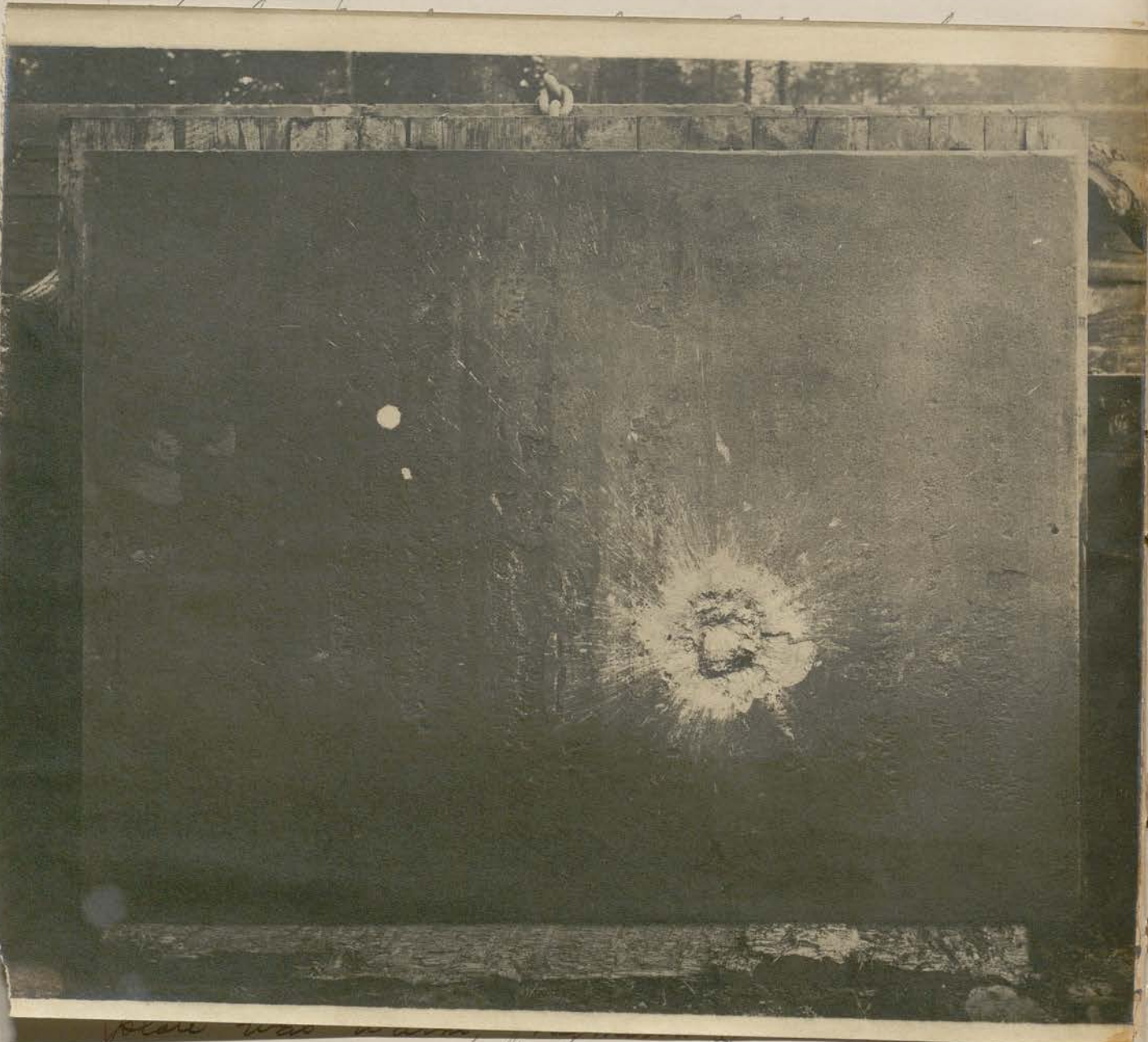
lar scaling as round (2). Through crack 5" to 7" opened to top of plate, another downwards to left meeting crack (2)(1) almost normally, a fine crack downwards

Buckled badly. Estimated penetration 10" to 11"

Regarding entire plate as target for first 3 shots, and the lower left hand fragments as that for the 4th shot, the following table is appended, see next page.

Feb. 11, '93.

Test of 14-inch, nickel steel, Harveized plate.
 Tested with 10-inch gun No. 10, and Holtzer A.P. projec-
 tiles, weighing 500 lbs each. Plate secured to 36-inch oak-



tion estimated 5" (?). Largest fragment of shell weighed
 63 lbs.

Round (3) Striking velocity 1959 f.s. Holtzer #12.
 Struck plate 34" from right hand edge, and 25" from
 top, & broke up, leaving lead welded in. Same cir-

Car scaling as round (2). Through crack 5" to 7" opened to top of plate, another downwards to left meeting crack (2)(1) almost normally, a fine crack downwards



Buckled badly. Estimated penetration 10" to 11"
 Regarding entire plate as target for first 3 shots, and the lower left hand fragments as that for the 4th shot, the following table is appended, see next page.

Feb. 11, '93.

Test of 14-inch, nickel steel, Harveized plate.

Tested with 10-inch gun No. 10, and Holtzer A.P. projectiles, weighing 500 lbs each. Plate secured to 36-inch oak-



tion estimated 5" (?). Largest fragment of shell weighed 63 lbs.

Round (3) Striking velocity 1959 f.s. Holtzer #12. Struck plate 34" from right hand edge, and 25" from top, & broke up, leaving lead welded in. Same cir-

car scaling as round (2). Through crack .5" to .7" opened to top of plate, another downwards to left meeting crack (2)(1) almost normally, a fine crack downwards to right edge, and a small one opened from (2) to top. Crack (3)(1) opened out became through crack & extended to bottom. Other crack opened out to .7". Estimated penetration 6". Backing & structure set back 2" recovering 1". Bolts & fastenings intact. Largest fragment of shell recovered was almost entire base, weighing 127 lbs. After this shot, the plate became into 3 almost equal fragments.

Round 4. Directed at centre of lower left-hand fragment, impact 23" from bottom, and 26" from left edge, & broke up lead remaining welded in to right hand portion of impact, case & body going into small pieces, heaviest weighing 75 pounds. Former cracks were opened out considerably & plate broken into seven fragments, all pieces holding to backing however by their bolts. Piece of plate that received the blow broke into 3 fragments. The backing directly underneath fragment struck was compressed & crushed to some extent, the structure set back bodily about 6", and the steel channel iron buckled badly. Estimated penetration 10" to 11"

Regarding entire plate as target for first 3 shots, and the lower left hand fragments as that for the 4th shot, the following table is appended, see next page.

Feb. 11, 93. Test of Harvey 14" nickel steel plate, continued.

	Total energy	Energy per ton of plate.
Round (1)	7520 foot tons	470.5" foot tons
" (2)	11995 " "	749.7 " "
" (3)	13320 " "	832.5 " "
" (4)*	14715 " "	3344.3 " "

* Weight of fragment attacked 4.4 tons.

The difference in performance of round (1) and of rounds (2), (3), & (4), seems due to a more direct cause than increase of velocity, with which last 3 were fired. The point of first shell did not penetrate as far as interior limit of Harvey-hardening, its effect being confined almost entirely to hard face of plate, nearly all of the energy being absorbed in shattering & heating projectile. As soon as velocities were so increased that projectiles penetrated beyond limit of face hardening, all impacts assumed like characteristics. A greater part of the energy was absorbed in plate and structure than in first round. More of the projectiles remained in the plate, greater penetration ensued, and its consequence, wedging effect, increased.

Considered externally, the plate fulfilled requirements of ideal plate, breaking up four standard A.P. projectiles fired with velocities varying from that which would be used at beginning of action, to that of a high powered gun at close range. It would have protected from all injury the interior of a ship.

Feb. 11, '93.

Test of Hawley 14" plate continued.

Regarded as a protection to a ship it shows su-
periority to other plates in causing more of the ener-
gy to be absorbed.

10

	"	(2)	200 T ₈	"	"	500	"	"	"	11.6,	"	1813,	"	39 $\frac{3}{8}$
	"	(3)	220 T ₈	"	"	500	"	"	"	14.4	"	1929,	"	39 $\frac{3}{8}$
2/11	"	(4)	210	"	Walters ATP	500	"	not abo.	"		"	1859	"	39 $\frac{3}{8}$
	"	(5)	225	"	"	500	"	"	"		"	1959	"	39 $\frac{3}{8}$
2/14	"	(6)	226	"	Commonshell	500	"	mean press	15.1		"	2016	"	39 $\frac{3}{8}$

Recommended for acceptance & accepted, charges, full 225, reduced 178 T₈

Feb. 11, 93.

Test of Harvey 14" nickel steel plate, continued.

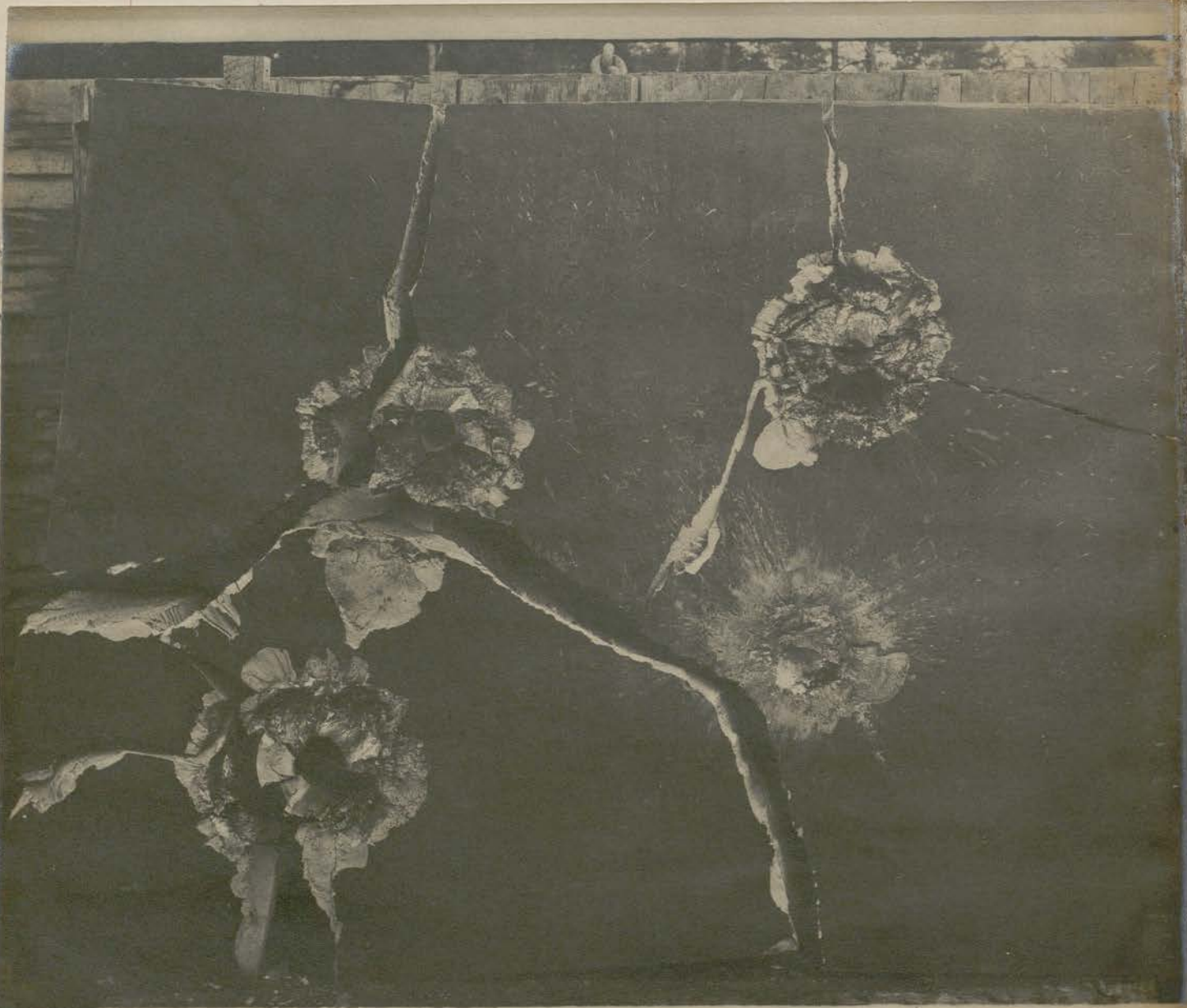
Total energy

Energy per ton of plate.

Round W

7520 foot tons

470.5 foot tons

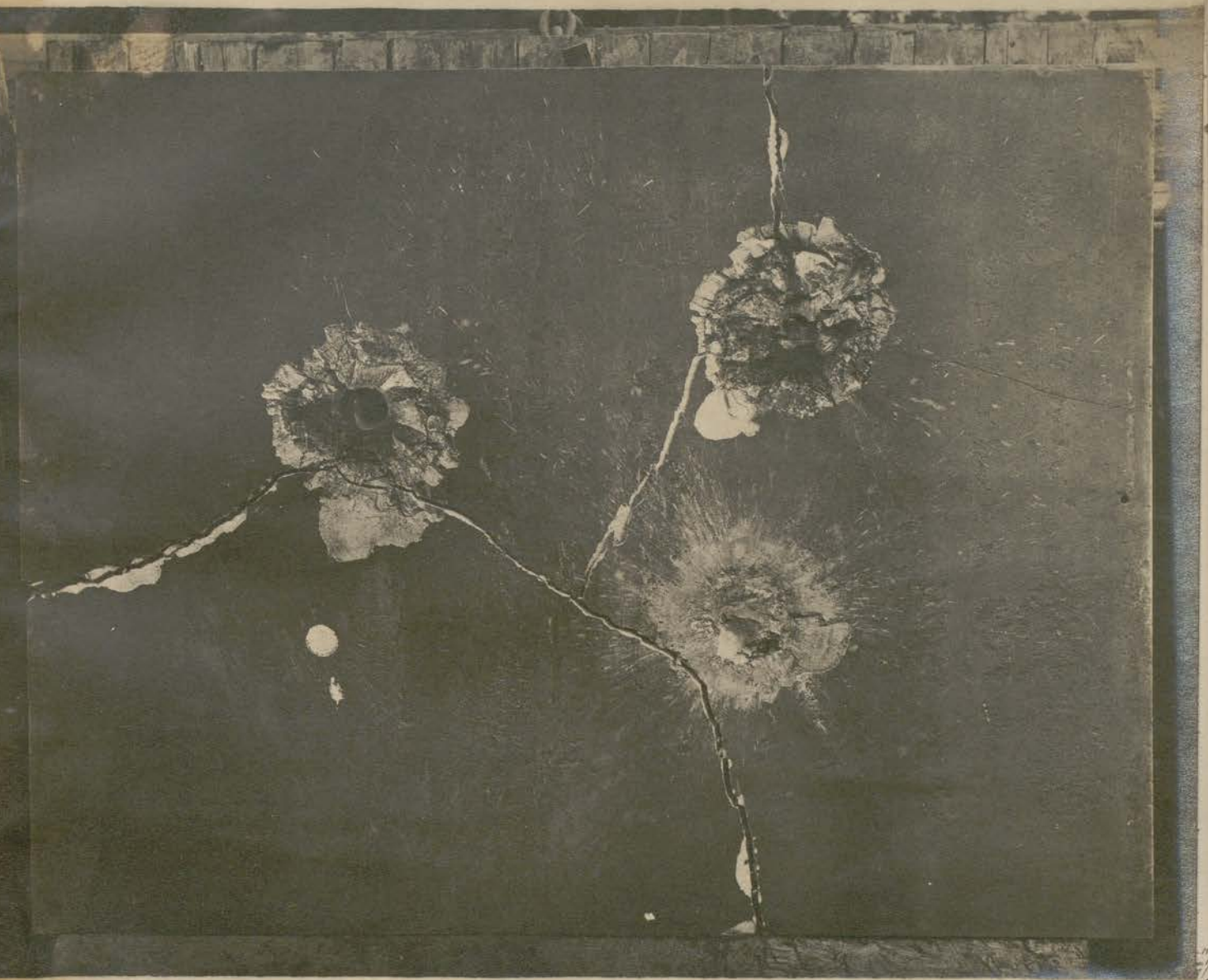


A.P. projectiles fired with velocities varying from that which would be used at beginning of action, to that of a high powered gun at close range. It would have protected from all injury the interior of a ship.

Feb. 11, '93.

Test of Hawey 14" plate continued.

Regarded as a protection to a ship it shows su-
periority to other plates in causing more of the ener-



10

	"	(2)	200 Fb	"	"	500	"	"	"	11.6,	"	1810,	"	39 1/4
	"	(3)	220 Fb	"	"	500	"	"	"	14.4	"	1929,	"	39 1/8
2/11	"	(4)	210	"	Holtzer ATP	500	"	not abo.	"		"	1859	"	39 1/8
	"	(5)	228	"	"	500	"	"	"		"	1959	"	39 1/8
2/14	"	(6)	226	"	Commonshell	500	"	mean price	15.1	"		2016	"	39 1/8

Recommended for acceptance & accepted, charges, full 220, reduced 178 Fb

Feb. 11, 1913. Test of Harvey 14" nickel steel plate, continued.

Total energy

Energy per ton of plate.

Round (1)

11.700.00 foot tons



A.P. projectiles fired with velocities varying from that which would be used at beginning of action, to that of a high powered gun at close range. It would have protected from all injury the interior of a ship.

Feb. 11, 93.

Test of Harvey 14" plate continued.

Regarded as a protection to a ship it shows superiority to other plates in causing more of the energy to be expended on the attacking projectile, this percentage growing less as velocities were increased.

The weights of the two plates (comparing ^{with} Massachusetts 14-inch) were as 25 tons to 16, in favor of the latter, and the velocity used on the latter 100 f.s. less than in first shot at former plate. Yet the heavier plate was on each round was set back & the structure racked very much more than in the case of the lighter Harvey plate of same thickness, with rounds of 1472, 1859, and 1959 foot seconds.

The last shot at 2059 f.s. caused the backing to suffer more, but it could still have stood another round.

In conclusion the behavior of the structure & backing are considered fully as important matters of consideration as the projectile breaking qualities of the plate.

Feb. 10

10" B.L.R.
10

Test of U.F.-26 for the 10" B.L.R.

	Round W.	Weight	Shell	Velocity	Measure	M.V.	R.
	(1)	170 T ₆	Common shell	500 T ₆	9.7	1682	38%
	(2)	200 T ₆	"	500 "	"	1813	39 1/4%
	(3)	220 T ₆	"	500 "	"	1929	39 3/8%
2/11	(4)	210 "	Holtzer AP	500 "	not abo.	1859	39 1/8%
	(5)	225 "	"	500 "	"	1959	39 1/8%
2/14	(6)	226 "	Common shell	500 "	mean prices 15.1	2016	39 3/8%

Recommended for acceptance & accepted; charges, full 225, reduced 178 T₆

Feb. 10. Test of U.F.-27, for the 10" B.L.R.

2/14	10" B.L.R. #10	Round (1)	175 ^{lb}	common shell	500 ^{lb}	pressure	9.0	M.T.	15-81	Recoil	393 ¹ / ₈
	"	(2)	210 "	"	500 "	"	11.2	"	1771	"	
	"	(3)	230 "	"	500 "	"	13.3	"	1993	"	
	"	(4)	242 "	"	500 "	"	15.2	"	1959	"	
	"	(5)	241 "	"	500 "	"	18.2	"	1967	"	393 ¹ / ₈

Feb. 18. Test of U.F.-21, for the 8" B.L.R.

	Round (1)	70 ^{lb}	common shell	250 ^{lb}	pressure	8.6	M.T.	1591	Recoil	27"
	"	(2)	90 "	"	250 "	"	12.3	"	1843	"
	"	(3)	100 "	"	250 "	"	14.1	"	lost	"
	"	(4)	105 "	"	250 "	"	15.5	"	2020	"
	"	(5)	103 "	"	250 "	"	14.5	"	2057	" 27 ¹ / ₂ "
	"	(6)	104 "	"	250 "	"	15.0	"	2069	"
	"	(7)	104 "	"	250 "	"	15.0	"	2065	"

Acceptance recommended & accepted: charges 104 full, 80 reduced.

2/20 Test of U.F.-22, for the 8" B.L.R.

	Round (1)	70 ^{lb}	common shell	250 ^{lb}	pressure	7.2	M.T.	1542	Recoil	27"
	"	(2)	90 ^{lb}	"	250 ^{lb}	"	10.5	"	1775	" 27"
	"	(3)	105 ^{lb}	"	250 ^{lb}	"	15.1	"	2035	" 27 ¹ / ₂ "
	"	(4)	105 ^{lb}	"	250 ^{lb}	"	15.0	"	2039	" 27 ¹ / ₂ "

Recommended for reduced charges only - 60^{lb}s.

In combination with the tests of this powder were also tested the second twin carriage for the New York, and the turret eight.

Carriage showed itself amply strong and worked well - recoil smooth & easy.

Arrangements for filling cylinders, and facility

of loading & operating inside turrets questionable.

The sight was emphatically condemned, on account of inaccuracy due to great amount of gear between axis of sight and axis of gun.

Test of 6-inch common shell of the American Projectile Company.

The explosion of 2.6" shell with shell powder is noted on page 66.

Two were also burst with charges of m.m.2, smokeless powder, with following results.

Weight empty shell	89.5 ¹ lbs	89.0 ¹ lbs
Charge m.m.2	4.5 ¹ lbs	4.75 ¹ lbs
Priming charge, shell powder	10 grms.	30 grms.
Number of pieces	30	115
Weight of heaviest piece	11.4 lbs	4 lbs
Weight of 10 heaviest	61 lbs	24 lbs
Weight of all pieces recovered	87 lbs	80 lbs

Remaining shell were fired from 6" 35 caliber gun, giving following pressures & velocities

(1) 13 tons, 2074 f.s. (2) 13.2, 2074 f.s. (3) 12.2 tons, 2056 f.s.

(4) 12.8 tons 2058 f.s. (5) 12.8 tons 2049 f.s.

Round (1) ² went through a¹ fired into butt, no. 2, not being recovered, but no. 1 recovered, unchanged in dimensions.

Round (3) was through a $\frac{3}{4}$ " plate recovered entire, set up at weld of joint .2". Both (1) & (3) entered muzzles again easily.

Round (4) was fired through same plate as (3) but not recovered. Round (5) through same plate inclined at

angle of 45° to line of fire. Penetrated & broke up.

The same charge of powder S M R-4, 46 lbs was used in all cases

Lot recommended as very satisfactory possessing large mining power, strength, & good penetrative powder

Feb. 20.

Explosion of 2-6" Armor Piercing shell, lot 5, Carpenter.

Item	# 436	# 696
Weight, including plug	99.5 lbs	100.5 lbs
Charge	1.35 M.R. 2	1 1/8 lbs shell
Number of fragments shell	71	36
" " " Band	4	4
Weight largest piece	16 3/4 lbs	31 3/8 lbs
" 10 largest pieces	50 lbs	76 lbs
" of all pieces	97 lbs	99 lbs

Exploded with electric dry battery and U.S. primers.

Feb. 27.

Test of Carpenter A.P. projectiles for 8" B.I.R.

Round (1) # 1158 lot 4. Charge 6 1/2 pounds WT-18. Penetrated plate, backing, 28" of blocking and 9' of bank. Recovered entire, shortened .06", diameter unchanged. Was easily put into muzzle again. Acceptance of lot recommended.

Round (2) # 902, lot 3. Charge 5.8 lbs WT-18. Penetrated plate and 2 tiers of backing, being stopped by last tier. Recovered entire shortened .02", body increased .01" in diameter. Acceptance of lot recommended.

Round (3) # 746, lot 2. 60 TB U.S.-18. Penetrated plate & lodged in last tier of backing. Recovered in two pieces, shell having broken at band score. The other shell of this lot to be tested later on arrival of new backing.

Round (3) # 593 lot 1. 61 TB U.S.-18. Penetrated plate and backing & caught in second tier of blocks. Base of shell broke off transversely through band score, and a longitudinal through crack from bounlet up over shoulder of ogival and down the other side in a zigzag line to band score.

Round 4. # 613 lot 1. 61 TB U.S.-18. Penetrated plate and backing & caught in tier of blocks behind backing. Shell broke in two transversely about 10° from base. Rejection of lot 1 recommended.

All shell fired against at 9" mild steel plate.

Feb. 27.

Test of 4" Shrapnel, American Projectile Company.

Exploded 2 in explosion chamber, being filled with shell powder.

Weight empty	# 11 36 TB	# 2 36.5 TB
Blanking charge shell powder	145 grams.	145 grams.
Number of fragments of shell	42	46
Weight of heaviest piece	3.6 TB	5.1 TB
Weight of 10 " "	14.5 TB	19.5 TB

Explosion of these shrapnel were very good, showing the advantage of central tube

Two of the shrapnel were then filled with sand &

plugged, and fired at high elevation, with normal flight and recoil.

Four were then loaded with 145 grammes shell powder, and fired with service charge, 2000 f.s., at a 4-inch screen. First and third burst at between 8' & 10' on other side of screen, giving a fair cone of dispersion of about 15°. The second & fourth failed to explode. Performance of these shrapnel considered very satisfactory.

Mar. 1.

Calling Bureau's attention to length of time necessary to fill cylinders of 5" R.F. G. No. 16.

March 2.

Calling Bureau's attention to score found in chamber of 4" R.F. G. # 33. Estimated depth .05".

March 6.

Test of 14" nickel steel plate for the battleship Oregon, with 10" B.L.R. and Carpenter A.P. projectiles. Charge 129.75 pounds U.F. 26.

Round (1) # 291, lot 1. Point of impact 30" from the top and 72" from right edge of plate, penetration 14.1" Hole was smooth with fine star cracks at apex. Usual fringe & bulge. Rebounded 80 feet shortened .60", Crownlet increased .06", Body .31".

Round 2. # 277 - lot 1. Point of impact 19.25" from bottom and 99" from right edge of plate. Penetration 13.2". Projectile rebounded 10 feet, shortened .57" Crownlet increased .10", Body .29". An irregular throy

crack opened from top to bottom $\frac{1}{4}$ " wide at face and $\frac{3}{4}$ " wide at back, passing through lower right hand portion of hole.

Round (3) # 282 lot 1. Point of impact 21" from bottom and 43" from right edge of plate. Penetration 14.2". Shell rebounded 10 feet entire but shortened .53", binnacle increased .08" body .23". Crack of second round opened out further, and a fine surface crack extended from impact to bottom of plate. Round (3) # 282 lot 1. Point of impact Plate passed sat-

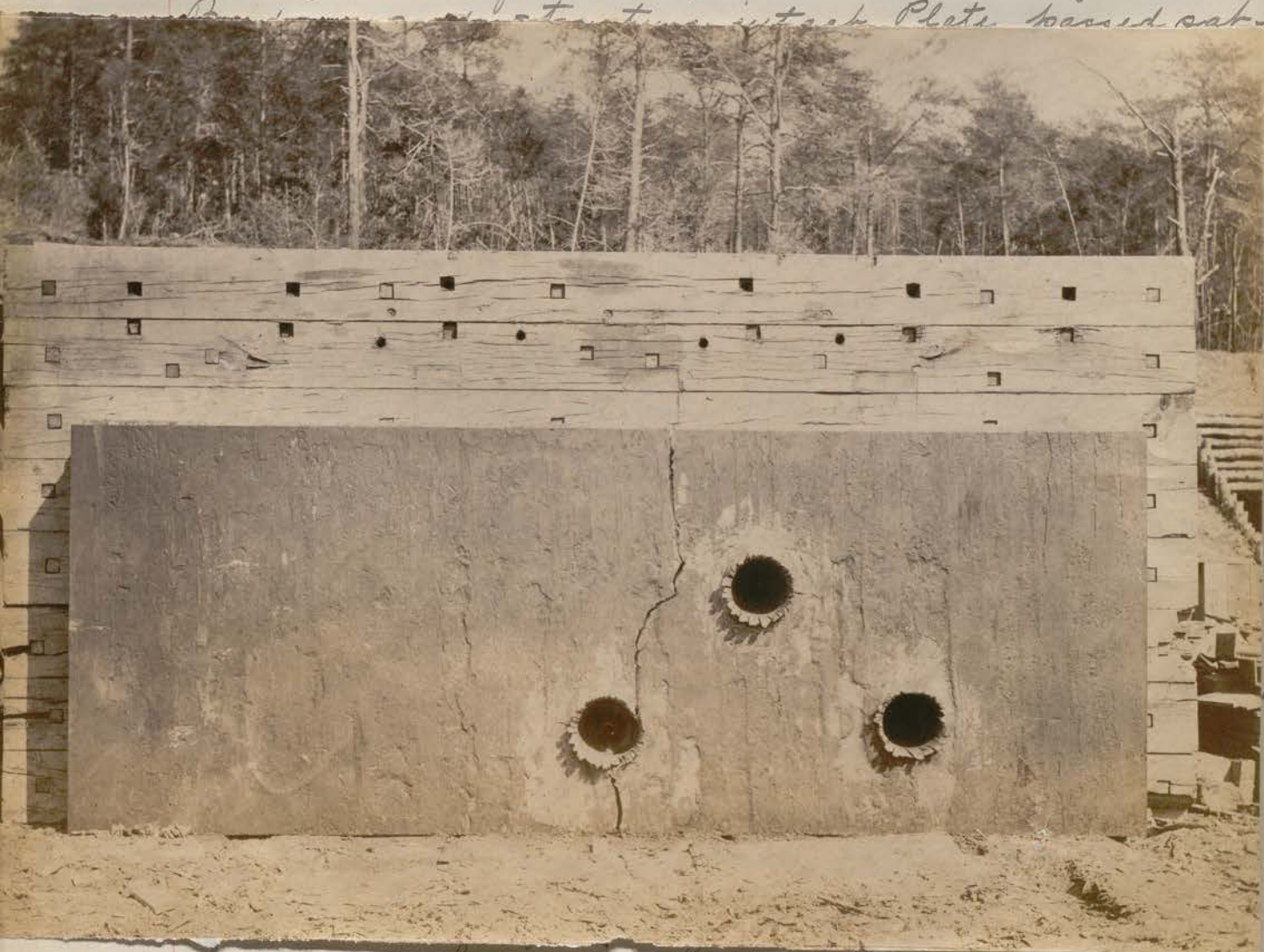


plate and lodged in backing, base 25" from face of plate, point just getting through last tier of back-

plugged, and fired at high elevation, with normal flight and recoil.

Four were then loaded with 145 grammes shell powder, and fired with service charge, 2000 f.s., at a 4-inch screen. First and third burst at between 8' & 10' on other side of screen, giving a fair cone of dispersion of about 15°. The second & fourth failed to explode. Performance of these shells considered very satisfactory.

Mar. 1.

March 2.

March 6.

Bottom and 99 from region of
tion 13.2. Projectile rebounded 10 feet, shortened .57
Crownlet increased .10", body .29". An irregular throug

crack opened from top to bottom $\frac{1}{4}$ " wide at face and $\frac{3}{4}$ " wide at back, passing through lower right hand portion of hole.

Round (3) # 282 lot 1. Point of impact 21" from bottom and 4.3" from right edge of plate. Penetration 14.2". Shell rebounded 10 feet entire but shortened .53", borelet increased .08" body .23". Crack of second round opened out further, and a fine surface crack extended from impact to bottom of plate. Backing and structure intact. Plate passed satisfactory.

ch 6. Test of Oregon's 4" casemate plate. Carpenter A.P. shells.

Round (1) # 252. Charge 8 $\frac{7}{8}$ 11.603 register 125; striking velocity about 1491 f.s. Penetrated plate and lodged in backing, with its base 15" in from face of plate. Usual fringe and bulge. Impact at centre of plate.

Round (2). # 237. Charge 10 $\frac{7}{8}$ 7.503, register 125. Striking velocity about 1776 f.s. Point of impact $3\frac{1}{2}$ calibres from that of 1st round, and to ^{right} [left] of it. Penetrated plate and 36" oak backing being stopped by timber in rear. Projectile shortened .03" but otherwise undeformed. Usual fringe and bulge.

Round (3). Carpenter shell # 98. charge 9.3 $\frac{7}{8}$, registers 127, striking velocity about 1561 f.s. Penetrated plate and lodged in backing, base 25" from face of plate, point just getting through last tier of back-

ing. Normal fringe & bulge.

Plate was considered to have passed the acceptance test.

Mar. 12.

Test of 20 Lb of New York's #4 casemate plate. Attacked by 4" R.F.G. and Carpenter A.P. projectiles. Round (1) # 78. 9.0875 S M A 4, register 125. Striking velocity 1595 f.s. Penetrated plate & lodged in backing base 10.5" from face of plate. Normal burn, and bulge.

Round (2) # 232. Striking velocity 1595 f.s. Penetrated plate and lodged in backing, base 17" from face of plate.

Round (3) # 85. Striking velocity 1595 f.s. Penetrated plate and lodged in backing, base 16.2" from face of plate.

Round 4. # 264. Striking velocity 1676 f.s. Penetrated plate & lodged in backing base 26.5" from face of plate. Charge 10 to 17.5 oz Register 12

Projectiles were fired so that points of impact were grouped to the right of center of plate, and about $3\frac{1}{2}$ calibers from each other, in the shape of a diamond.

Mar. 16-17

Test of M.A.-4, in Heavy 1 Pdr. R.F. Gun.

Mean of 4 rounds 140 grms. pressure 13.4, M.V. 1747 f.s.

Mean of 10 rounds 145 grms. " 9.4, M.V. 1768 f.s.

Case would contain handily only 145 grammes, there.

the limits

NAVY DEPARTMENT.

3 4 1/2" from
 small burr and bulge
 2 8 3/4" from face of

Holes show fractured
 & entire, plate slightly

dished. As result of experiment plate was considered
 to have passed the test for acceptance.

ing. Normal fringe & bulge.

Plate was considered to have passed the

Mar. 12.



Projectiles were fired so that points of impact were grouped to the right of centre of plate, and about $3\frac{1}{2}$ calibres from each other, in the shape of a diamond.

Mar. 16-17

Test of N.A.-4, in Heavy 1 Pdr. R. F. Gun.

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Mean of 10 rounds 145 grms. " 9.4, M.V. 1768 f.s.

Cases would contain handily only 145 grammes, these

the limits



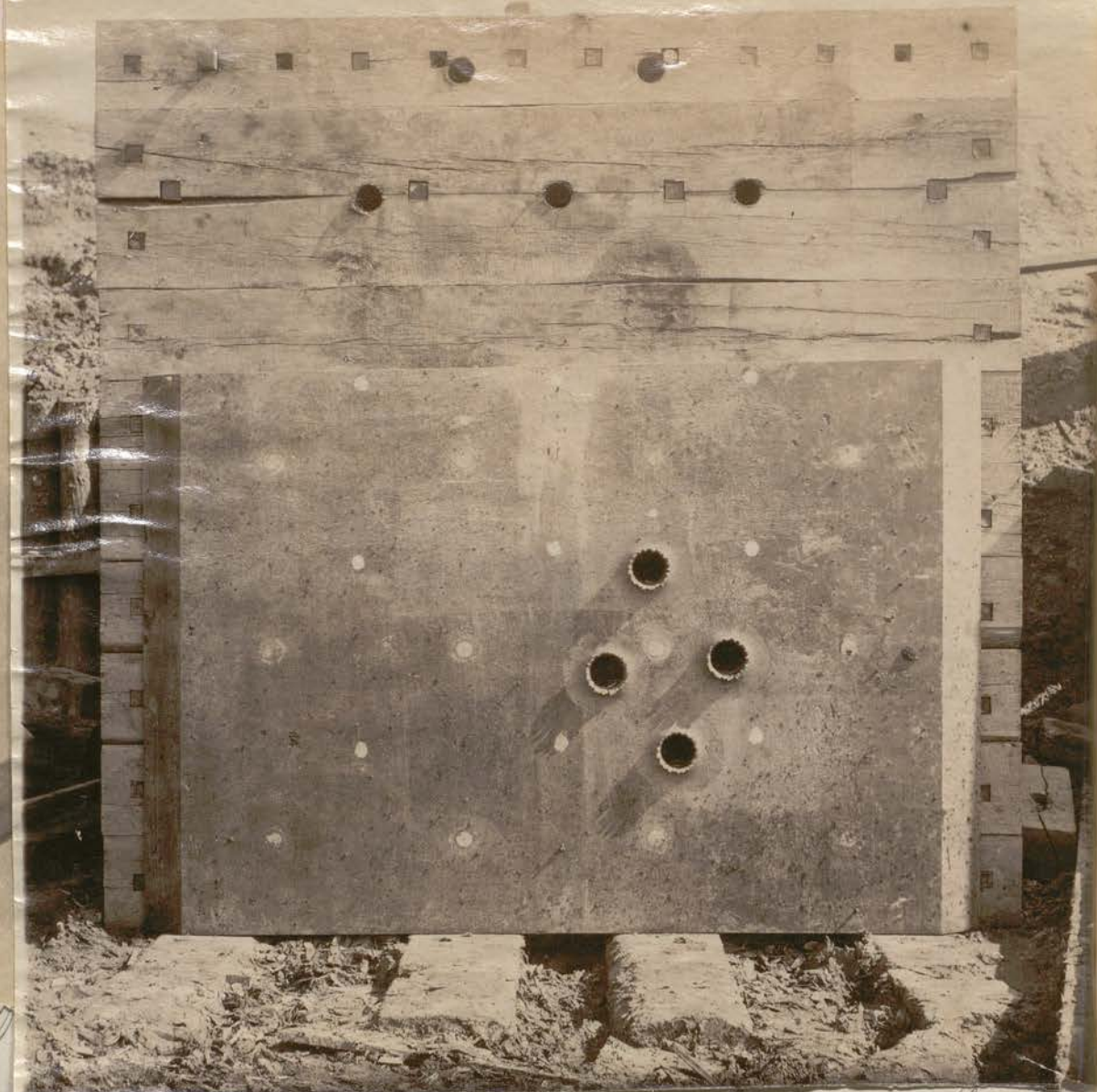
NAVY DEPARTMENT.

3 4 1/2" from
normal burr and ledge
2 8 3/4" from face of

Holes shown fractured
entire, plate slightly

dished. As result of experiment plate was considered
to have passed the test for acceptance.

Mar. 12.



four were grouped to the right of centre of plate, and about $3\frac{1}{2}$ calibres from each other, in the shape of a diamond.

Mar. 16-17

Test of N.A.-4, in Heavy 1 Pdr. R. F. Gun.

Mean of 4 rounds 140 grms. pressure 13.4, M.V. 1747 f.s.

Mean of 10 rounds 145 grms. " 9.4, M.V. 1768 f.s.

Cases would contain handily only 145 grammes, these.

fore although the pressure was considerably under the limits

SPECIFICATIONS

FOR

STEEL FORGINGS

FOR

TEN-INCH B. L. MORTAR

FOR

THE UNITED STATES NAVY.



NAVY DEPARTMENT.



*right edge, $3\frac{1}{2}$ " from
normal burr and budge
 $2\frac{3}{4}$ " from face of*

*Holes shown fractured
entire, plate slightly
dished. As result of experiment plate was considered
to have passed the test for acceptance.*

Mar. 12.



joint will go
plate, and a
in the shape

Mar. 16-17

Test of N.A.-4

Mean of 4 rounds

Mean of 10 rounds 145 grams.

9.4, M.T. 1768 f.s.

Cases would contain Landis only 145 grammes, there.

25. Test bars shall be cut, and tests made under the supervision of an agent or inspector of the Department, who may make the tests personally if he should so desire. He will stamp and have the custody of each test bar.

26. If the contractor provides a testing machine of a pattern approved by the Department, the tests may be made at his works; otherwise, the test bars will be suitably packed and delivered by the contractor, F. O. B. cars, for transportation to such place as the Department may direct. The expenses of testing in this latter case will be borne by the Department. The contractor has the right to be present at tests outside his works. Under any circumstances the Department may, if it so elects, have the tests made at any place.

27. The minimum physical characteristics shown by the specimens upon which acceptance or rejection of the forgings is based shall be as follows:

	Tube.	Jacket.	Plug.	Trunnion band.	Mush- room.
Tensile strength lbs.	85,000	90,000	90,000	90,000	70,000
Elastic limit lbs.	42,000	45,000	45,000	45,000	35,000
Elongation per cent.	20	18	18	13	22

28. The steel from which the forgings are made shall contain about 3 per cent. of nickel, uniformly distributed throughout the mass.

29. The contractor shall first present three specimens from each end of the tube or jacket and from the end nearest the upper end of the ingot or casting of the plug or trunnion band; and from the mushroom, two transverse specimens from the head and one longitudinal specimen from the stem. The central axis of these longitudinal specimens from the mushroom stem need not be nearer the central axis of the forging than one-half of the radius of the latter.

30. The three specimens taken from either end of the tube or jacket shall be considered independently of those taken from the other end of the same piece.

31. If each specimen from a forging or casting shows physical qualities equal to or exceeding in every particular the figures given above for the piece being considered, the piece shall be accepted.

fore although the pressure was considerably under the limits

7

32. If, in making the above tests, one specimen from either end of the piece falls below these figures, the contractor may take two more specimens from the near vicinity of the spot from which the failing specimen came, and the average of the results of the two specimens will be taken to represent the failing bar in considering the acceptance or rejection of the forging or casting, according to Paragraph 31.

33. After a piece is cut or otherwise detached from a forging, no specimen from the piece will be considered if the latter has received any treatment after being detached as aforesaid.

34. In case the results obtained from the first submission do not conform to the specifications, and in case the contractor is of opinion that the quality of the metal will be improved by retreatment, he may retreat the forging or casting, and submit additional specimens, and the results obtained from the former specimens will no longer be considered, except with reference to the presence of slag, sand, and other foreign substances.

35. If three or more specimens taken from a test slice from any forging or casting show slag, sand, or other foreign substance, visible to the naked eye, the Department may reject the forging or casting without considering the physical results obtained from the specimens. But if the piece is of sufficient length to allow the contractor to cut an additional slice from the same end, a complete set of specimens (seven) will be submitted from this slice, and if two of these specimens show slag, &c., as above, the Department may reject the forging without considering the physical results obtained from the specimens. But if the piece is of sufficient length to allow the contractor to cut a third slice, a complete set of specimens (seven) will be submitted from this slice, and if any of the specimens show sand, &c., as above, the Department may reject the piece.

36. The fracture of every specimen falling below the requirements shall be examined with a magnifying glass for the presence of slag, sand, or other foreign substance, and the presence of any such foreign substance in two specimens from the same end of any forging shall cause its rejection.

37. In these cases the results of previous tests will only be considered so far as slag, &c., is considered.

38. In all cases of retreatment the last process must also be an annealing one.

39. If the Department should wish to have specimens taken for its own purposes, and independent of the official tests, it will so

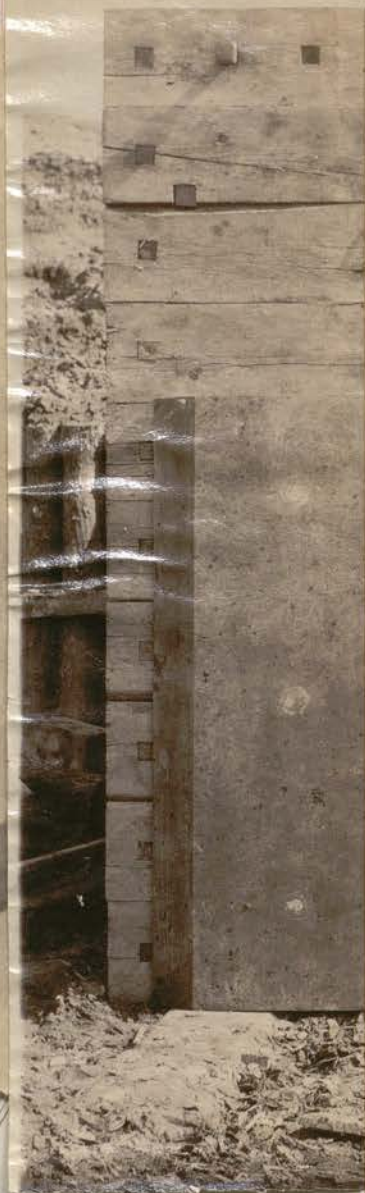


edge, $3\frac{1}{2}$ " from
burr and budge
 $\frac{3}{4}$ " from face of

slower fractured
this, plate slightly

dished. As result of experiment plate was considered
to have passed the test for acceptance.

Mar. 12.



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plate, and a
in the shape

Mar. 16-17

Test of M.A-4

Mean of 4 rounds

Mean of 10 rounds 14.5 grams.

" 9.4, M.V. 1768 f.s.

Cases would contain Landily only 14.5 grammes, there-

inform the contractor in writing, and will pay for the bars at a rate agreed upon.

40. Tests of any kind that are to be made by the contractor on his own account must be reported to the chief inspector beforehand, in order that the Government inspectors may have opportunity to witness them.

41. If, during the manufacture of a gun or its parts, or subsequently thereto, but before proof, defects have been discovered which have led to the rejection of a forging, but which, in the opinion of the contractor, are of so slight a character as to give rise to reasonable doubt whether the strength and resistance of the forging for use in cannon is thereby lessened in any material way, he may make a written statement to the Department to that effect, and the Department will thereupon cause the question to be referred to a board of naval officers, which shall report the facts and a majority opinion for the Department's consideration previous to final action. When practicable one member of the board shall be from the office in which the rejection was made.

42. If, during powder-proof, after the completion of a gun, any forging therein shall fail on account of the presence of flaws, slag, cavities, or foreign substances in number or quantity serious enough to be clearly the sole cause of such failure, the forging shall be replaced by the contractor. The proof rounds to which this rule applies shall not exceed five, and shall be fired within six months after the final delivery of all the forgings herein referred to. Forgings are not *finally accepted* until the expiration of the six months above referred to, unless the guns are proof fired at an earlier date.

43. Provisionally accepted forgings are to be delivered free on board a convenient transportation line (to be approved by the Department) that runs from the town in which the contractor's works are situated.

44. If the Department makes no selection the shipment will be made by the contractor by the most convenient reliable line.

45. The Department will not pay for any hauling in wagons, or otherwise, to the depot of a transportation company.

46. The Department may, at its discretion, allow parts of rejected forgings to be offered by the contractor for other purposes than those for which the piece was originally intended, as for instance, certain parts of jackets or tubes for hoops or plugs.

47. Except as herein otherwise provided, the behavior of the specimens under test, the place at which tests shall be made, the position at which test bars shall be taken, the nature and number

fore although the pressure was considerably under the limits

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of tests, and the results of all shall be determined by the Department, whose decision on all questions in relation to all matters shall be final and whose construction of all the terms of a contract shall prevail.

48. The Department may waive any tests that it pleases.

DELIVERY.

49. Forgings may be made by the contractor in such order as he sees fit, and they will be examined by the inspector during manufacture, and tested when completed; but they must be delivered as soon as practicable after acceptance.

50. Rejected forgings will be replaced by the contractor in time to complete each set within the contract time for its delivery.

51. In cases where rejection takes place after the piece has left the contractor's works, he will remove it at his own expense within a reasonable time, and he will replace it F. O. B. at the Washington Navy Yard, where the gun is to be put together.

52. The complete set of forgings will be paid for when it is provisionally accepted, the contract reservation being deducted.

53. In case any of these forgings should afterwards be rejected the sums paid on them will be deducted from the payment on the next set (or piece) provisionally accepted.

INSPECTORS, &C.

54. The Department shall have the right to keep agents or inspectors at the works, who shall have free access to all parts thereof, and who will be permitted to examine freely the raw material, to witness all processes of manufacture, and to examine all the contractor's records with reference to such matters.

55. A statement of work and contractor's tests, to be commenced and in progress each day, must be furnished to the chief inspector.

56. All information and reports, written or verbal, concerning material, tests, processes, &c., &c., and all the assistance that the inspectors may require from the contractor or his employes, shall be rendered free of charge to the Department.

57. The inspectors will be supplied, free, with suitable office room at the works, and with such plain office furniture as may be necessary to the proper transaction of their business as agents of the Department.

58. If the chief inspector present considers that any of the work is not in accordance with the contract, he will so inform the contractor at once, and immediately thereafter give his reasons



eye, $34\frac{1}{2}$ " from
burr and budge
 $\frac{1}{4}$ " from face of

shower fractured
tri. plate slightly

dicked. As result of experiment plate was considered
to have passed the test for acceptance.

Mar. 12.



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Mar. 16-17

Test of M.A-4,

Mean of 4 rounds

Mean of 10 rounds 14.5 grms.

Case would contain Landis only 14.5 grammes, there-
9.4, M.V. 1768 f.s.

for so doing, in writing, both to the Department and the contractor. Any work done by the contractor on the material in question, after the verbal notification, shall be at his own risk.

59. Except as hereinafter provided, all tests, measurements, &c., shall be made at the expense of the contractor, under the observation and supervision of the inspectors, and with the contractor's gauges and instruments. The inspector has the right to verify all testing or gauging instruments at any time.

60. Inspections shall be made at any time or times that the inspectors shall see fit, and without notice being given.

61. The obligation is upon the contractor to satisfy the inspector as to the correctness of everything, and its accordance with the terms of the contract.

62. The inspector is to decide, in the first instance, as to the results of all official tests, but if he is in doubt he may refer the matter to the Department.

63. Specimens shall be presented to him in sets, each comprising all those belonging to one forging. He is to test and decide upon these within four days after presentation. Any delay after this shall be allowed the contractor as additional time within which to make delivery, provided he has supplied ample facilities for testing all specimens. If the inspector is in doubt as to accepting, and refers the matter to the Department, the delay thus caused will be allowed the contractor as additional time.

64. The contractor shall give the inspector two copies of the results of tests in such form as may be approved by the Department immediately after the tests are made; and the four days interval allowed the inspector for decision will not commence until these copies are furnished.

65. If any objects, operations, machines, or methods employed by the contractor for this manufacture, production, &c., are protected by caveats, patents, or otherwise, the contractor is to save the Department harmless against all claims of patentees, or others, with regard to such matters.

66. The contract will provide that it may be declared forfeited on the part of the contractor in case of failure or undue delay in delivering the forgings within the contract times. The reservations on payments will be fixed at 10 per cent. to cover the Department from risk of loss on rejected material.

67. In case the Department shall find it advantageous to have the rough-boring and turning of forgings done at the Navy Yard, Washington, D. C., they will be delivered by the contractor, F. O. B. cars, the Department paying freight to and from the Navy

fore although the pressure was considerably under the limits

11

Yard, and returning the rough-bored and turned tubes and jackets, and the scrap therefrom, to the contractor, F. O. B. cars, at his works. The Department will use reasonable care in gathering up the scrap, but will not guarantee anything in regard to its weight. The scrap from the trunnion bands will not be returned, as the work on them will not cease at the rough-bored and turned stage.

68. In case the Department shall rough-bore and turn the tubes, jackets, and trunnion bands, if any tube, jacket, or trunnion band shall develop during rough-boring or turning, such faults (see Paragraph 3) as require its rejection, or if any tube or jacket, after being rough-bored or turned, shall fail to exhibit the required physical characteristics and shall be rejected, the Department will deduct from the next payment due the contractor under the contract all the expense it has incurred in connection with the material rejected under the circumstances cited.

69. In case the Department shall rough-bore and turn the tubes and jackets, it will undertake that each tube and jacket shall be rough-bored and turned and reloaded on cars for return to the works of the contractor within thirty days after its arrival in Washington in the rough-forged state, and any delay beyond this shall be allowed the contractor as additional time for the delivery of the set of forgings involved.

70. In the exhibits the weights are made up from the drawings of the rough-bored and turned material (see prints), using 0.2833 pound as the weight of a cubic inch of steel.

EXHIBIT A.—*Tube and Jacket.*

(See Print No. 3985.)

Caliber of gun.	Part of gun.	Weight of one.	Weight of number required.
		Pounds.	Pounds.
10-inch	Tube	6,844	6,844
10-inch	Jacket	12,331	12,331
Total		19,175

eye, $3\frac{1}{2}$ " from
burr and budge
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shower fractured
tri, plate slightly

dashed. No result of experiment plate was considered
to have passed the test for acceptance.

Mar. 12.



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Mar. 16-17

Test of M.V.

Mean of 4 rounds

Mean of 10 rounds 14.5 grms.

Cases would contain Landily only 14.5 grammes, there-

12

EXHIBIT B.—Trunnion Bands.

(See Print No. 3985.)

Caliber of gun.	Weight of one.	Number required.	Weight of number required.
	<i>Pounds.</i>		<i>Pounds.</i>
10-inch	1,369	1	1,369

EXHIBIT C.—Plugs and Mushrooms.

(See Print No. 3985.)

Caliber of gun.	Part of gun.	Weight of one.	Number required.	Weight of number required.
		<i>Pounds.</i>		<i>Pounds.</i>
10-inch	Plug	579	1	579
10-inch	Mushroom	161	1	161
Total				740

71. The weight of material to be paid for will be determined, to the nearest pound, by calculation of the volumes of the rough-bored and turned pieces from the drawings, which shall always show the allowances, above finished dimensions, indicated in Paragraph 14. The weight of a cubic inch of steel will be assumed to be 0.28330 pound; 2240 pounds equal one ton.

72. All pieces delivered rough-bored and turned must be *within* the dimensions allowed, and they will be measured and calipered at the expense of the contractor, to satisfy the inspector that the dimensions have not been exceeded.

BUREAU OF ORDNANCE,
NAVY DEPARTMENT,
WASHINGTON, September 29, 1892.

WM. M. FOLGER,
Chief of Bureau.

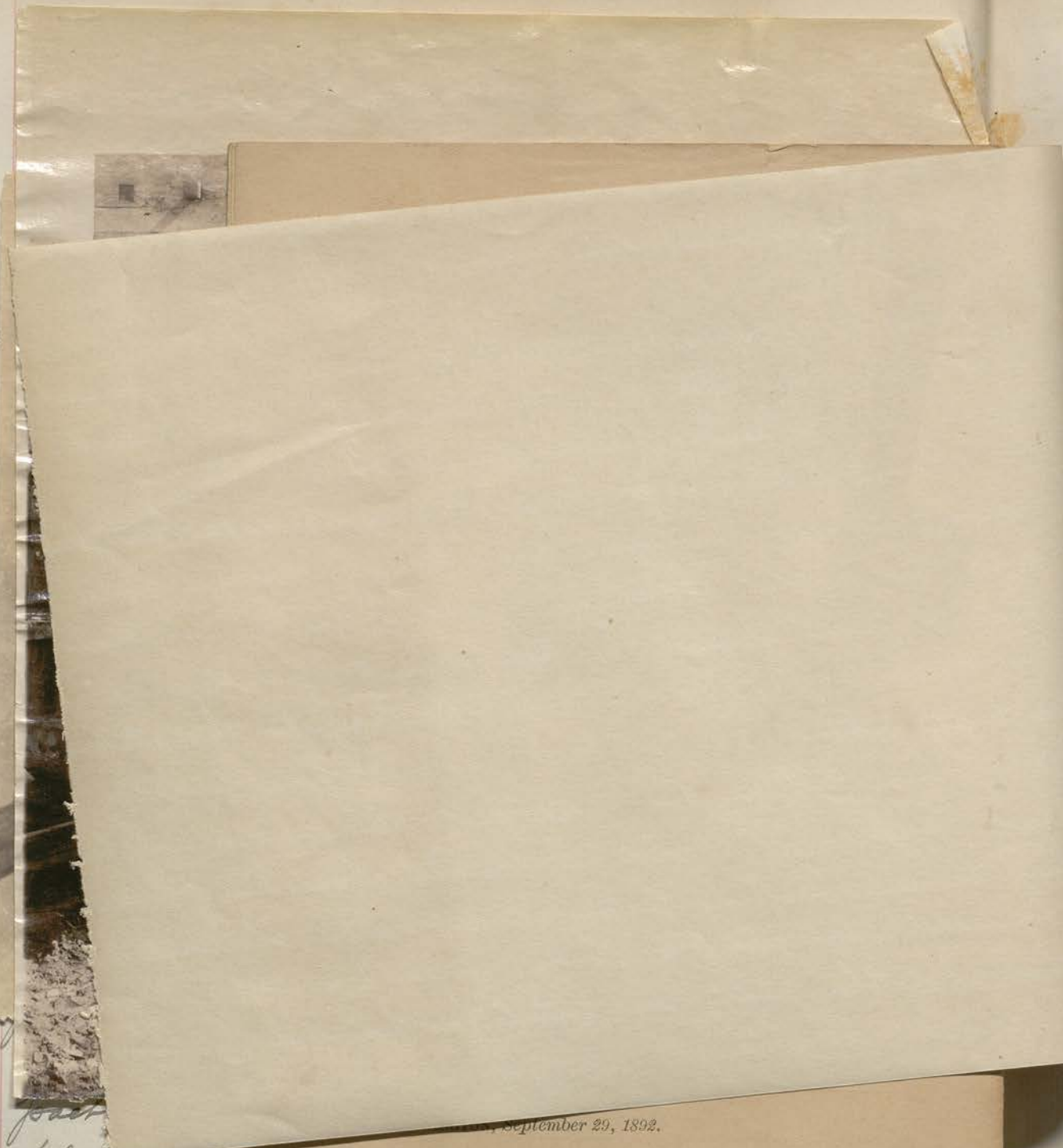
fore although the pressure was considerably under the limits



about 1561. Impact $19\frac{1}{2}$ " from right edge, $34\frac{1}{2}$ " from bottom. Penetrated plate raising normal burr and bulge and lodged in backing, base in $28\frac{3}{4}$ " from face of plate.

In all impacts, the rear of holes showed fractured back-bulge. Plate & backing sound & entire, plate slightly dished. As result of experiment plate was considered to have passed the test for acceptance.

Mar. 12.



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September 29, 1892.

WM. M. FOLGER,
Chief of Bureau.

Mar. 16-17

Test of M.

Mean of 4 r

Mean of 10 rounds 14.5 grms.

9.4, M.V. 1768 f.s.

Case would contain hardly only 14.5 grammes, there-

fore although the pressure was considerably under the limits the velocity could not be increased, consequently rejection of lot was recommended.

18. Test of 4" nickel steel plate of Carnegie Co., representing casemate armor of the Massachusetts. Attacked by 4" R.F.V., using Carpenter A.P. shells.

Round (1) # 216-3375, charge 875 7.603, register 125; striking velocity 1491 f.s. Penetrated plate raising normal burr and bulge, and lodged in backing, base in 14.5" from face of plate. Impact 34 1/4" from bottom, 35" from left edge.

Round (2) # 85-33760. Charge 1075 7.5" register 125; striking velocity about 1676 f.s. Struck plate 18" from left edge, 33 1/2" from bottom. Penetrated plate raising normal burr and bulge, and [lodged in] backing, a part of backing behind backing & picked up entire, shortened .06"; Couplet increased .03", body increased .01" to .04". By this shot the plate was tested for premium, and failed to pass.

Round (3) # 30-3375. 9.375 register 125; striking velocity about 1561. Impact 19 1/2" from right edge, 34 1/2" from bottom. Penetrated plate raising normal burr and bulge and lodged in backing, base in 28 3/4" from face of plate.

In all impacts, the rear of holes showed fractured back-bulge. Plate & backing sound & entire, plate slightly dished. As result of experiment plate was considered to have passed the test for acceptance.

Mar. 18

Test of Johnson cast steel shot for the 10" B.S.L.
Tested against a 10" nickel steel plate represent-
ing barbette armor of New York, these 8" S.T. shell
having already been fired against it.

Ma

Round (1) Weight of shot. 5.00 lb , charge 170 lb U.S.-27.
striking velocity about 1500 f.s. Struck plate 28" from
left edge, and 34" from top of plate. Penetrated
plate and backing and broke into 2 principal
pieces, one weighing 183.5 lb and consisting of base
and lower part of body falling in woods about
150 yards from plate, the other consisting of ogival
and point and weighing 213 lb took account a
little to right of first piece & dug out of ground
about 500 yards from target. Fractures transverse
and clean. Normal fringe and bulge around shot
hole. Two cracks opened in plate one to right & up-
wards to top, the other downward and to left edge.
The crack already existing in plate opened a little
more and ran downwards nearly to bottom of plate.
The fragments of shell recovered showed an in-
crease in diameter of .03" to .04", point in good
condition.

Ma

Round (2) $\frac{3}{10}$, 5.00 lb , charge 135 lb U.S. 27, striking
velocity about 1200 f.s. Struck plate 44" from left
right edge and 24" from bottom, penetrated 6.2",
rebounded, falling very near plate & little to left
in two pieces. One piece consisting of point
and weighing 32.5 lb , the other of rest of shell



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Mar. 1

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hole. Two cracks opened in plate one upwards to top, the other downward and to left edge. The crack already existing in plate opened a little more and ran downwards nearly to bottom of plate. The fragments of shell recovered showed an increase in diameter of .03 to .04, point in good condition.

Round (2) # $\frac{3}{10}$, 5.00 to, charge 135 to U.S. 27, strike velocity about 1300 f.s. Struck plate 44" from left edge and 24" from bottom, penetrated 6" rebounded, falling very near plate & little to left in two pieces. One piece consisting of point and weighing 32.5 to, the other of rest of shell

Mar. 1

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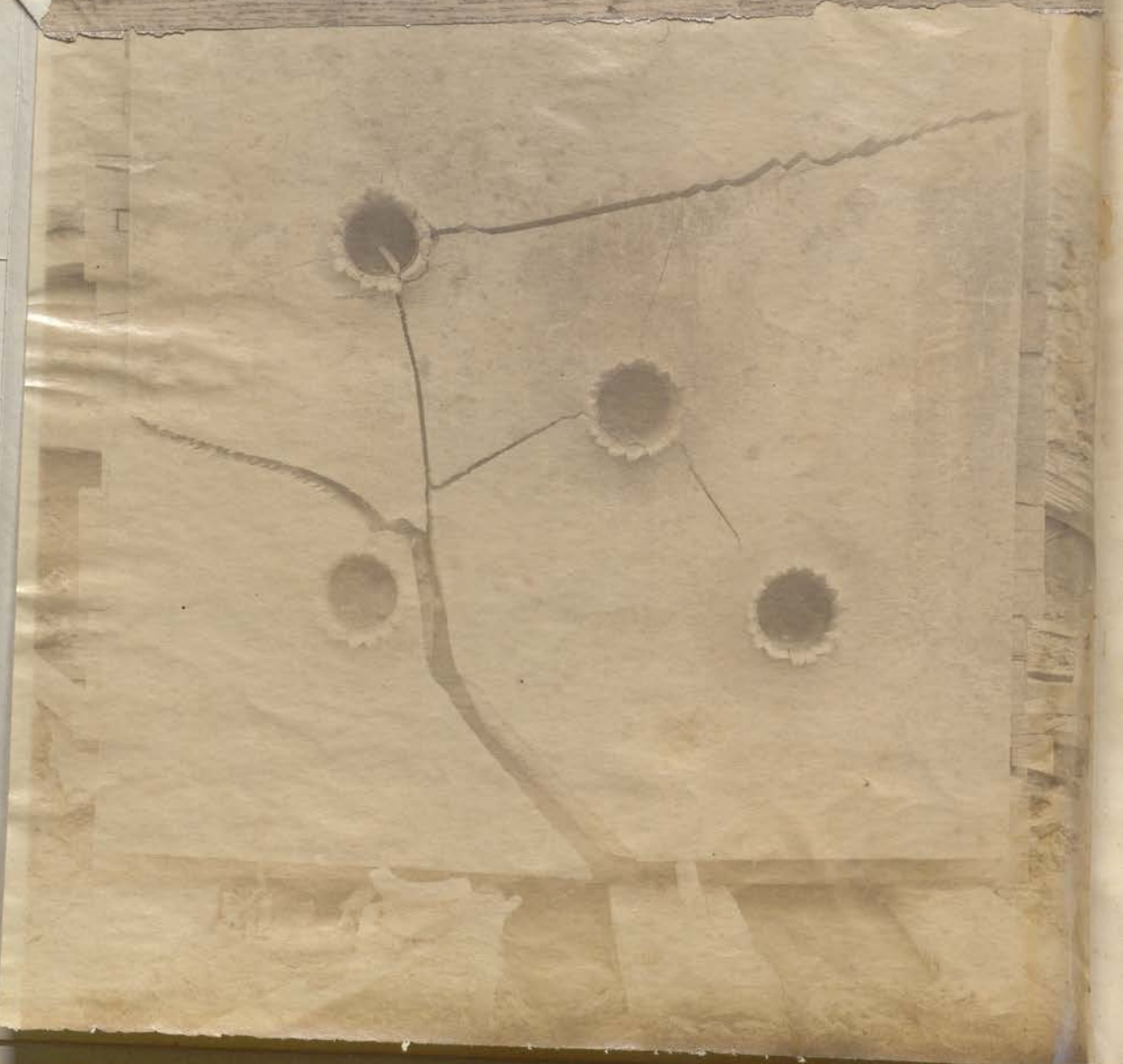
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Both pieces very much set up, the body part into the shape of a mushroom. A number of longitudinal cracks 4" to 6" long and 2.5" in depth opened in borelet, width from a hair to .25". Maximum diameter just above borelet 12.0, tapering to original diameter just above band. Shell shortened 6.17. Cracks already existing were opened out 1" to 2", and 2 new cracks were formed.

Mar. 23

Test of 8" A.S. shell manufactured by Carpenter Steel Co. Tested against a mild steel plate 8' x 8' x 9".

Round (1) # 479 lot 2 - 250 T₅₀. Charge 61 T₅₀ U.S.-18, striking velocity about 1385 f.s. Struck plate 28" from left edge and 30" from top, penetrated plate & backing, glanced from blocking back over plate and 10" to right front. Opened out crack to upper right hand corner, and another face crack downward and to right for about 4.5". Shell recovered entire and unchanged in dimensions. Acceptance of lot recommended.

Round (2) # 1183-V. 250 T₅₀. 61 T₅₀ U.S.-18, striking velocity about 1385 f.s. Struck plate 28" from left edge and 30" from bottom. Raised normal burr and bulge and penetrated plate and backing, 24" of blocking and 6' into earth. Shell recovered entire, slightly set up. Shortened .03" other dimensions unchanged. Acceptance of lot recommended. Two fine cracks from (1) to left to top respectively and the one from (1) downward extended to edge, & opened out. A crack 2"-2 1/2" opened from just above impact to left edge.

Round (3) #1116 lot 1. Impact 4 1/2" from right edge, and 5.7" from bottom. Projectile penetrated plate, normal burr and bulge, two tiers of backing and lodged in last tier. Recovered entire, uncracked; shortened .01; body increased .005. Striking velocity 1585 f.s.

Round (4) #1138 lot 1. Fired with 61 lbs, & striking velocity of 1385. Struck plate in lower right corner raised normal burr and bulge, penetrated plate and backing, 18" of blocking & fell down amongst blocking, entire and uncracked. Shortened .02", body & crownlet unchanged.

All shell easily entered muzzle of gun after being fired, and were of an excellent quality of A.P. shell.

Mar. 28.

Test of S.M.A-43 for the 6" B.L.R.

Round (1) 35 lbs Pressure 9.0 tons Velocity 1696 f.s.

Round (2) 46 1/2 " " 14.3 " " 1987

Round (3) 47 " " 14.6 " " 1991

Round (4) 47 " " 14.1 " " 2007

Acceptance of the lot recommended with charges 35 lbs reduced, and 47 lbs full.

Test of bronze case mount. Fired 44 times with full charges in service 1 pounder, and 25 times in H.R.C. 37 mm.

Mar. 29, '93.

Test of 10" A.P. shell - Carpenter. Fired at a 10" mild steel plate.

striking velocity
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26. Struck
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body increased .03; uncracked. The upper right hand cor-
 ner of plate separated from rest in a crack through
 impact & thrown 60' to right.

Round (4) # 527 lot 9. Charge 120^{FB} U.S. 26, striking velocity
 about 1327 f.s. Struck plate 32" from right edge and 39"

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Mar. 28.

Test

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full charges in service 1 pounder, and 25 times from
 H. R. C. 37^{mm}.

Mar. 29, 93.

Test of 10" A.P. shell-Carpenter. Fired at a 10" mild
 steel plate.

Round (1) # 441 - lot 6. Charge 140 FB U.S.-26, striking velocity about 1461 f.s. Struck plate 39" from bottom and 29" from left edge, penetrated plate & backing, being deflected to right and passing on, being found about 400 yards from plate, in a line 45° to line of fire. Recovered entire, uncracked, shortened .03", body increased .02. Appearance of shot hole normal, plate uncracked.

Round (2) # 444 lot 7. Impact $67\frac{1}{2}$ " from bottom & 53" from left edge. Charge 120 FB U.S. 26, striking velocity 1327 f.s. Penetrated plate and backing, 2' of backing turned upward and fell to earth about 50 yards in rear of plate. Recovered entire, uncracked, shortened .12", body increased .05". A crack opened in plate in line of two impacts, another from (1) to right & downward to bottom, and a triangular, measuring 27" along upper edge wood weighing about $1\frac{1}{2}$ tons was detached and fell behind backing amongst blocks.

Round (3) # 492 lot 8. Charge 125 FB U.S.-26. Struck plate with velocity of about 1360 f.s., raising normal burr & dishing plate in upper right corner slightly, penetrated plate & backing, deflected upward, & fell 100 yards behind target. Recovered entire, shortened .04" body increased .03", uncracked. The upper right hand corner of plate separated from rest in a crack through impact & thrown 60' to right.

Round (4) # 529 lot 9. Charge 120 FB U.S.-26, striking velocity about 1327 f.s. Struck plate 32" from right edge and 39"

from bottom, penetrating plate & backing, being deflected upwards high in the air & falling 800 yards from target. Recovered entire, uncracked, shortened .16", body increased .06". Appearance of plate as in photograph. All projectiles considered to have passed satisfactorily.

Mar. 30.

Test of Bliss common shell for 5" R.F.G.

Filed 12 shell with service charges, projectiles flying smoothly & being satisfactory in every particular. The bases however, were found to be too small to fit properly in mouths of cases.

April 1.

Test of Blake 6 Pdr. A.P. shell.

Three shells were tested, the first being fired against a piece of 3" deck plate about 5". The last two against a piece about 8' x 8'.

Round (1) Service charge, striking velocity about 1800 f.s. Struck plate normally, the point getting through but wall remaining in hole & base rebounding.

Round (2) Striking velocity about 1760 f.s. Behavior very similar to round (1).

Round (3) Striking velocity same as (2). Shell lodged in plate, & broke up, point about 2 1/2" beyond back of plate.

April 5, 93.

Test of 6" A.P. shell - Carpenter lot 1. Fired at a plate of unknown characteristics, but believed to be of lam-



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on Hotchkiss block. Blow-

ell, lots 10, 11, 12, 13, fired
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velocity of 1350 f.s.
plate 35" from right
normal burr r
dashed plate slightly, and re-
bounded falling close to plate. Recovered entire,
set up, but without cracks. Shortened .50", body in-
creased .25", 12" from base. A small crack opened

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Mar. 30.

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April 1.

Test of Blake 6 P
 Three shells were
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 Round (1) Service
 1800 f.s. Struck plate
 through but wall re-
 bounding.

Round (2) Striking
 very similar to round
 Round (3) Striking
 in plate & broke up
 of plate.

April 5, 93. Test of 6" H.P. shell - Carpenter Lot 1. Fired at a plate
 of unknown characteristics, but believed to be of Lam.

mered steel from the Bethlehem Iron Company.

Round W #1521 lot 1. Charge 27 to SMA-38, striking velocity 1459 f.s. Struck plate, raising normal burr & bulge penetrated plate & backing & fell amongst blocking. Recovered entire not cracked shortened .11", bournlet increased .01, body increased .035". Easily reentered muzzle of gun. Plate showed four fine radial cracks. Acceptance of shell recommended.

April 7. Test of Sponell 1 Pdr. R. P. G. 10 shots in 32 seconds. 60 shots in 202 seconds. Mechanism of block disassembled in 30 seconds, reassembled in 1^m 10^s. Block worked well ejecting cases properly, & without injury. A disadvantage in position of lever & of locking. Faulty arrangement in locking so that gun may be fired before mechanism is locked. Slight improvement if any on Hotchkiss block. Blow-backs properly provided for.

April 12. Test of Carpenter 10" A.P. shell, lots 10, 11, 12, 13, fired at Onizois 14" nickel steel plate, charges of 140 pounds U.S.-27, and striking velocity of 1350 f.s. Round W #545 lot 10. Struck plate 35.5" from right edge and 23" from top. Raised normal burr & bulge, penetrated 14.4", dished plate slightly, and rebounded falling close to plate. Recovered entire, set up, but without cracks. Shortened .50", body increased .25", 12" from base. A small crack opened

from impact to right & downward for 16", another from old lower right impact to right & upward for 26", and another from top downward passing to left of impact about 2" from it, on to old impact just below.

Round (2) # 573 lot 11. Struck plate 25" from top and 70" from left edge. Penetrated 13.8 & rebounded entire & set up, but not cracked. Shortened .25. Body increased .11.

Round (3) # ~~573~~⁵¹⁸ lot 12. Struck plate 30 1/2 x 80. Penetrated 13.2. Rebounded 30'. Shortened .62, Body increased .34. Five fine cracks one to two inches long in just below courselet.

Round (4) # 583 lot 13. Penetrated 13.1, & rebounded entire & set up. Shortened 1.0, Body increased .44. Seven fine longitudinal cracks similar to those of # 618.

In each shell it was noticed that it was set up uniformly ^{from the base} to a point about 2" below courselet, where there was a distinct ridge showing the extent of the hardening.

All shells were considered to have behaved very well, the test probably being more severe than usual.

Another round being necessary to the proof the gun used, a cast iron shell was fired at plate with a charge of 240 pounds U.F. 27, wrecking the plate.



round (3), and 16.0 tons for round 4. Shell behaved very well, the bourrellet on front of band probably causing sharper sound.

Dimensions of Taylor Shell.

Length	
Bourrellet	9.93
Body ₁	9.82
Body ₂	9.82
Body ₃	9.93
Band	10.13
Rear.	9.87

The shell weighed 45-6 pounds each, and it is doubtful if they can be brought up to standard weight by bursting charge alone.

from impact to right & down...

...erred to have behaved very well, the test probably being more severe than usual.

Another round being necessary to the proof the gun used, a cast iron shell was fired at plate with a charge of 240 pounds U.F. 27, wrecking the plate.

April 16. Explosion of 4" Shrapnel, # 205 - lot 4. Head detachable.

Weight empty 3 4/2 pounds

Charge (shell powder) 150 grammes

No. pieces Lead 6

Weight of all pieces 3 1/4 pounds

Head blew off, and broke up, and balls scattered well. Continuation of experiment of January 24.

Four of these same shrapnel were fired down the range, flying normally.

April 17. Test of Taylor cast steel common shell for 10" B.L.R.

Round (1) Cast iron, weight 500 ^{226 to U.S. 26.} Pressure 14.5 tons. Fired as a standard with which to compare the others. Flew normally & struck about 10000 yards down the range.

Round (2) Taylor shell #1. Charge 226 to U.S. 26. Pressure 14.4 tons. Flew smoothly with a somewhat sharper sound than the cast iron shell, & appeared to strike at a somewhat less range. The other two shells were fired with same charges, and at same elevation -10°. Behaviour similar to that of round 2, pressures being 14.5 tons for round (3), and 16.0 tons for round 4. Shell behaved very well, the bourrelet on front of band probably causing sharper sound.

Dimensions of Taylor shell.

Length	
Bourrelet	9.93
Body	9.82
Body ₂	9.82
Body ₃	9.93
Band	10.13
Rear.	9.87

The shell weighed 456 pounds each, and it is doubtful if they can be brought up to standard weight by bursting charge alone.

April 18. Recommendation as to treatment of base of shell which may be too small to be gripped by mouth of cartridge case. To paint the base with a mixture of red lead in oil mixed with litharge until of a thick pasty consistency. The base of the shell with this coating was then forced into case and allowed to remain 48 hours. At the end of that time the paint was found to have hardened & to hold the shell tightly in the case. By this means unsewiceable shell may be made sewiceable.

April 18. Test of U.F.-28, for the 10" B.L.R.

Round (1)	180 75	Pressure	11.5	Velocity	1726 f.s.
Round (2)	200 75	"	12.3	"	1799 f.s.
Round (3)	220 75	"	16.0	"	1934 f.s.

April 20. Test of Grenfell night sights.

Sights to be shipped over regular sights and current supplied from a portable storage battery. Tested at night the line of sight was easily caught by the eye, and were not affected by firing. Besides being good night sights, they are also good as day sights, and do not give any light to the front when in operation at night. Pitkin's improved battery was used to run the lamps, doing the work very satisfactorily. Outfit commended for service.

April 18. Test of P.W. Gave a maximum velocity of 2082 f.s. with a pressure of 14.3 tons, charge 720 grammes.

April 20. Test of VZ-6, and VZ-8, and VZ-7.

VZ-6 gave 2258 f.s. with 16.0 tons pressure & 25 $\frac{1}{5}$ lbs.

VZ-8 gave 2240 f.s. " 16.2 " " & 25 $\frac{1}{2}$ "

The rejection of both lots recommended.

VZ-7 gave 2226 with 25 $\frac{1}{5}$ lbs & 14.0 tons pressure

VZ-7 gave 2310 with 26 $\frac{1}{2}$ lbs & 16.0 tons "

April 24. Subcalibre Range practice with 1 & 6 Pdrs. R.F.G.

Regular service Winchester cartridges used, ranges plotted by plane tables, no lateral deviation or times of flight being taken. Axis of gun 12' above water level.

1 Pdr. 0° Mean range 290 yds.

1° " " 340 "

2° " " 629 "

3° " " 808 "

6 Pdr. 0° " " 315 "

1° " " 550 "

2° " " 760 "

3° " " 1095 "

4° " " 1256 "

April 27. Report on Hydraulic mount for 10" gun of the Maine.

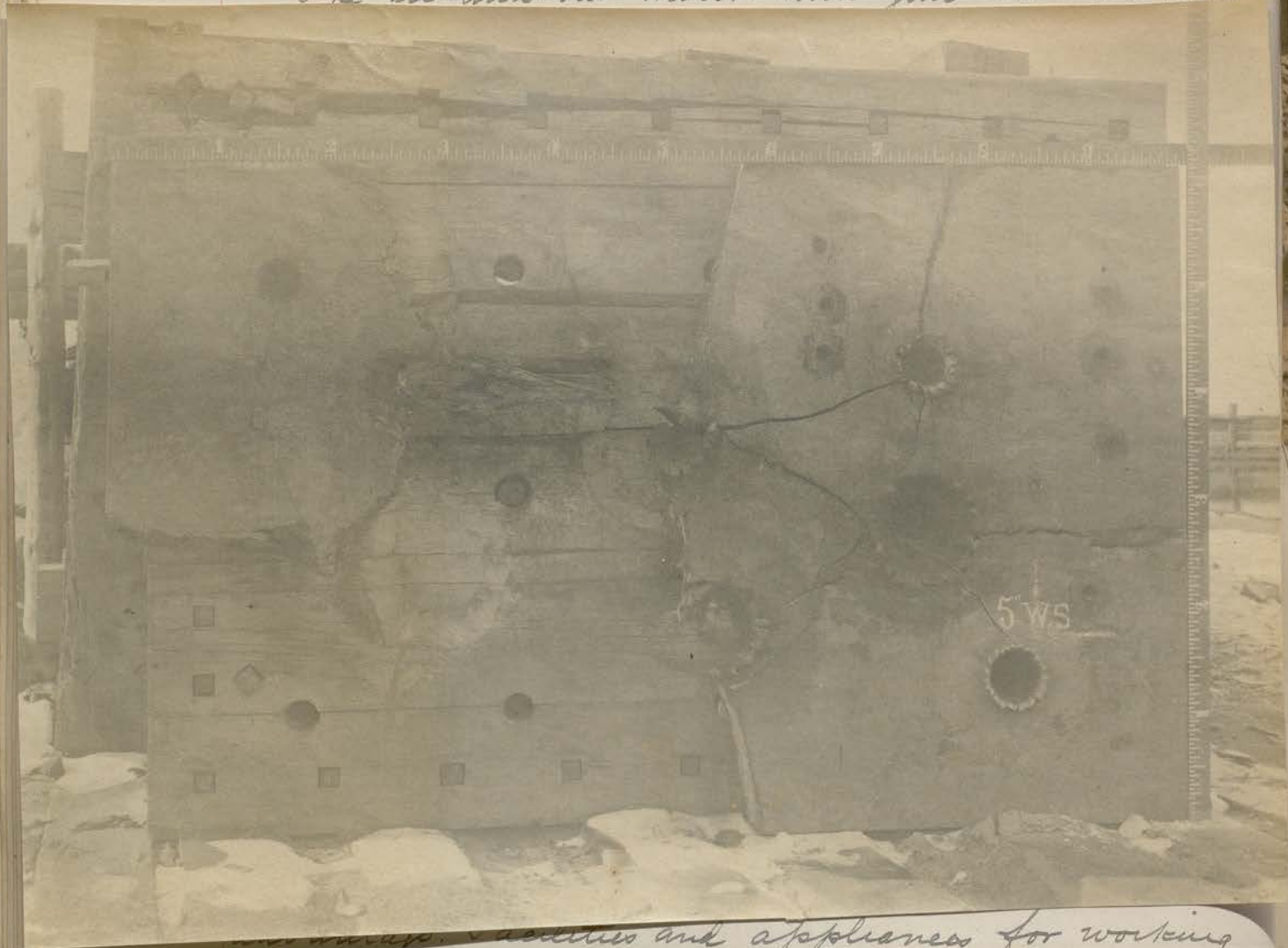
Recoil was smooth & uniform at all elevations.

Friction clutch worked well & held gun out when

elevated, and relieved itself easily when run in by power.

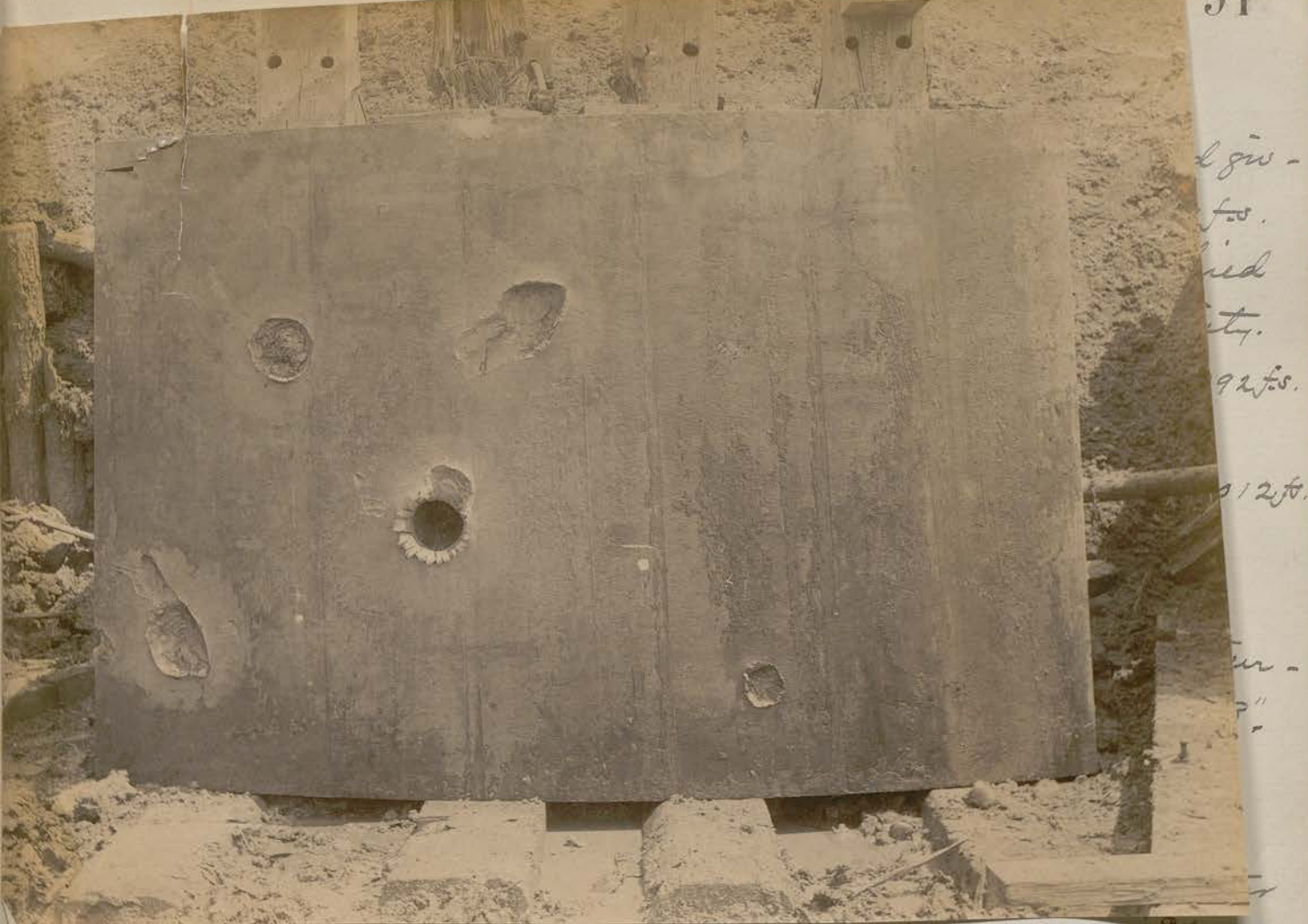
The pressure valve on the elevator works quickly & satisfactorily, but the exhaust valve has too small an opening causing loss of time in depressing breech.

The in-and-out motor runs gun in & out with



...access and appliances for working by hand should be provided.

April 27. Test of returned ^{6" B.L.R.} powder from U.S.S. Charleston.
The powder was in a bad condition,



A.P. shell 1265 lot 2, striking velocity 1762 f.s. Struck
 plate 31" from bottom and 45" from left edge,
 penetrating plate with point about 2" into wood
 backing behind, raised normal burn and bulge
 and rebounded 40', slightly set up. Plate un-
 cracked, backing sound. Projectile shortened .09",
 Goumet increased .01, body increased .05.

Round (2). Charge 42.4 lb register 142. Carpenter A.
 P. Shell #1330 lot 2. Velocity calculated from charge
 1965 f.s. Projectile broke up, either in the gun or im-
 mediately after leaving it, and struck plate in
 three places. One piece, probably the point, struck
 the plate 26" from top, 26.5" from left edge, about

elevated, and relieved itself easily when run in by power.

The pressure valve on the elevator works quickly & satisfactorily, but the exhaust valve has too small an opening causing loss of time in depressing breech.

The in-and-out motor runs gun in & out with fair speed, the valve tripping gear sometimes working automatically at other times requiring to be worked by hand. The piston valves leak.

The rammer worked efficiently but the telescopic joints & piston valve leaked.

Grip handles should be provided with loading tray and the level of shot locker should be same as the tray otherwise the projectile drops on entering gun and might damage the tray.

Inside of cylinders should be very smooth, to prevent tearing of bag when ammunition is entered.

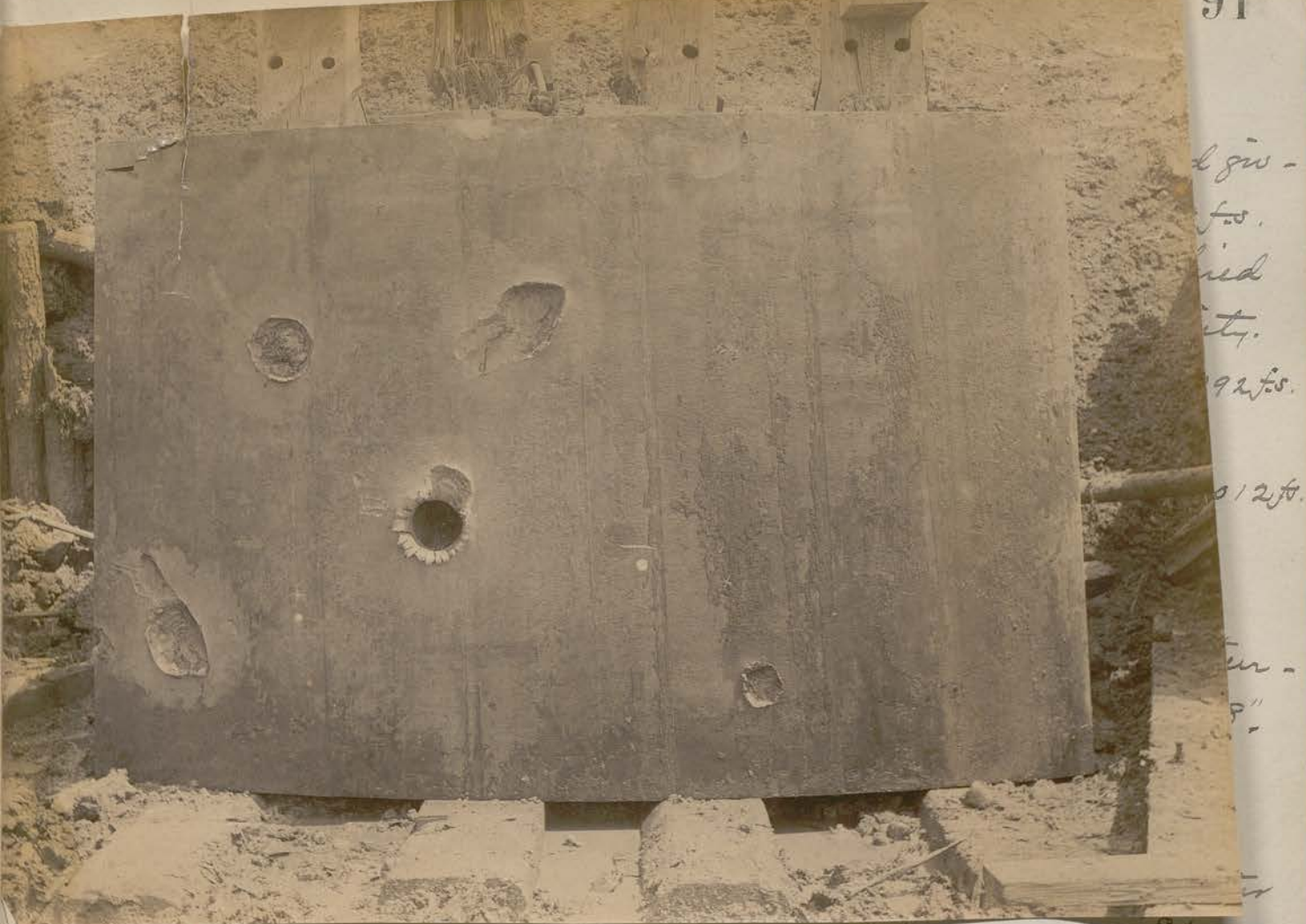
Gas checks and breech mechanism worked well.

The block was easily withdrawn but more difficult to force up the incline.

The complications in gear, number of levers, & machinery necessary to work the gun are a disadvantage. Facilities and appliances for working by hand should be provided.

April 27. Part of returned ^{6" B.L.R.} powder from U.S.S. Charleston.

The powder was in a bad condition,



A.P. shell 1265 lot 2, striking velocity 1762 f.s. Struck
 plate 31" from bottom and 45" from left edge,
 penetrating plate with point about 2" into wood
 backing behind, raised normal burn and bulge
 and rebounded 40', slightly set up. Plate un-
 cracked, backing sound. Projectile shortened .09",
 diameter increased .01, body increased .05.

Round (2). Charge 424 to register 142. Carpenter A.
 P. Shell #1330 lot 2. Velocity calculated from charge
 1965 f.s. Projectile broke up, either in the gun or im-
 mediately after leaving it, and struck plate in
 three places. One piece, probably the point, struck
 the plate 26" from top, 26.5" from left edge, about

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April 27. Part of returned ^{6" B.L.R} powder from U.S.S. Charleston.
The powder was in a bad condition,

covered with τ damp inside τ out.

Three charges of 49.5 lb of Register 43 were fired giving mean pressure of 4.7 tons, τ velocity of 1258 f.s.

Three charges of 47 lb of Register 44 were then fired giving mean pressure of 4.4 tons τ 1244 f.s. velocity.

Register 43 gave 14.1 tons pressure τ a velocity of 1992 f.s. with charge of 50 lb on test of March 2, 1889.

Register 44 gave 14.7 tons pressure τ a velocity of 2012 f.s. with charge of 48 pounds in test of March 26, 1889.

Test of nickel steel curved plate representing turret armor of the "Monterey". Thickness of plate 8". Attack made by 6" B.L.R., and Carpenter and Holtzer A.P. projectiles.

Round (1). Charge 341 lb , register 143; Carpenter A.P. shell 1265 lot 2, striking velocity 1762 f.s. Struck plate 31" from bottom and 45" from left edge, penetrating plate with point about 2" into wood backing behind, raised normal burn and bulge and rebounded 40', slightly set up. Plate uncracked, backing sound. Projectile shortened .09", diameter increased .01, body increased .05.

Round (2). Charge 424 lb register 142. Carpenter A.P. Shell #1330 lot 2. Velocity calculated from charge 1965 f.s. Projectile broke up, either in the gun or immediately after leaving it, and struck plate in three places. One piece, probably the point, struck the plate 26" from top, 26.5" from left edge, about

the spot selected to have the projectile strike had it remained entire. This piece penetrated to a depth of 2" or 3", and if it were the point would lead to the supposition that the projectile broke up after leaving the gun. The largest piece of the projectile struck the plate sideways, making an irregular dent about 2" deep just above centre of plate. Other fragments struck plate and earth and timbers about it.

Round (3) Charge 42.4 ~~75~~, register 142. Carpenter A.P. shell # 1071 lot 1. Calculated velocity 1965 f.s. This shell broke up similarly to that in round (2), probably a little later however as all pieces were not so scattered, and no piece struck with original direction. Largest fragment struck in lower left corner making an irregular dent 12" by 5" about 1 3/4" in depth.

Round (4). Charge 42.4 ~~75~~ register 142. Holtzer A.P. shell # 54. Striking velocity 1965 f.s. Struck plate 51.5" from right edge and 27.5" from bottom of plate. Projectile penetrated plate and backing and about 16" of oak structure behind & buried itself in butt. Shot hole & bulge were normal in character plate uncracked.

By this round the plate was decided not to have passed the premium test and was next subjected to the reception test consisting of

Round (5). Charge 35 ~~75~~ register 142. Holtzer A.P.

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Round (1). # 205 lot 1. Striking velocity 2000 ft. per sec.
Struck plate 18" from the right edge and 38" from the bottom, raising normal burr & bulge, penetrating plate, point of shell getting into front face of wood backing about 2". Upper part of plate thrown down. Projectile rebounded very much set up, and with seven fine longitudinal cracks running down over shoulder of ogival into bourellet. point of projectile made very blunt, the metal there appearing softer than in same part of armor piercing shell usually submitted. Plate considerably cracked around impact. Projectile shortened 1.47, bourellet increased 38, body

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Round (4). Charge 42.4 R register 142. Hertz
A.P. shell #54. Striking velocity 1965 f.s. Struck plate
5.5" from right edge and 27.5" from bottom of
plate. Projectile penetrated plate and backing
and about 16" of oak structure behind & buried
itself in butt. Shot hole & bulge were normal
in character plate uncracked

By this round the plate was decided not to
have passed the premium test and was next
subjected to the reception test consisting of

Round (5). Charge 35 R register 142. Hertz A.P.

shell #9. Striking velocity 1809 f.s. Struck plate 19" from bottom and 28" from left edge, penetrating plate & remained sticking in hole, base of projectile out 3/4 from face of plate, giving a penetration for the point of about 6" into the backing. In penetrating the axis of the projectile turned slightly as if to place itself normal to plate. Plate uncracked, backing sound.

The lot of armor represented by this plate was then considered to have passed the test for acceptance.

May 2.

Test of Wheller Sterling 6" A.P. shell, lot 1.

Attacking a 6" mild steel plate backed by 36" oak.

Round W. # 205 lot 1. Striking velocity 1800 f.s. Struck plate 18" from the right edge and 38" from the bottom, raising normal burr & bulge, penetrating plate, point of shell getting into front face of wood backing about 2". Upper part of plate thrown down. Projectile rebounded very much set up, and with seven fine longitudinal cracks running down over shoulder of ogival into barrel. point of projectile made very blunt, the metal there appearing softer than in same part of armor piercing shell usually submitted. Plate considerably cracked around impact. Projectile shortened 1.47, barrel increased .38, body

increased .41 at lower edge of binnacle. From there to base distortion grew uniformly less. This shell having failed to get through the plate the lot should have been rejected, but the second shell of the lot was fired for information.

Round (2) #341 lot 1. Striking velocity 1540 f.s. Impact 22" from bottom 16" from right edge. Penetrated plate & backing, locking & buried itself in earth behind butt. Recovered entire, with one fine crack in shoulder of ogival 1.5" long, shortened .12 binnacle increased .07, body increased .04. Lot recommended to be rejected.

May 4.

Test of VZ-9, for the 5" R.F.G.

Round (1) 18 $\frac{7}{16}$ Pressure 8.0 tons, Velocity 1862 f.s.

Round (2) 26 $\frac{1}{2}$ " " 15.8 tons " 2302 f.s.

Round (3) 26 $\frac{1}{2}$ " " 16.2 tons " 2301 f.s.

Round (4) 26 $\frac{7}{16}$ " 16.0 tons " 2289 f.s.

Recommended to be accepted, charge to be 26 $\frac{7}{16}$

May 5.

Ranging the 5" R.F.G.

Weather favorable, dry, calm. Deviations measured by theodolite to centre of splash, fall plotted by plane tables. Gun laid on line of fire by by aerial sights, elevations determined by quadrant, theodolite in line of fire. Times of flight and ricochets not measured.

Muzzle velocity 2300 f.s., common shell of 50 lbs, brass cases. Shell loaded to weight with base fuze but uncharged.

Powder	Charge	Elevation	Deviation	Dev. yards	Range yds.	
Y2-7	26.1	1°30'	4' R	2.7	2311	Band struck at 200 yds.
	26.1	1°30'	4' R	2.7	2313	
	26.1	1°30'	6' R	4.8	2321	
	26.1	2°00'	9' R	7.1	2721	Band struck just before impact
	26.1	2°00'	8' R	6.3	2721	
	26.1	2°00'	8' R	6.2	2707	
	26.1	3°00'	10' L	10.3	3547	Band struck at muzzle. Shell ^{had} not
	26.1	3°00'	11' R	11.2	3517	
	26.1	3°00'	20' R	19.1	3287	Band struck at 100 yards.
	26.1	3°00'	12' R	12.0	3447	
	26.1	3°00'	12' R	12.1	3477	
	26.1	5°00'	19' R	26.0	4707	
	26.1	5°00'	20' R	26.7	4595	Band struck
2		5°00'	20' R	27.9	4789	
		7°00'	33' R	53.4	5559	
		7°00'	36' R	58.2	5559	
		7°00'	34' R	55.1	5574	
		10°00'	44' R	86.9	6791	
		10°00'	44' R	88.8	6937	
		10°00'	42' R	83.3	6821	
		13°00'	50' R	114.8	7893	
		13°00'	53' R	121.6	7881	
		13°00'	58' R	130.0	7701	
		0°30'	Det. obs.	—	1165	
		0°30'	"	—	lost	Shell broke up in gun.
		0°30'	"	—	1191	

May 9, 1892

Test of Mn-2 in 4" R.F.G.

Sticks tied up in bundles, ignition by one grain of black powder. Very little smoke in the blast, projectile being seen from within 10 feet of the muzzle. Bright flash from muzzle & empty case in some cases after firing. Mn-2, #166, & projectiles of 33 pounds.

Round (1)	Charge	6.0 lbs	pressure	15.4	velocity	2156 f.s.
(2)	"	6.0 lbs	"	14.2	"	2112
(3)	"	6.0 lbs	"	15.2	"	2140
(4)	"	6.0 lbs	"	15.4	"	2150
Mn-3 #171 (5)	"	6.0 lbs	"	13.2	"	2024

May 13.

Test of pipe-graphite as bands for 6" shell. Bands calibred from 6.16 to 6.24, shell being fired at velocities from 1750 to 2050 f.s. muzzle velocities. All of the shell tumbled in flight and fell at about $\frac{1}{2}$ to $\frac{2}{3}$ normal range. Material not sufficiently tenacious.

May 11

Test of Amphitrite's side armor. Nickel steel 9" thick from Carnegie, Phipps & Co.

Round (1) Carpenter's A.P. shell # 809-B-7, charge 61 lbs WT-18, striking velocity about 1391 f.s. Point of impact 52" from left edge and 45" from bottom. Penetrated 10" just reaching back of plate & exposing backing. Shell rebounded entire set up, shortened .72, bounelst increased, 15" body increased .39" about 14" from the point. Plate uncracked, and backing undisturbed.

Round (2) Carpenter's A.P. shell # 836-5, charge 86 lbs

W-18, striking velocity 1672 f.s. Point of impact 29" from left edge and 30" from bottom of plate. Shell penetrated plate & lodged in backing base 29 $\frac{3}{4}$ " in from face of plate. Plate uncracked & backing undisturbed. Armor represented by this plate considered to have successfully passed test for premium & so recommended.

May 17

Test of Mn-3 in 5" R.F.G.

Round ① 11.75 lbs Com. shell 50 lbs pressure 12.8 tons, M.V. 2293.

May 18.

Accident to 6 Pdr. R.F.G. #105 long. Mount recoil #73

In firing with service charges, the gun recoiled with such violence as to strike against rear end of slide & drive it back $\frac{1}{8}$ ". No reason to be ascribed to the cause.

May

Test of Mn-2 in 1, 3, & 6 Pdr. R.F.G. All the powder that could be gotten in cases was put in. Ignition by means of 20 grammes musket powder held between tissue paper discs.

3 Pdr. Round ①	450 grammes	pressure	9.5 tons	1909 f.s.	M.V.
#183 (2)	.75 lbs	"	9.0 "	1934 "	M.V.
#183 (3)	.75 lbs	"	8.0 "	1912 "	"
1 Pdr. Round ①	#172, 95	grammes,	pressure 5.4,	M.V. 1295 f.s.	
(2)	#177, 95	"	" 10.5,	" lost	
(3)	#177, 95	"	" not obs.	" 1302	
6 Pdr Round ①	470	"	" 9.8	" 1782	
(2)	#183, 420	"	" 8.2	" 1694	
(3)	#183, 465	"	" 8.2	" 1657	

May 24.

Experiment of firing 3, 5 & 6 Pdr Art. shell at a $\frac{1}{2}$ " steel plate, also a 6" B.L.R.

(1)	3 Pdr. M.V. 800 f.s.	Depression $1\frac{1}{4}$ " on front,	back bulge 2"
(2)	" M.V. 2002 f.s.	" 1.4" " "	" " 2.6
(3)	6 Pdr. M.V. 800 f.s.	" 1.4" " "	" " 2.1
(4)	" M.V. 1818 f.s.	" $3\frac{1}{4}$ " " "	" " 1.9
(5)	6" B.L.R. M.V. 800 f.s.	" 7" " "	" " $7\frac{3}{4}$ "
(6)	" M.V. 2000 f.s.	" 5" " "	" " 6"

May 25.

Test of smokeless powder in 6" B.L.R., of 30 caliber. Same charge fired in all rounds. In every case there was a bright sheet of flame extending about 40' from muzzle, the energy of this blast being considerably greater than that of the full charge of brown powder. The bore after each round found full dark purple smoke and fumes. On opening breech after rounds 3, 4, and 5, a quick flash of flame occurred extending to rear & from 2 to 4 feet, taking place in about a second of time after opening breech. Blast almost smokeless and quite transparent. The 30 caliber gun is considered too short to obtain good results with this powder, all the powder not being consumed probably in the 40 caliber gun.

Round (1) M.V. 7# 180, 2d grade 25th pressure 15.1, M.V. - 2203

(2) " " " 25th " 16.1 M.V. - 2225

(3) M.V. 7# 180, 1st grade 25th " 11.1 M.V. - 2028

(4) " " " 25th " 11.0 M.V. - 1983

Test of Smokeless powder continued

Round (5)	MN-7, #180X @ 2d grade	25 ⁷⁵	pressure 16.5"	M.V.	2260
(6)	" " " "	25 ⁷⁵	" 16.4"	M.V.	2249
(7)	MN-7 #180, X @, 1st grade	25 ⁷⁵	" 10.8"	M.V.	1948
(8)	MN-7 #174- ^{#179--21⁷⁵} #174- 4 ⁷⁵	25 ⁷⁵	" 11.1"	M.V.	2103

May 27.

Test of lots 14 & 15, Carpenter 10" S.P. shell. Fired at the 14" nickel steel plate of the "Organ", with striking velocity of about 1350 f.s. & charge of 140⁷⁵ M.V.-27.

Round (1) ^{#706-14.} Struck centre of triangular point of impact about 2 calibres distant from each edge. Broke up fragment into 3 pieces and passed through backing and about 10' into earth behind. Recovered entire shortened .14", Courelit increased .02", body increased .04 at 12" from the base.

Round (2) #646 Lot N. Struck near centre of a rectangular piece about 16" from nearest edge. Penetrated until point was just through rear face, and rebounded entire & without cracks. Shortened .69", Courelit increased .12", body increased .28 at 10.5" from base.

Performance considered satisfactory, & acceptance of lots recommended.

May 29.

Test of Harvitz American Company electric welded steel common shell. In the lot were 26 shells, four of which (1) were high carbon points to low carbon bodies & Harvitz inside & out, five (2) were low carbon

points welded to low carbon bodies, and Harvey-ized outside only, and the other seventeen⁽²⁾ were high carbon points to low carbon bodies, & Harvey-ized outside only. The test was made against a 3" annealed steel plate, the test taking place in 3 series.

Series (1). One of each the treated shell, and one untreated were fired at a velocity of 2000 f.s. All passed through plate breaking up in doing so. Judging from the holes, the breaking taking place while actually passing through the plate. Interiors of holes made by Harvey-ized shell were rough, that of untreated shell smooth & larger than the others.

Series (2). One of each treated class, and an untreated shell were ^{loaded with} full bursting charge of shell powder and base percussion fuze, & fired with 2000 f.s. velocity at same kind of plate. Interiors of shot holes resembled those of first series. The treated shell exploded after passing through the plate, the flash appearing 3 to 5 feet in rear of it. The fractures viewed from the back were perfectly clean, & free from powder residue. The delivery of the fragments was in the line of fire & beyond the plate. The untreated shell exploded while passing through the plate, the base and other fragments falling to the several hundred yards, the front part of shell getting through.

Series (3). One ^{shell} of class (1) & (2) and one untreated shell were filled with $1\frac{1}{4}$ lbs of MN-2, & base percussion fuse and fired at 2000 f.s. velocity at same plate. The treated shell exploded beyond the plate, class (1) at a distance of about 3', leaving fracture of back bulge perfectly clean, while class (2) seemed to explode close to plate fouling somewhat the back bulge with powder smoke. Fragments of both these shells got through the plate. The untreated shell exploded while passing through, back bulge being fouled, & pieces of shell falling in front of plate.

Conclusion. That of the three treated classes it is difficult to say which is superior, all however being superior to the untreated shell. Harveyzing seems to be able to carry the bursting charge through a hard steel plate, which the untreated shell is unable to do. No superiority being for the Harveyzing inside and outside, it seems hardly worth while to do this as it is probably more costly.

May 27.

Test of MG in 4" R.F.S. Brown prismatic, manufactured by Dupont.

Round (1) 12 lbs pressure 13.8 M.V. 1946.

Round (2) 13 lbs " 14.8 " 1990

Round (3) 13 lbs " 14.0 " 1990

Round (4) 13 $\frac{1}{4}$ lbs " 15.2 " 2004

Recommended to be accepted, weight of charge 13 $\frac{1}{4}$ lbs

June 1.

Test of new type carriage for 4" R.F.G.

Twenty-five rounds were fired rapidly at a target 1200 yards distant, with a crew of four men. Everything connected with carriage worked well. Training is quick easy and powerful, elevating gear strong and efficient. Gun captain can align gun on object without interfering with loading. Back lash is unimportant, and elevation does not change after firing. When the eye is close to the sights (to the rear sight) correct sighting is difficult. Recommended a peephole for rear sight. Hand-wheel connected by sprocket chain to main training shaft suggested.

May 29.

Test of VV-5. Brown prismatic manufactured by Dupont for 12" B.L.R.

Round (1) 325 T₆ pressure 9.5 tons M.V. 1701Round (2) 425 T₆ " 22.0 tons M.V. 2060(3) 360 T₆ " 11.7 tons M.V. 1816(4) 380 T₆ " 14.4 " " 1926(5) 405 T₆ " 17.0 " " 1974(6) 400 T₆ " 14.0 not obs.

Recommended to be accepted for reduced charges only, charge 325 pounds.

June 1

Test of U.F.-29. Brown prismatic manufactured by Dupont for 10" B.L.R.

Round (1) 180 T₆ 11.3 tons 1771 f.s.Round (2) 220 T₆ 15.4 " 1993 f.s.

Test of U.S. 29, continued

Round (3) 222 lbs 16.0 tons 2010 f.v.

Round (4) 221 lbs 15.9 tons 2000 f.v.

Recommended the acceptance Reduced charge 170, Fuel 220 lbs

June 2.

Test of Gun full night sights, continued from page
In sighting on an object just visible at twilight the black framework of the sights gives a good line of sight and when the lights are turned on, the object is still plainly seen in line with sights. As darkness comes on the illumination of the sights becomes more brilliant, but the amount of light is so small as not interfere with the sight by glare. When darkness has advanced far enough to obscure the ^{object} sight the sights are still bright & could be aligned on any visible target as a light. There is no glare from these sights.

June 3.

Target practice with smokeless powder in the 4" R. F. G.

Seven rounds were fired rapidly, using $5\frac{1}{2}$ lbs of M76-3, #171, giving about 120 tons pressure and 1950 f.v. velocity.

The blast was practically smokeless. The bore after each round was full of dark fumes, which was blown out in the next round, & obscured target for several seconds. The day was calm, & the masking of the target became serious, the firing being too rapid to allow the fumes to dissipate themselves. When the breech

Target practiced with smokeless powder in 4" R.F.C. was opened there was the usual bright flash to the rear.

The cartridge bag added little if any to the smoke Phenomena of firing due to incomplete combustion of powder, forming vapor which explodes when mixed with sufficient quantity of air.

June 3.

Smokeless powder in 3" B.L.R. of 30 caliber. One grain of black powder used for ignition. Blast showed bright flame about 10' from muzzle. No flash on opening breech, only yellowish-brown fumes, darker than those in the bore.

Round (1) $\left. \begin{array}{l} \text{Reg 1. 1st grade } 15 \frac{7}{8} \\ \text{20 } \frac{7}{8} \\ \text{Reg 2. } \quad \quad \quad 9 \frac{1}{4} \end{array} \right\} 44 \frac{9}{16} \text{ pressure } 9.5 \text{ tons M.V. } 1810 \text{ fs.}$

June 6.

Test of Hawkeyed 4" Common Steel Shell - American Co. See page 99.

One shell each of (1) & (3) and one untreated shell were loaded ^{with m.n. 2} & fired with full service charges at a 3" steel plate.

The Hawkeyed shell penetrated plate and exploded about 3' beyond it. The untreated shell exploded on impact, the lead only getting through, the rest of the shell flying to sides & rear with great violence. This test confirmed the superiority of the treated over the untreated shell.

June 6.

Test of Bliss U.S.P.C. shell for 5" R.F.G.

One shell each of lots 1, 2, 3, 14, with loaded with bursting charge of shell powder and base percussion fuse and fired with full service charges at a 3" steel deck plate. All passed through and exploded 3' to 5' behind it.

June 7

Test of M.N.-2, # 178 in 4" R.F.G., ignition by means of 1 grain of black powder weighing about $\frac{1}{2}$ of a pound.

Round (1) 5 T₆ pressure 11.6 T₆ M.V. 1871

Round (2) 5 T₆ " 11.8 T₆ M.V. 1917

Round (3) 5 T₆ " 11.8 T₆ M.V. 1937

June 8.

Test of U.D.-18, a black square grain powder manufactured by Dupont for the G.Pdr. R.F.G.

Pressure 11.9 tons mean of one round of 830 grammes.

Velocity 1805 f.s. mean of four rounds of 830 grammes.

Recommended acceptance + charge to be 830 grammes.

June 9.

Test of 6" B.L.R. Shrapnel, manufactured by American Projectile Company.

Three shrapnel were filled with shell powder, about 320 grammes, and exploded in explosion chamber by percussion.

Weight empty

20

9

4

91

92 $\frac{3}{4}$

91

Charge

320 gms.

315 gms.

315 gms.

Number of pieces

10

55

56

Weight heaviest piece

90 T₆10 $\frac{1}{4}$ 12 $\frac{1}{2}$

Weight of 10 heaviest

91 T₆41 $\frac{1}{2}$ 51 $\frac{1}{2}$

Test of 6" Shrapnel continued

Shrapnel #10 did not explode, the point only being blown off, none of the balls getting out. In the other two shells the balls scattered well but with not very much force.

Three of the shrapnel were then loaded with sand & fired down the range at 10° elevation, flying smoothly and attaining normal range. Two were loaded with $\frac{3}{4}$ lbs shell powder, fused and fired through a 1" wrought iron plate. Both exploded 6 to 8' beyond plate, scattering the balls and fragments remarkably well.

Recommended an increase in powder chamber by lengthening shell so as to carry bursting charge of 1 lb of shell powder, & bringing shell up to normal weight of 100 pounds.

June 9.

Test of mn-7 in 6" B.L.R. See #8, page 99. One charge of 25 lbs, a blend of mn-7-174, and mn-7-179, in bundles of equal weight carefully and uniformly packed in service cartridge bag, and ignited by one gram of black pyrostatic powder. But little flame in the blast, and nothing unusual on opening the breech, the fumes from breech being a mixture of the yellow and very dark brown. The bore was practically clean. The cartridge bag caused but little smoke.

June 11,

Further test of new type 4" R. F. G. carriage.

The mount was blocked so that plane of base was inclined 10° to horizontal. One man trained gun 360° in 30 seconds. The old type carriage required under same conditions $2^m 10^s$ to cover same arc, and caused great fatigue to trainier. With training gear of old type unclamped, the gun was trained 360° in 15 seconds, but gun could not be stopped within 10° of given point when one set revolving. The sights as modified with peep-hole in rear sight act well. No shield required on gun as leaning on it gives no jar.

June 11.

Test of 5 W-12, a black square grain powder representing 100 barrels manufactured by Dupont for the 3 Pdr. R. F. G. (order of Driggs).

Acceptance recommended, charge 710 grammes.

June 13.

Test of Paylor cast steel common shell for 12" B. L. R. Round (a) # 2. charge 400 to VV-3. Shell flew smoothly attaining normal range, and with no abnormal performance of any kind. Pressure observed 17 tons. Round (a) # 4. charge 375 to VV-3. Acted similarly to # 2, with no abnormal performance of any kind. The first shell loaded easily into gun, the second struck a moment as bourellet passed over rifling.

Test of Taylor cast steel shell - continued.
 due probably to residue in bore.

The third shell was exploded in explosion chamber. A charge of 20 lbs failed to explode the shell, the fuze adapted blowing out shell un-injured.

Weight shell empty	765 pounds.
Charge shell powder	30 "
Number of pieces	76
Weight of heaviest piece	44 "
Weight of 10 heaviest	311 "
Weight of all pieces	756 "

Good explosion, the shell going into pieces of almost uniform size. Exploded by electric primer and dry battery.

June 13.

Test of turret sight for New York 8" guns.

The sight consists of a swinging arm pivoted to band on gun behind elevating arcs, the upper end pivoted to slide working in vertical grooves, the rear sight being connected to this slide by a short arm. A seat for the gun pointed is fixed just in rear of sight.

Testing for accuracy & lost motion, twenty times the gun was laid by quadrant on a distant object elevated & depressed & again trained on object, when the sight bar was at its original position. Rounds were fired at level, and elevations of

3°, 5°, and 13°, the sights working well and without strain. Three rounds were fired at a target 300 yards distant, the maximum variation either laterally or vertically being 2", so that all three shells passed through the same hole practically. The rear sight recommended to be fitted as a peep sight. The width of slide recommended to be increased.

June 15. Ensign R. B. Dashiell detached, and Lieutenant N. S. Mason assumed charges as Inspector in charge.

July 1. Test of VY-6, a brown pneumatic powder manufactured by Dupont & Co. for the 12" B.L.R.
 316 lbs gave 9.3 tons, and 1690 f.s.
 410 lbs " 14.8 tons, and 2006 f.s.
 Charges recommended. Reduced 320 lbs, Full 410 lbs.

July 6. Test of Carpenter 12" shell, lot 1.
 Test against a Crewsot 6' x 8' x 12" mounted on a 36" oak backing.
 Round (1) Charge 203 lbs VY-6, striking velocity 1300 f.s. projectile # 20 lot 1. Struck plate 21" from bottom and 21" from left edge, penetrating plate and about 16" of backing, & rebounded 50' to front, entire and uncracked, walls and base somewhat bruised & a piece of the band gone. Shell shortened .23, body increased .58 in diameter.

Round (2) 210 lbs VY-6. Shell # 10 lot 1, 850 lbs. Impact 30"

from bottom, 24" from right edge. Penetrated plate backing, 12" of blocking, and 8' into earth behind butt from which it was recovered entire & uncracked. Shortened .70, body increased .21. Plate badly wrecked, though most of it still adhered to backing by means of bolts.

July 8.

Test of MN-2 #185.

One grain black ignition powder in rear of each charge, and the charge placed in a woolen cartridge bag. Shell weighted to 33 lb

Round (1) 5 lb. Missed screens Pressure 9.6 tons

Round (2) 6 lb M.V. 2409 f.s. " 21.7

Round (3) 5 lb " 1927 " 10.0

Round (4) 5.5 " 2072 " 11.2

Round (5) 5.75 " 2212 " 17.7

A very thin smoke or haze was visible after each round - no flame on opening breech.

July 10.

Test of detonator for 3 Pdr. shell.

Shell fitted with these detonators were fired at wooden screens 1" thick, 2" thick, & 4 ³/₄" thick and at an iron plate 1" thick, and a ¹/₂" steel plate all placed 50' from gun, and none broke up or burst.

Four shell fitted with detonators fired at a 1" iron plate 102' from broke up before reaching a wooden screen 2' beyond.

July 11. Test of 9" nickel steel plate representing armor of Monadnock.

Round (1) Charge 62.2 lb U.S.-18. Hattzer A.P. shell # 7. Striking velocity 1400 f.s. Impact 47.5" from right edge, and 29" from bottom, penetrated plate point getting about 1" into wood backing, & rebounded 30' set up, but entire and uncracked. Shot hole smooth & back-bulge fractured. No cracks in plate. Shell recovered shortened .5", borelet unchanged, body increased .38", 9" from base.

Round (2) Charge 85.9 lb U.S.-18. Hattzer # 47. Striking velocity 1683. Impact 27" from top, 27.5" from right edge. Penetrated plate backing, 12" struck & entered bank for 3'. Normal fringe & bulge. Shot hole smooth and without cracks.

Round (3) 72 lb U.S.-18. Hattzer # 73. Striking velocity 1545 f.s. Impact 28" from top and 43.5" from left edge. Penetrated plate and 3" backing, & rebounded 40' set up but entire and uncracked. Normal fringe & bulge, but no cracks. Shell shortened .57", body increased .4".

Plate considered to have passed test.

July 11. Test of 17" nickel steel plate representing barbettes armor of the Indiana. Attacked by a 12" gun and ^{Carpenter} "12" A.P. projectiles. The plate was curved to a radius of about 15', and measured 12' x 8.5' on face. Distance of plate from muzzle of gun 318'.

Round (1) Charge 210 lb V.Y.-5. Shell # 19 lot 1. Striking velocity 1322 f.s. Impact 42" from upper and 42" from right edge. Left line of fire normal to plate. Shell penetrated

16.5 and rebounded 78', set up, entire, and uncracked.
 Fringe regular 3.5 high, front bulge 2.9 high and 4.2" diam-
 eter. Shot-hole smooth and without cracks. Shell short-
 ened .37, Bournelet increased .03, body increased .15.

Round (2) Charge 257 to VY-5, shell # 23 lot 1. Striking ve-
 locity 1495 f.s., striking energy 13188 ft. Impact 37.5" from
 bottom, and 75" from right edge, and $3\frac{1}{2}$ calibres from
 former impact. Line of fire 85° to plate. Penetrated 20"
 and rebounded 81', entire and uncracked but set up.
 Fringe 3.3, diameter front bulge 41". One long longitudi-
 nal crack in shot-hole, and six smaller ones,
 back bulge fractured, the point just getting through
 plate. A small bulge crack 7" from lower part of impact.
 Structure set back 2". Shell shortened .38", Bournelet
 increased .02, body increased .19

Round (3) Charge 377.3 to VY-5, Index 165. Shell # 9-1.
 Striking velocity 1858 f.s. Striking energy 20370 f.t. Impact
 40" from left edge, 43" from top, $3\frac{1}{2}$ calibres from im-
 pact (2). Line of fire normal. Penetrated plate 40"
 of backing, 24 oak struts, 10 feet rammed earth,
 & passed on falling into river down the range.
 Plate uncracked, fringe 3.3 high, bulge 45" diameter
 Pieces of broken back bulge fell out to front from
 hole. Structure set back 1".

Plate considered to have passed test.

July

Test of Carpenter 8" A.P. shell lot 1B fired at a 9"
 nickel steel plate representing side armor of No.

radnoek, and already attacked by 3-8" A.P. projectile but still sound and uncracked.

Round (1) 8475 W-18. Shell # 1465 lot 1B. 25075. Striking velocity 1656 f.s. Impact 33.5" from bottom, and 27" from left edge. Penetrated plate, 36" oak backing, and 10" into earth behind butt. Fringe 2", bulge 25" diameter, fragments of back-bulge came out of shot-hole & fell in front of plate. Projectile recovered set up and deformed, a piece of the body just below bournelet gone. Two cracks extending around shell from this break, and two fine hair cracks in bournelet. Shell shortened .09, bournelet increased .01, body increased .07.

Round (2) Charge 7475 W-18, shell # 1484-25075. Striking velocity 1572 f.s. Impact 51" from right edge, 26" from top and 3 calibers from other shot holes in same plate. Normal fringe & bulge. Shell penetrated plate and stopped with base 3" in from face of plate. Backing removed and shell found to have broken transversely into 2 pieces with an annular crack around body 6" from base. Fracture irregular beginning about $\frac{3}{4}$ " below bournelet on one side and running diagonally downwards to a point 3.5" below bournelet on other side. Bournelet increased .005, and body just below bournelet .01, the other dimensions could not be taken.

This lot of shell was recommended to be rejected.

July 12.

Test 10" Carpenter A.P. shell, lot 16. Fired at a fragment of the Oregon 14" nickel steel plate.

Charge 140 T₆ W.P. 27. Shell # 729 lot 16. Striking velocity 1350 f.s. Shell struck fragment 21" from right edge 24" from bottom and 12" from a former crack, the point turning a little toward nearest edge in penetrating and rebounded 10' set up but entire and uncracked. Point of projectile just reached backing back bulge fractured, three longitudinal cracks in shot hole. Fragment considerably cracked up. Shell shortened .46, bournelet increased .06, body increased .22.

July 14.

Test of Wheeler Sterling 6" A.P. shell, lot 1. Fired at a 9" nickel steel plate representing armor of No. nadnock, already attacked by 5-8" A.P. shell in previous tests.

Round (1) Charge 35.9 T₆ Smt-42. Shell # 923-1, weight 100 T₆. Striking velocity 1725 f.s. Impact 28" from bottom and 49" from left edge. Penetrated 10.4, and rebounded 40', entire & uncracked. Normal fringe and bulge. Interior of shot hole smooth, star crack in apex. Shell shortened .16, bournelet unchanged, body increased .11. This test was a continuation, or the secondary test of the same lot, which had failed on the primary test. By the secondary test the lot was considered to have passed.

July 14. Test of Wheeler-Sterling 4" A.P. shell. Fired at the same 9" nickel steel plate. Shell weighted to 33 lbs.

Round (1) Charge 10.7 lbs Smt-31. Shell # 313. Striking velocity 1800 f.s. Impact 31" from right edge 29" from bottom. Penetrated 7" and rebounded 60' set up, cracked, and all of base below band gone. Shell was hardened to a point 1 1/4" below crownlet, at which point there was an irregular ridge running around shell. Body increased .1 to .18. Weight of fragment 19.0 lbs.

Round (2) Charge 10.7 lbs Smt-31. Shell # 237-33 lbs. Striking velocity 1800 f.s. Impact 17" from right edge and 42" from bottom. Penetrated 5.9 and rebounded, set up and all of base below band broken off. Long cracks running down over ogival & body. Body increased in diameter .4 to .43, weight of fragment 20.5 lbs.

Lot recommended to be rejected or to be tried against thinner plate.

July 15. Test of smokeless powder M.N.-3 #187. Fired in 4" R.F.G., common shell all loaded to 33 lbs.

Round (1) Charge 5 lbs Pressure 9.5 tons M.V. 1765 f.s.

Round (2) Charge 5.5 lbs Pressure lost M.V. 1904 f.s.

In both rounds there was very little flame in blast, but there was a thin dark smoke or haze after each discharge. No flame or explosion on opening breech but a small quantity of dense smoke.

July 17

Test of American Company 4" Steel common shell lot 12.
Three rounds were fired at 3-1" wrought iron plates
shell passing through without breaking up.

One shell fired down range flew smoothly and
attained normal range.

Lot recommended for acceptance.

July 19.

Test of smokeless powder MK-2 # 185, in 6 Pdr. A.R.F.
Round (1) 450 grms. Pressure 6.2 tons M.V. 1596 f.s.

Round (2) 475 grms. " 8.5 tons M.V. 1695 f.s.

Round (3) 500 grms. " 9.1 tons " 1815 f.s.

7 rounds 510 grms. " 9.6 tons " 1805 f.s. (mean)

Three grammes of musket powder in paper discs were
used for ignition. Each round practically smokeless, slight
flame from muzzle, none on opening breech.

July 19.

Test of MK-2, Brown prismatic powder manufactured
by Dupont for the 4" R.F.G.

14 T₆ gave 14.3 tons and 2004 f.s. M.V.

Acceptance of lot recommended

July 19.

Test of American Co. central tube shrapnel for the 5" R.F.G.
Shrapnel fitted with tap points, and base fuzes, &
weighed as fitted 47 T₆. They could not be brought
up to weight even by filling with lead. Not
more than 8 or 9 oz. of shell powder could be gotten
into shrapnel as a loading charge. Three were

Test in explosion chamber with following results.

	# 4	# 8	# 11
Weight empty	47 1/4	46 3/4	47 3/4
Charge	9.03	9.503	9.5
No. pieces band	3	5	4
No. pieces shell	31	59	48
Weight heaviest piece	10 1/2	7 1/4	6 7/8
Weight 10 heaviest pieces	33	28	31
Weight of all pieces	46 7/8	46	47

Explosions fair. Balls thrown out with moderate force, shell broken into large pieces. Each shrapnel contained about 130 balls of .75 diameter.

Three of these shrapnel loaded with lead to weigh 49 lbs each, were fired down range at an elevation of about 7°, attaining normal range with smooth flight.

Four shrapnel from same lot loaded with 8 to 903 shell powder & fitted with base fuzes, were fired through a 1" wrought iron plate, giving a cone of dispersion of about 20°.

July 20.

Test W 4-3, a brown prismatic powder manufactured by Dupont for the 4" R. F. G.

Three rounds of 13.27 lbs each gave a mean pressure of 15.0 tons and M.V. of 2004 f.s.

Acceptance of lot recommended.

July 20.

Test of American Co. 5" Steel common shell for V.R.F.G.
Two shells were burst in explosion chamber, using dry
battery and electric primers.

	# 1	# 2
Weight empty inc. plug	46.5	46
Charge, shell powder	3 $\frac{3}{8}$	3 $\frac{3}{8}$
No. pieces shell	5.3	4.8
No. pieces band	7	7
Weight heaviest piece	3 $\frac{7}{8}$	6 $\frac{1}{4}$
Weight 10 heaviest	23 $\frac{7}{8}$	27 $\frac{7}{8}$
Weight of all pieces	46	45

One shell loaded with sand fired at a 3" Steel plate
at angle of inclination of about 10°. Shell broke up in
penetrating plate

Another was fired at 3-1" iron plates, penetrating
them without breaking up apparently, but could not
be found. Another shell fired at same 3-1" iron plates
missed them.

Two more shells recommended to be sent down
before final report is made

July 20.

Experiments to determine combined effect of gravity
and resistance of the air on projectiles fired horizon-
tally from a height 89' above level of river.

The time as found from calculating time of
fall of a 1 $\frac{1}{2}$ shell fired from a V.R.F. 1 Pdr was
2 $\frac{3}{4}$ seconds, a little more than time required from
a theoretical calculation of the effect of gravity alone.

July 21. Test of American Co. 4" steel common shell.

One round was fired at a 2" wrought-iron plate penetrating it. Shell was recovered entire but set up at base of ogival, to 4.25.

Four rounds were fired at a 3" wrought-iron plate, all shell penetrating plate but breaking up in passing through.

Lot recommended for rejection.

July 27.

Test 10" Carpenter's shell lots 17, & 18, #10" B.L.R. #11, of 30 caliber on hydraulic mount, was used. Distance muzzle of gun to face of plate 138', axis of gun prolonged passing about 2' over top of plate. Plate was of nickel steel 10' 4.5" x 6' 1" x 10 1/8", being the second half of New York's Barbette armor.

Round (U) 136.875 U.S. 27, Shell # 858 lot 17, 50075, striking velocity 1351 f.s. Gun depressed 20° 20'. Projectile struck plate 28" from right edge, & 28" from top, penetrated plate 36" oak backing, 4' loose timbers & 5' of earth, leaving the butt and rising high in the air, deflected 15° to left of line of fire and fell in the river about 600 yards from gun. Recovered next day set up but uncracked. The burr at impact was 2" high in upper left-hand quadrant; the rest of it was chipped off & fell at considerable distance 300 to 500 yards, from plate. Bulge 22" in diameter. The back bulge to a depth of about 1/2 the plate was slabbed off, leaving an irregular dish-shaped cavity in

the back of plate 18" in diameter. A fine internal crack running from impact upward to the left, showing on the face about 16" from impact as a short hair crack 6" long.

Round (2) Charge 128 lb U.S.-27. Shell # 957 Lot 18,500 lb S.V. 1300 f.s. - gun depressed $2^{\circ}50'$. Impact 28" from bottom and 62" from left edge; penetrated plate, backing, 6" of loose oak blocking, and 12' of earth, and when recovered was entire & uncracked but slightly set up. Burr 2" high, with lower left hand quadrant chipped off, leaving bevel edge similar to that in round (1)

Round (3) Fired before shell of round (1) which was supposed lost, was recovered. Charge 128 lb U.S.-27, Shell # 817 Lot 17,500 lb , striking velocity 1300 f.s., depression of gun $3^{\circ}10'$. Impact 49" from top and 28" from left edge; penetrated plate, 36" backing, oak strut, and about 3' of earth; deflected after leaving butt running along over the ground finally stopping 100 feet to the left & 150' to rear of plate, uncracked and slightly set up. Burr 2" high, bulge 22" in diameter. Back bulge slabbed off similarly to that of rounds (1) & (2)

Dimensions of shell

	# 855-17			# 857-18			# 817-17			
Length	30.59	30.25	.084	30.61	30.49	.12	30.61	30.21	.40	Point # 817-
Bour.	9.94	9.97	.03	9.94	9.94	.00	9.94	10.01	.07	Slightly distorted.
Body ₁	9.91	9.94	.08	9.91	9.91	.00	9.91	10.03	.12	ed. Ridge mark
Body ₂	9.91	10.02	.11	9.91	9.96	.05	9.91	10.11	.20	ing hunting
Body ₃	9.90	9.91	.01	9.91	9.91	.00	9.91	9.92	.01	hardening.
Band	10.14	—	—	10.13	—	—	10.14	—	—	
Rear	9.86	9.86	.00	9.86	9.86	.00	9.86	9.86	.00	

August 1. Secondary test lot 1-B Carpenter 8" A.P. Shell

Gun - 8" B.L.R #15, 30 calibres, C.P. carriage #15. Fired against 2d half of a 10" nickel steel plate representing barbette armor of New York, already attacked by 3-10" A.P. shell. Plate 144 feet from muzzle of gun, line of fire slightly inclined to normal of plate. Charge 65.7 lb W-18 Shell # 1505-1.B, 250 lb. Striking velocity 1450 f.s. Impact 44.5" from left edge and 35" from top. Shell penetrated plate and backing, struck loose oak timbers, & fell about 3' to right of target entire and uncracked, and was afterward entered in muzzle of gun. On striking plate shell turned slightly to right and downwards, forcing off a piece of plate weighing about one ton, and breaking off a number of smaller pieces. Burr 2", bulge 18". Back bulge broken out in slabs. Shell shortened .14, maximum increase in diameter .08 at a point 7" from the base, & shell symmetrical & uniformly set up.

In examining the fractures of this plate, the metal showed up very poorly. Coarse crystals in strata were found in centre of plate, along with blow holes & impurities. It seemed as if plate would split in the middle of its thickness under slight strain.

Test Carpenter 8" A.P. shell lot 2.B, 8" B.L.R. 30 calibres on C.P. mount #15. Fired against same plate as in former test. Charge 65.7 lb W-18. Shell # 1619-2.B, 250 lb. Striking velocity 1450 f.s. Impact on a fragment about $2\frac{1}{2}$ calibres from any edge or crack. Projectile penetrated plate and about 6" of backing, turning slightly up-

ward and to right forcing off part of plate between impact & crack above, & rebounded 6' entire and uncracked. Shell shortened .46, maximum increase of diameter .23 at 6.5" from base. Shell symmetrical and uniformly set up

August 3, 1893.

Angular impact of 6" shell on the 8" curved nickel steel plate of the "Monterey". Hatter's shell #54-100 T₅.

Gun-6" B. L. R. # 125-30 Calibres, C.P. carriage #97

Line of fire inclined to normal at point of impact 22°, plate distant from muzzle 54". Charge 43.4 T₅ S.M.T.-43
Striking velocity 1900 f.s. Impact 43" from left edge and 30" from top of plate. Struck plate at angle of 22°, inclining away from normal to 30° at first, then inclining towards normal as it penetrated plate finally stopping with axis of shell about 18° to normal. Point got through back of plate about 3", giving a penetration in line of fire approximately of 13". Shell broke up the point as far as bourellet remaining in plate, but badly cracked. The base & walls broke up into many pieces, scattering indiscriminately. The left hand portion of fringe was partly broken off, the remaining portion 4" high. Bulge 18" in diameter. Plate & backing set over to left & back 1", plate uncracked.

August 4. Angular impact (former experiment continued)

Round (1) 6" B. L. R. # 125, 30 calibres. C.P. carriage #97

Chase 434 To Smt 43 . Hotter A.P. # 30, 100 To . Striking velocity 1900 f.s. Line of fire 31° to normal. Impact 14" from top, 20" from left edge. Shell first turned away from normal, beginning to bite at an angle of about 50° to normal then turned toward normal as it penetrated, & broke up, most of the pieces scattering, but that portion of the shell as far as the base of the ogival remaining in the plate but broken up. Burr ^{penetration of 9.5" line of fire} partly broken off. Plate and backing set back 1.5" springing back nearly to the original position again. Plate uncracked, bulge about $26" \times 18"$.

Round (2) Same gun & carriage. Carpenter A.P. # 1935-1
Chase 472 To Smt 42 , S.V. 2000 f.s. Impact 24" left edge & 35" from the top, line of fire making angle of 31° at point of impact. Shell behaved similarly to previous shell in round (1) but gave less penetration - about 8.5" in general line of penetration which was inclined about 30° to normal. Shell broke up badly point & ogival remaining in hole, pieces scattering in line of reflexion. Bulge $20" \times 18"$. Structure set back to left about 3" plate uncracked. All the shell in these experiments seemed to break when the shell whipped, due to point getting well into plate.

August 14, 1893. Test 4" R.F.G. # 33.

Ex March 2, 1893, This gun was tested with four rounds, and found unfit for issue to the

service due to a score about .05" depth in the middle of the chamber. Good cases when fired in this gun could be extracted only after 3 to 4 heavy pulls, the case filling out in the score and dragging heavily for a length of about 2". The cases could not be reentered in the gun except by hammering. The rapidity could not have been greater than one round in five seconds. The gun was returned to the Washington Navy Yard and a liner fitted in the chamber.

In the retest of this gun, on the first fire the liner started to the rear about .003, and remained so for subsequent fires without change. The cases struck very badly at times, and could not reentered in this gun or any other 4" gun except with great difficulty. On some of the cases a bulge was quite apparent, being found in the vicinity of the junction of the liner & chamber. On all eighteen rounds were fired from this gun, & then it was returned to the Gun Factory for examination.

August 15, 1893. Angular impact against 8" nickel steel plate of "Morterey"

The plate ^{was backing} was turned upside down & again secured to the target structure. 6" B. L. R. # 120 on C.P. carriage # 97, Hotzler A.P. shell # 71 of 100 pounds weight. Charge 47.2 to S.M. # 42, striking velocity 2000 f.s.

Shell struck plate 45° with normal 22" from top, 5" from left edge, gouged out a groove 6" to left of point of impact, 10" long, 6" wide, 2" ^{maximum} ^{elliptical} depth. Shell broke up and glanced off. Bulge, about 18" x 16". Plate & backing set over to left 2". Plate uncracked.



Chase 39876 Smt. #2. Carpenter A.P. shell #1276-1, of 100 pounds. S.V. 1816 fs. Projectile struck plate 29d x 41a, penetrated plate, backing, 12" and about 8' into earth. A crack, ^{1/8" wide} opened out from middle of impact to left edge

service due to a score about .05" depth in
 when fired
 in this gun could be extracted only after 3 or 4
 heavy pulls, the case filling out in the score
 and dragging heavily for a length of about 2".
 The cases could not be reentered in the gun
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 cases a bulge
 in the vicinity
 ber on all sides
 & then it was
 examination.

August 15, 1893

Steel plate of "Mortier"

The plate ^{& backing} was turned upside down & again ex-
 cured to the target structure. 6" B. L. R. # 125 on C.P.
 carriage # 97, Hotchkiss A.P. shell # 71 of 100 pounds weight.
 Charge 47.2 lbs S.M. 5-42, striking velocity 2000 f.s.

Shell struck plate 45° with normal 22" from top, 5 ft
 of point of impact, 10" long, 6" wide, 2.8 maximum
 depth. Shell broke up and glauced off. Bulge, ^{elliptical,} about
 18" x 16". Plate & backing set over to left 2". Plate un-
 cracked.

August 15. Test 7" nickel steel plate of "Ferro".

Dimensions of plate 75" x 101.5" x 6 7/8", weight N 083 T 00.
 Distance plate to muzzle of gun 61' 9". 6" B. L. R. # 125 of
 30 caliber, C.P. carriage # 97. Line of fire normal to
 plate about 24" from upper edge.

Round (1) Charge 32.475 S.M.T. # 42. Carpenter's S.P. shell
 # 1650-0, S.V. 1620 f.s. Impact 24.5" x 42.5" d. Projectile
 penetrated 10.2, fracturing back. Bulge, and rebounding
 60', cracked and set up, with several surface pieces
 chipped off lower part & lower part of ogival. Two
 transverse cracks around ogival and a number of
 longitudinal cracks ran down ogival & into lower
 part. No cracks in plate. Shot hole rougher than
 usual with irregular transverse crack in lower part.
 Fringe chipped off in places evidencing hardness
 of plate. Burn 10" high, bulge 16" in diameter.

Round (2) 2d premium test.

Charge 39.875 S.M.T. # 42. Carpenter's S.P. shell # 1276-1, of
 100 pounds, S.V. 1816 f.s. Projectile struck plate 29d x 41a,
 penetrated plate, backing, 12" and about 8" into earth
 A crack, ^{1/2" wide} opened out from middle of impact to left edge

A smaller and shater crack appeared about 2" below this crack at left edge, exposing at temper crack in left edge. Shortly after firing a fine face crack appeared in plate, running to right and downwards from impact. Interior of shot hole rough. Burr 1.7 high, & partly broken off. Bulge 16" in diameter. Plate considered to have failed on premium test but to have passed the acceptance test satisfactorily.

Test (secondary) of Wheeler Sterling 4" A.P. shell.
 Round (1) 4" R.F.C. # 43. C.P. carriage No 23. Fired at fragment of nickel steel plate representing Car-bette armor of New York. Charge 6.6 T₅ Smt. 31, Shell # 157-1, 33 T₅. S.V. 1550 f.s. Impact on fragment 12" away from nearest crack. Penetrated 6.1, & broke up point & ogival the largest piece weighing 10 T₅. Normal burr & bulge. From pieces recovered, shell began to swell at limit of hardness. Marks of rifling on upper part of body.

August 17. Test 5" Steel Common shell U.S.P.C. Shell loaded with sand to weigh 50 T₅.

Round (1) Shell # 4 322. S.V. 1800 f.s. Fired at a 3" soft steel plate, penetrated and broke up in passing through. Diameter shot hole 6". Shell recovered in two principal pieces, the ogival flattened out to shape of mushroom in one piece, and the body and base in the other, front part of body very much swollen.

Round (2) Shell # 1-129, fired against same 3" plate

same striking velocity. Penetrated and broke up as before, being recovered in two principal pieces resembling those of former round. Diameter hole 6"

Round (3) Fired at a 3" wrought iron plate, at same velocity. Penetrated plate and 10' of sand & recovered entire. Shortened 3.4, diameter increased at base of ogival .65
Diameter shot-hole 5.75

Round (4) Shell #5-36 fired at same 3" wrought iron plate with same velocity. Penetrated plate and recovered entire, shortened 2.5, diameter increased .75 at base of ogival. Diameter shot-hole 5.75

August 17. Test of 5" steel common shell of the American propellant Company. Shell loaded to 50 lb and fired with striking velocities of 1800 f.s.

Round (1) Fired at a 3" wrought iron plate. Penetrated plate, diam hole 5" and broke up into a number of pieces the largest being the base. Ogival split in half, welded point holding on.

Round (2) Fired at a 3" soft steel plate. Penetrated plate and broke some small pieces falling in front of plate. Welded point broken off but still sharp. Edges of hole chipped by broken pieces of shell. diameter of shot hole $6\frac{3}{4}$ ". Effect on plate was that of punching a large piece of metal disk-shaped about about 10" in diameter being driven to rear from rear face of plate.

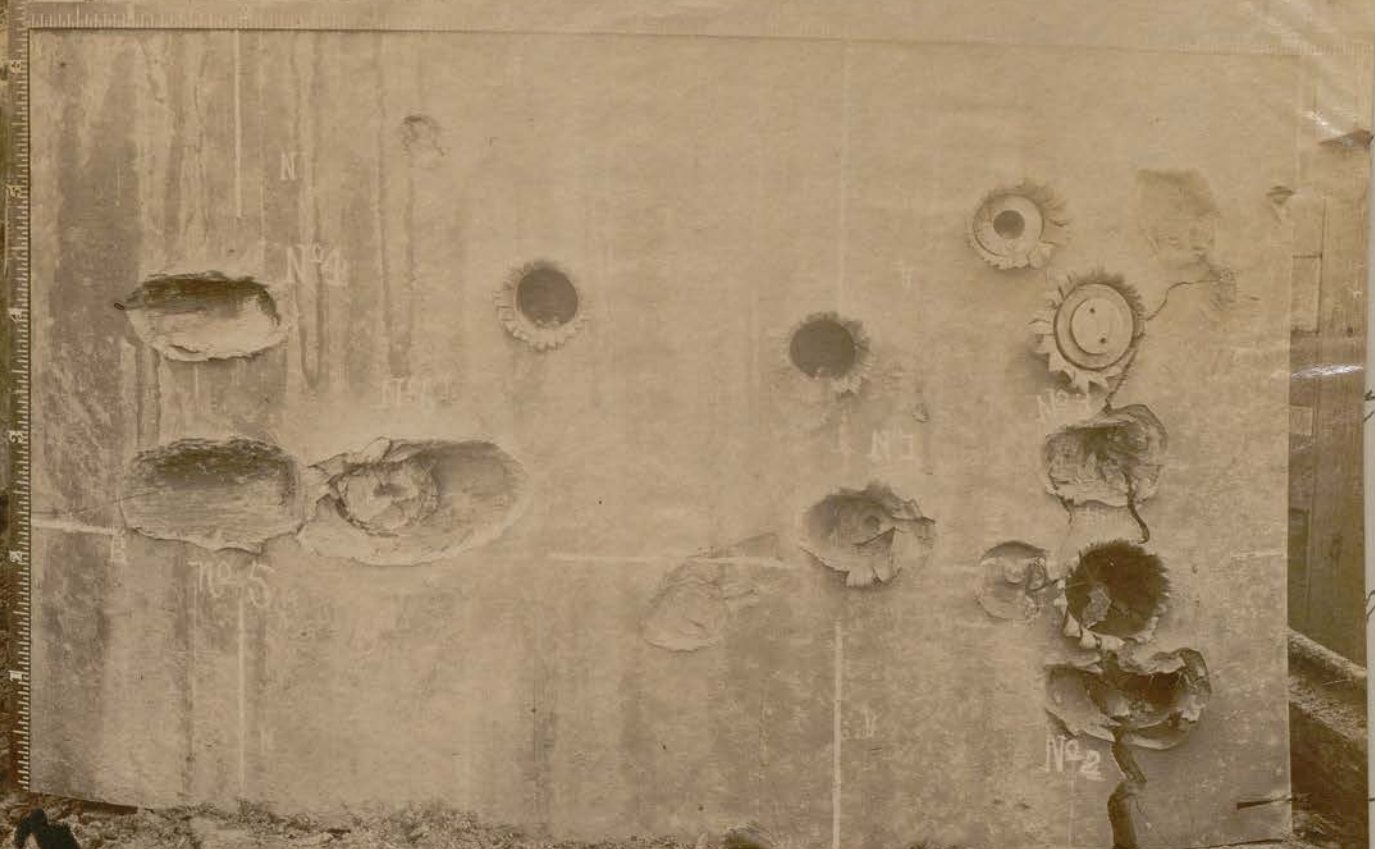
August 22. Test of Wheeler Sterling 8" A.P. shell. Fired against 8" curved nickel-steel plate of "Monterey" at angle as near normal as could be given. S.T. 1500 f.s.

Round (1) # 983 lot 1-250 lb , struck plate 20" from right edge and 28.5" from top at an angle of about 12° with the normal. Shell penetrated plate and 16" of the backing body of shell breaking up just below Bourrelet. Base remained wedged in hole. The projectile after entering plate at angle of 12° , changed direction towards the normal, the point being in the backing quite a little to the right of the line of first penetration. Plate uncracked.

Round (2) Shell # 1035 lot 1, same striking velocity. Struck plate 25" from bottom and 17" from right edge at angle of about 6° with the normal. Shell penetrated plate, backing, and 24" of earth, recovered uncracked. Bourrelet increased .04" body .06", and shortened .14". The plate had been weakened by previous firing, and cracked vertically from bottom through impact to impact of round (1), then toward right edge of plate. Plate and backing set well over to right, and supports badly shaken up.

August 23. Inclined fire against 8" curved plate of "Monterey". 8" B.L.R. & 8" A.P. shell used.

Round (1) Holtys A.P. shell # 9-250 lb , struck plate at an angle of 45° , with velocity of 1850 f.s. Impact 26" from left edge, 23" from bottom, and about 15°



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Below impact of 6" S.P. shell fired at same angle. Shell glanced and broke up making a gouge in plate 19" long, 9" wide and 3.4 deep. Gouge chipped off bulge $1\frac{1}{4}$ " high. No cracks developed in plate, but both plate and backing badly shaken up. All holding in bolts broken, & all except four armor bolts. Plate & backing sprung to right & front 13"

Round (2) Keltzer S.P. shell # 300 with same striking velocity, but at an angle of 35° with normal at point of impact. Shell penetrated plate, turning first a little away and then a little toward normal line. Point of shell about 3.5" into wood backing behind plate. Base & body broke up & fell in vicinity of plate, ogival also broken but wedged into hole. Penetration about 12" in normal line. Impact 33" from bottom, 46" from left edge. A face crack in plate opened out from impact to left edge.

August 26. Test of 8" curved nickel steel plate representing armor of Oregon Barbette and of the "Katakai". Plate measured $129" \times 62\frac{1}{2}" \times 8"$ & weighed 8 tons. Mounted on oak backing $4\frac{1}{2}"$ thick in middle, and 36" thick at edges. Gun to plate 61 feet.

Round (A) Carpenter A.P. shell # 1224-1, 10075. Striking velocity 1752 ft/s. Impact 53.5" from right edge, and 21" from top, line of fire making an angle of about 6° with normal at point of impact. Penetrated plate point getting about 2" into wood backing, rebounded

50' struck the ground, glanced & struck chase of gun then gun carriage & fell to the platform spinning around for some time. Shell apparently sound & uncracked but set up. As it cooled 6 cracks developed running down over ogival into binnacle, and several pieces chipped off surface about upper edge of binnacle. Shell shortened .52, binnacle increased .12 body .23. Plate sound and uncracked. Burn 2" high, ledge 21" diameter. Interior shot-hole smooth, star crack at apex, back ledge fractured. Structure undisturbed

Round (2) Charge 48.3 TB Smt-42. Striking velocity 2012 f.s. Carpenter's shell 93-2-10070. Impact 23" from bottom, 63" from right side, gun depressed about 2°. Penetrated plate 47" backing, 2' of oak blocking, and recovered body cracked, base below binnacle missing. Plate sound & uncracked. Right side of plate & backing set forward 1/4". Burn slight & partly broken off. Bulge 21" in diameter. Interior shot hole fairly smooth, back ledge broken off & choking hole in backing

August 28. Test M7-3787A & 187B

Charge	5.76	187A	Pressure	11 tons	Velocity	1857	Recoil	9"
"	5 1/4	"	"	11.9 "	"	1908	"	9"
"	5 1/2	"	"	12.6 "	"	1964	"	9"
"	5 3/4	"	"	13.8 "	"	1982	"	9"
"	5 3/4	"	"	16.4 "	"	2112	"	9"
"	5	187B	"	9.3 "	"	1740	"	8 1/2"

40 gr musket

Test M.N.-3, 187B in 4" R.F.G. continued

Charge	Pressure	Velocity	Record
5 ¹ / ₄ 187B	11.0 tons	1868	8 ¹ / ₂
5 ³ / ₄ " "	12.7 " "	2022	9
6 " "	11.2 " "	2046	" "
6 " "	13.5 " "	2050	" "

August 28, Test M.N.-2-186 in 6 Pdr. R.F.G., of 40 caliber

Charge	Pressure	Velocity
475 gr M.N.-2, 1867 9 gr ^{Musket} _{at bottom}	8.5	1686
(1) " 500 " " " " "	9.3	1743
(2) " 510 " " " " "	9.5	1787
(1) " 520 " " " " "	9.8	1807
(2) " 550 " " " " "	10.8	1926
(1) " 560 " " " " "	11.2	1950
(1) " 475 " " 9 gr. ^{musket} _{between}	6.7	1697
(1) " 500 " " " " "	9.0	1747
(1) " 510 " " " " "	9.7	1789
(1) " 520 " " " " "	10.1	1829
(1) " 550 " " " " "	11.2	1928

Discharge practically smokeless, dirty fumes in case a few seconds after firing.

August 29. Detonator for 3 Pdr. R.F.G. - Test

Detonator consisted of a metal disc screwed into shell behind powder, containing a small anvil in the centre, on which would impinge a fulminate cap set in a wooden block acting as a plunger. Holes through disc let flame into charge of powder.



Shells were loaded with 38 grammes of powder all they would hold, detonators introduced, and then fired with service velocities.

(1) Two shells fitted as above fired through a 3" pine board screen 20' from the gun, and a second one 15' beyond and passed down the range without breaking up.

(2) Three more fitted in the same way fired through a 5" pine screen. Two detonated but the third did not, and passed down the range whole.

(3) Three more fired through a 6" pine screen & all detonated, breaking up into small pieces.

(4) Fired one shell loaded with sand through same screen, penetrating it & passing down range whole.

September 1, 1893. Increase in diameter 6 Pdr. N. R. F. G. #12.

On examination Hotchkiss 6 Pdr. #12 was found to have swelled in diameter about .005" at one inch from the muzzle and from .005" to .01" between one and four inches from the muzzle. One of the Cauds was also found injured about 10" from the muzzle. Calipered 6 months before, everything was found to be normal. From the records the gun was found to have been fired 1011 times, 48 of these having been fired using smokeless powder, and there has never been an abnormal pressure as far as the records go, 2 pressures of 18.0 tons each & several of 16.0 being

the highest. It is possible that the use of smokless powder has caused the swelling.

September 1, 1893. Test of Driggs-Schroeder 1 Pdr. R.F.G. Gun mounted on experimental top mount # 53, using service ammunition and common shell, ammunition put up by M.R.A. Co. Charge 140 grammes, index 142, loaded in April '93 at Fort Wadsworth. Cases crimped around base of shell, during the firing 21 of them either splitting or blowing through in the crimp marks. Cases extracted easily without exception though the extractors sometimes failed to throw them clear of the gun.

Two hundred rounds were fired in 1 hour and 5 minutes.

Before firing the sleeve between the operating lever and guide bolt was found to be a misfit & filed down, though afterwards it still may have caused some of the many missfires.

A. Steel chain lanyard was used, & broke several times during the trial.

- (1) Fired 5 shots with 2 miss fires & lanyard broke.
- (2) Fired 10 shots in 44 seconds with five missfires. Changed firing spring & sponged out gun.
- (3) Fired 10 shots in 26½ seconds, 1 missfire.
- (4) Fired 20 shots in 65½ seconds, 5 missfires. Sponged out gun.
- (5) Fired 50 shots in 2 minutes 38 seconds, 15 missfires. Sponged out gun & changed operating levers.

- (6) Fired 42 shots in 2 minutes 41 seconds, 3 miss fires.
 (7) Fired 10 shots in 40 seconds, 5 miss fires.
 (8) Fired two shots & broke lanyard.
 (9) Fired 27 shots in 1 minute 36 seconds, 12 miss fires.
 Gun failed to cock frequently due to burr on sear, which prevented it going home.
 (10) Fired 19 shots in 1^m 10^s. 5 miss fires.

In all there were 55 miss fires, though the ammunition was good & always fired on second or third trials.

The gun became very hot. Both extractors were badly dented by shell striking against them on entering. Recoil was about $1\frac{1}{8}$ " the top mount springing considerably.

September 1, Test m n-34 190 in 4" R.F. 4.

Round (1)	5-T6 #190,	Pressure 11.5 tons M.V.	1865 J.V.	Recoil 9"
(2)	5 $\frac{1}{4}$ T6 "	" 12.4 "	" 1928 "	" 9"
(3)	5 $\frac{1}{2}$ " "	" 13.4 "	" 2004 "	" 9"
(4)	5 $\frac{3}{4}$ " "	" 13.9 "	" 2055 "	" 9"
(5)	6 " "	" 15.0 "	" 2118 "	" 9"

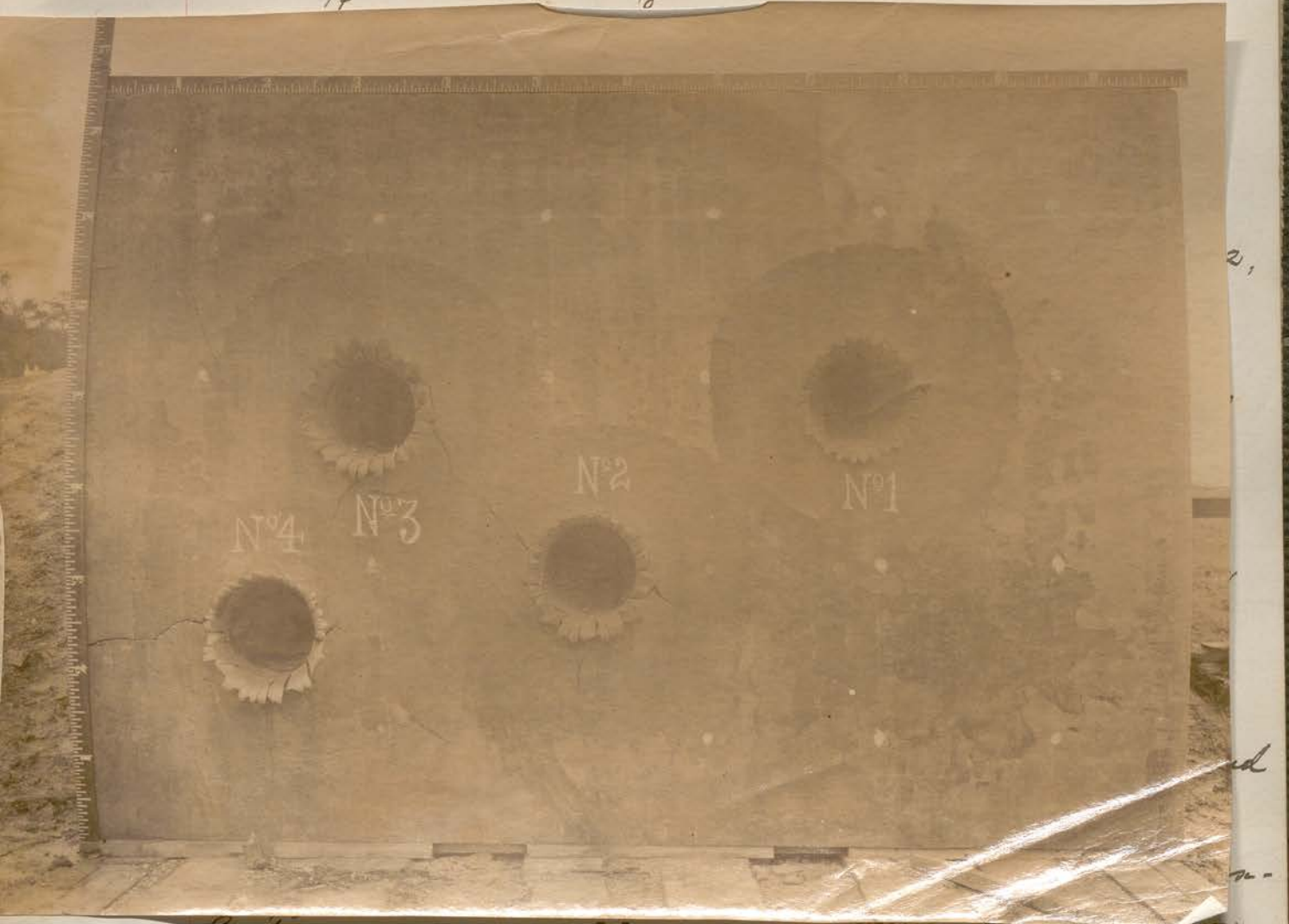
Discharge practically smokeless, concussion some what greater than usual with smokeless powder. Dirty fumes in bore. In third round vivid flame 4' from muzzle. 6 pounds is all that can be gotten into cases.

The following recommendations & figures are given in reference to the difficulty of getting

sufficient powder into cases.

Length in case available	"	"	"	"	Length sticks recommended	"	"	"	"	^{Number} Sticks
4"	..	24"	6	Length sticks recommended	3.9	..	6	3.9	..	8
"	"	"	"	5"	..	3.1	3	"	"	8
"	"	"	"	6 Pdr.	..	9.6	"	"	"	3
"	"	"	"	3 Pdr.	12.7	"	"	"	"	4
"	"	"	"	1 Pdr.	2.15	"	"	"	"	2

For the 6 Pdr., 3 Pdr., and 1 Pdr. R.F.G. it is suggested (N.E.M.) that small ^{pierced} hexagonal grains of about the following dimensions be used. Length $\frac{1}{4}$ " circumscribing circles $\frac{1}{4}$ " diameter, hole $\frac{1}{8}$ " in diameter.



Body	11.91 - 11.93 - .02	10.5 from base.
Band	12.14 - — — —	
Rear	11.91 - 11.91 - .00	

- (6) Fired 42 shots in 2 minutes 41 seconds, 3 miss fires.
 (7) Fired 10 shots in 40 seconds, 5 miss fires.
 (8) Fired two shots & broke lanyard.
 (9) Fired 27 shots in 1 minute 36 seconds, 12 miss fires.
 Gun failed to cock frequently due to burr on sear,
 which prevented it going home.
 (10) Fired 19 shots in 1st 10^s. 5 miss fires.

In all there were 55 miss fires, though the ammunition was good & always fired on second or third trials.

The gun became very hot. Bolt set +
 back. . . .

who
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sufficient powder into cases.

Length in case available	"	"	"	"	Length sticks recommended	"	"	"	"	Number sticks
4"	...	24"	...	3.9	...	6				
"	"	"	"	5"	...	31.2	"	"	"	3.9... 8
"	"	"	"	6 Pdr.	...	9.6	"	"	"	3.15... 3
"	"	"	"	3 Pdr.	...	12.7	"	"	"	3.15... 4
"	"	"	"	1 Pdr.	...	24"N"	"	"	"	2.00... 2

For the 6 Pdr., 3 Pdr., and 1 Pdr. R.F.G. it is suggested (N.E.M.) that small ^{pierced} hexagonal grooves of about the following dimensions be used: Length $\frac{1}{4}$ ", Circumscribing circles $\frac{1}{4}$ " diameter, hole $\frac{1}{8}$ " in diameter.

September 2. Test Carpenter 12" A.P. shell lot 2.

12" Red L. R. #4, on Pintavis hydraulic mount, fired at Indiana's 17" nickel steel curved barrette plate.

Round V Charge 231 ~~75~~ VY-5. Carpenter 12" A.P. #54 lot 2, weighing 845 ~~75~~. ^{striking J. = 1400 ft/s} The base plug could not be gotten out to buy shell up to weight. Projectile struck plate in lower left-hand corner, at an angle of 3° with the normal, & penetrated 17.5", not quite through back bulge, & rebounded about 70° to front, entire and uncracked but set up. Burn 3.5" high, bulge 4.8" in diameter. Interior hole fairly smooth. Left edge backing set back 3" & somewhat crushed, but not disabled. Photograph shows cracks. Shell shortened

Length	36.05 - 35.77 - .31	Shell symmetrical & uniformly set up. Maximum diameter & increase 10.5" from base.
Rear	11.945 - 11.96 - .015	
Body ₁	11.91 - 11.93 - .02	
Body ₂	11.91 - 12.15 - .24	
Body ₃	11.91 - 11.93 - .02	
Band	12.14 - — — —	
Rear	11.91 - 11.91 - .00	

September 6. Test Wheeler - Stealing 4" H.P. shell lot 1 being second shell of secondary test.

Fired from 4" R.F.G. # 40 against a 4" nickel steel plate representing 2d half New York's Casemate armor, distant from gun 330'. Striking velocity 1450 f.s. using charge of 10.0375 W.G.-3. Line of fire normal to plate at point of impact.

Round (C) Shell # 291-1-3375. Penetrated plate & backing, & recovered in 2 pieces, the point & ogival sticking in an oak upright, the base falling down behind backing, break being at band score. No cracks in shell. Burr 1" high, bulge 11" in diameter.

Length	12.35	--	---	..	---	The base being same diameter as body & being nipped by edges of hole, broke off at the weak part - the band score.
Body,	3.94	--	3.94	--	.00	
Body,	3.94	---	3.94	---	.00	
Band	4.06	---	---	---	---	
Rear	3.94	--	3.94	--	.00	

September 7. Test Johnson 10" Cast steel shot.

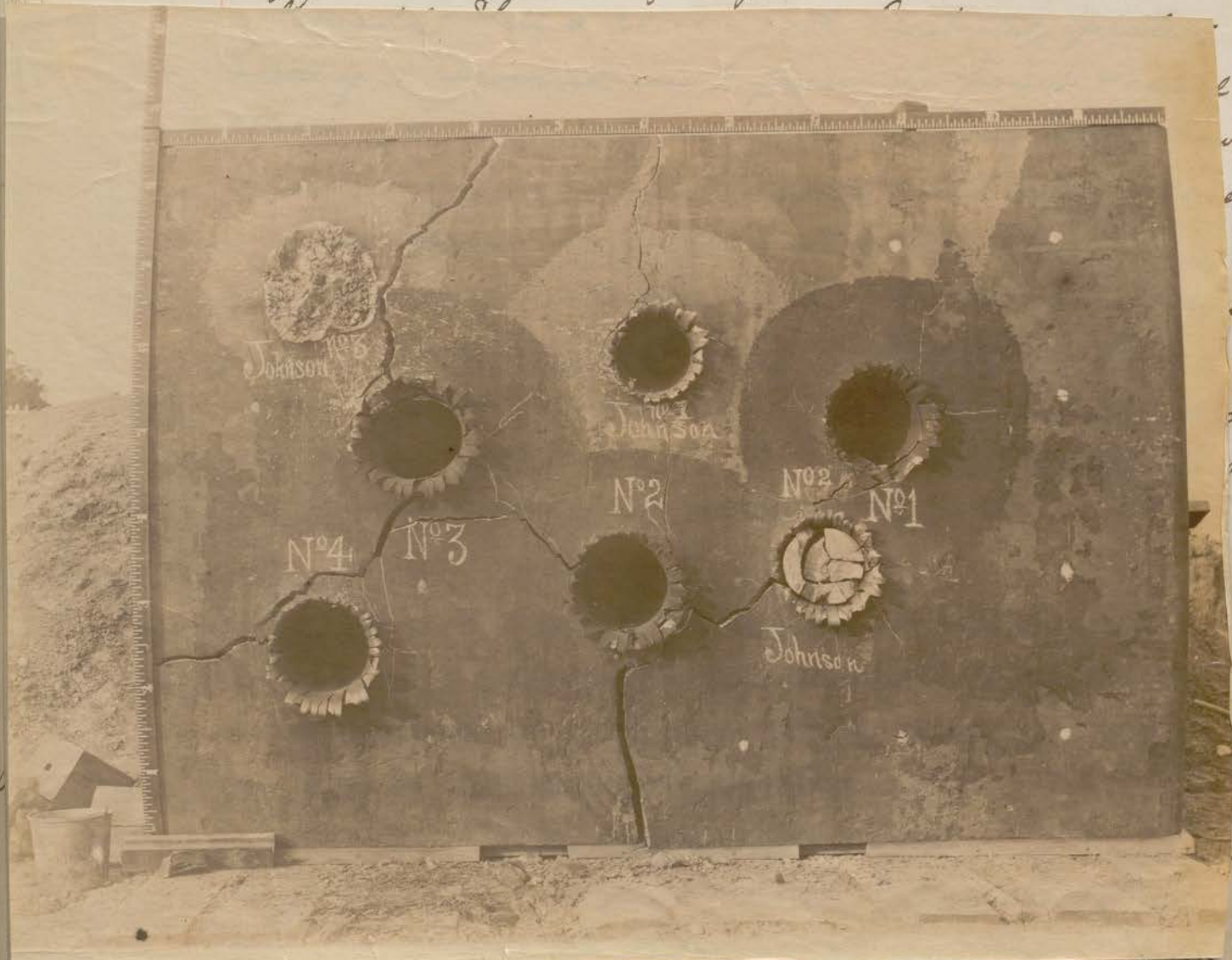
Fired at Indiana's 17" nickel steel plate, distant from muzzle of gun 330'. Plate previously attacked by 4-12" H.P. shell.

Round (C) Johnson shot # P¹² weighing 503.575. Charge 144.275 W.G.-27, striking velocity 1400 f.s. Line of fire inclined 5° with the normal at point of impact. Projectile struck plate 32" from top, and 42" from right edge near centre line, and from 30" to 35" from impacts 1, 2, & 3. of test of plate. Penetrated 13.6 and

broke up at Cannellet, the ogival remaining whole
 uncracked and but little set up or increased in
 diameter, & weighing 154 $\frac{70}{10}$, & rebounding 50' to front
 and right of target, the rest of shell going to pieces.
 On penetrating shell turned a little to right & up-
 wards, line of penetration 10° to normal. Burr $3\frac{1}{2}$ "
 high, bulge $4\frac{1}{8}$ " in diameter. Shell seemed to have
 a hard point for 2" of its length, and to be hard
 from ~~from~~ Cannellet to near the base. The ^{junction of the} point &
 rest of ogival was very plain to the touch after
 shot had been fired. & the penetration

September 6. Test Wheeler - Stealing 4" N.P. shell Lot 1 being second shell of secondary test.

Fired from 4" R.F.G. # 40 against a 4" nickel steel plate representing 2d half New York's Casemate armor, distant from gun 335'. Striking velocity 1450 f.s. using charge of 10.0375 W.G.-3. Line of fire normal to plate at point of impact.



Projectile struck plate 32" from top, and 42" from right edge near centre line, and from 30" to 35" from impacts 1, 2, + 3. of test of plate. Penetrated 13.6 and

broke up at bounelot, the ogival remaining whole uncracked and but little set up or increased in diameter, & weighing 157 T₅, & rebounding 50' to front and right of target, the rest of shell going to pieces. On penetrating shell turned a little to right & upwards, line of penetration 10° to normal. Burr 3.2 high, bulge 4.8" in diameter. Shell seemed to have a hard point for 2" of its length, and to be hard from ~~ogive~~ bounelot to near the base. ^{Impaction of the} The point & rest of ogival was very plain to the touch after shot had been fired, & the penetration was about equal to that of an N.P. shell though the latter would not have broken up probably.

Round (2) # P $\frac{12}{3}$ ^{504 T₅}. Charge 235 T₅ U.F. 27, striking velocity 1890 f.s. Line of fire inclined about 5° to normal at point of impact. Projectile struck 50" from right edge, 40" from bottom, & broke off at surface of plate after penetrating about 19", the ogival being broken up in hole. The rest of shell broke up, & pieces scattered in all directions.

Round (3) # P $\frac{12}{2}$ weight 504 T₅. Charge 144 T₅ U.F. 27, velocity 1400 f.s. Line of fire inclined about 7° to normal at point of impact. Projectile struck plate in upper left hand corner 22" from top, 26" from left edge, & smashed up on plate, the point getting into plate probably 8", & remaining welded in, the rest going into small pieces. Splash about 17" in diameter. This shell # P $\frac{12}{2}$ was not solid, ^{an} ~~an~~ hole 2.2" ^{an}

and 1.3 diameter running in shell from base toward joint.

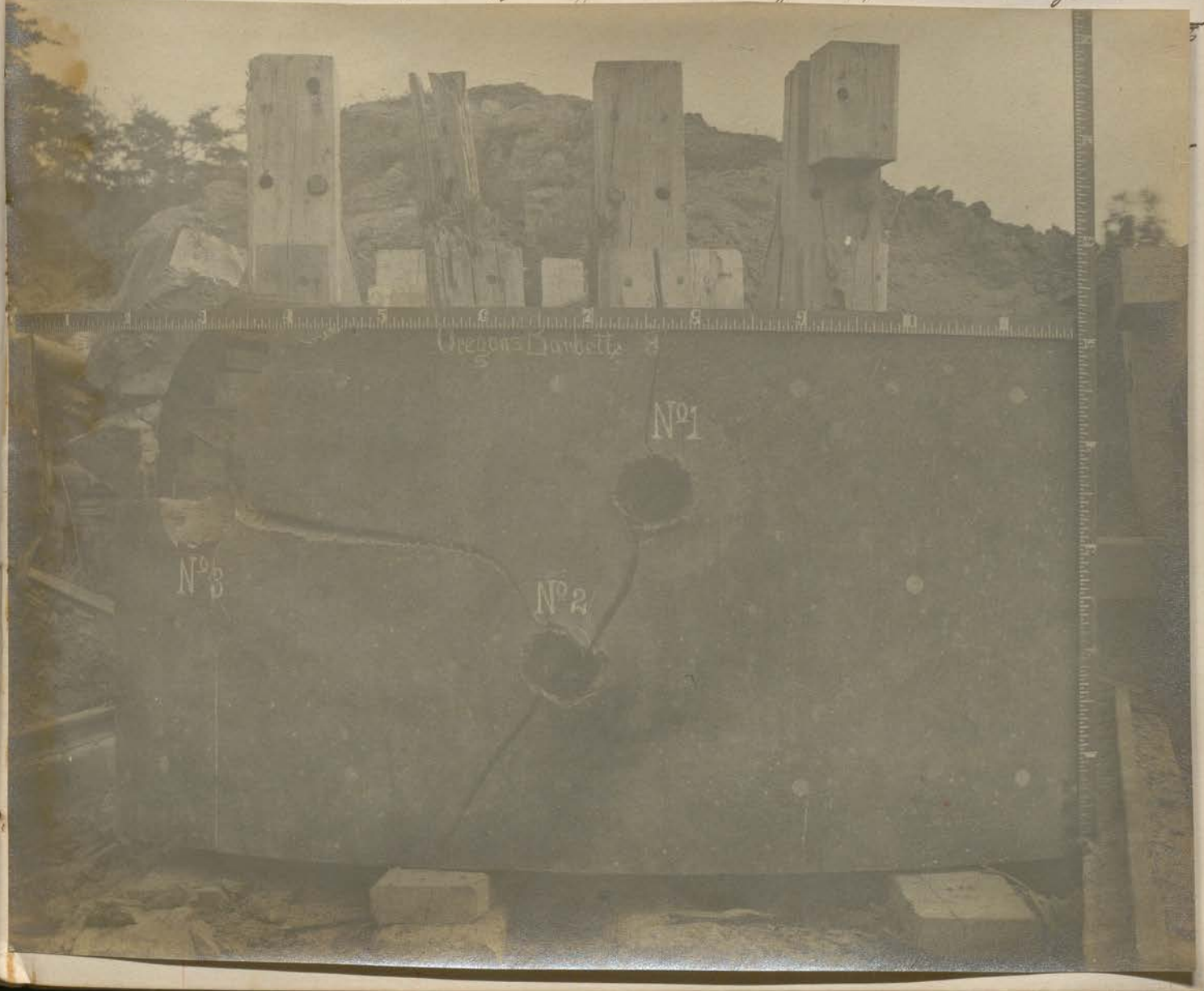
	# P 17	P 17	P 17
Length	28.92	29.94	28.93
Base	9.96-05	9.95	9.95
Body ₁	9.93	9.93	9.94
Body ₂	9.93	9.93	9.94
Body ₃	9.93	9.93	9.94
Band	10.13	10.13	10.13
Rear	9.93	9.93	9.93

September 7, 1893.

Inclined fire against Oregon's curved ^{nickel} steel plate
 - 8" B.L.R. # 15 of 30 calibre on C.P. carriage # 15. Plate
 mounted on usual backing & supports 55" from gun. Car
 8" H.P. shell # 300 lot 7 weighing 250 pounds, striking velocity
 1850 f.o., angle of impact making 45° with normal.
 Impact 40.5" from bottom, 20" from left edge, failing to pen-
 etrate & glancing off broken into pieces. Impact in
 shape of a horizontal gouge 3" deep & about 13" long
 & very similar to previous 45° impact. Upper left
 hand corner of plate broken off, several cracks, leaving
 a piece 20" x 25" hanging by an armor bolt and par-
 tially turned on top of backing. A through & nearly horizon-
 tal crack extended from 6" impact to left edge, &
 another from same impact to bottom of plate & upwards
 through No. 1 to top of plate. Plate & backing set out one
 foot to front, and torn away from target structure.

Sept. 11. Test of a $\frac{1}{2}$ inch riveted steel cylinder 43" long and 43" in diameter. Fired at with 5" R.F.C. & U.S.P. Co. Full common shell, striking velocity 200 f.s. Cylinder set on end in front of sand butt. Projectile passed through front & rear of cylinder without breaking up, front hole 7.5" diameter back bulge 3.3" high, rear hole same diameter back bulge 4.5" high.

Round (2) Same charge & velocity. Front hole $5\frac{1}{4}$ " in diameter, back bulge $3\frac{1}{2}$ " high, back bulge of rear hole (?)
A shot at 800 f.s. S.V., gave front back-bulge 2.8, rear back bulge 3.8



and 1.3 diameter running in shell from base toward joint.

	# P 17	P 17	P 17
Length	28.92	29.94	28.83
Base	9.96-05	9.95	9.95
Body ₁	9.93	9.93	9.94
Body ₂	9.93	9.93	9.94
Body ₃	9.93	9.93	9.94
Band	10.13	10.13	10.13
Rear	9.93	9.93	9.93

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Sept. 11. Test of a $\frac{1}{2}$ inch riveted steel cylinder 43" long and 43" in diameter. Fired at with 5" R.F.C. + U.S.P. Co. Steel common shell, striking velocity 200 f.s. Cylinder set on end in front of sand butt. Projectile passed through front & rear of cylinder without breaking up, front hole 7.5" diameter back bulge 3.3" high, rear hole same diameter back bulge 4.5" high.

Round (2) Same charge & velocity. Front hole $5\frac{1}{4}$ " in diameter, back bulge $3\frac{1}{2}$ " high, back bulge of rear hole (?)
A shot at 800 f.s. S.V., gave front back-bulge 2.8, rear back bulge 3.8

September 13. Test m n-3, #188 in 4" R.F.C. Common shell 3376

Round (1) - 576 - 14.6 tons - 1943 m.v.

(2) - 576 - 14.2 tons - 2023 Powder practically smokeless.

(3) - $5\frac{1}{2}$ 76 - 14.7 tons - 2040 less. Weather damp &

(4) - $5\frac{1}{4}$ 76 - 14.1 tons - 2124 rainy. Chronographs

(5) - $5\frac{1}{4}$ 76 - 14.6 tons - 2027 working poorly.

(6) - $5\frac{1}{4}$ 76 - 14.1 tons - 1988

(7) - $5\frac{1}{4}$ 76 - 14.8 tons - 2023.

Sept. 14. Test of m n-3, -189.

(1) - 576 - 11 tons - 1831 f.s. Powder not so smokeless

(2) - $5\frac{1}{4}$ 76 - 12.2 tons - 1913 f.s. as usual - black fumes

(3) - $5\frac{1}{2}$ 76 - 12.4 tons - 1961 f.s. in bore after firing.

(4) - $5\frac{3}{4}$ 76 - 13.5 tons - 2023 f.s.

(5) - 676 - 13.9 tons - 2100 f.s.

(6) - $6\frac{1}{8}$ 76 - 15.6 tons - 2148 f.s.

(7) - 676 - 14.6 tons - 2075 f.s.

September 14, Test Cartridges 6" A.P. shell Lot 2B, fired against fragment of 10" nickel steel plate, representing 2d half New York's Cabbette armor. Striking velocity 1550 ft., line fire inclined about 8° to normal. Shell penetrated about 10" in line of impact, rebounded 4' and fell to ground uncracked and very little set up, easily being entered in muzzle of gun.

Dimensions shell # 2157 Lot 2B.

Length	17.53	17.41	.12	Maximum diameter and in crease in middle of Counsel Shell symmetrical and uniformly set up.
Barrel	5.945	5.98	.035	
Body 1	5.91	5.94	.03	
Body 2	5.91	5.93	.02	
Body 3	5.91	5.92	.01	
Band	6.11	—	—	
Rear	5.88	5.88	.00	

September 20. Test of Newark's powder.

1st lot. S.M.T.-30, charges put up at Fort Hadsoworth in November '91. On examination grains covered with layer of thin white dust but still dry.

2d. lot. S.M.T.-29. Put up at Fort Mifflin November '91. On examinations grains found mouldy, spotted with salt-peter and slightly damp.

3d. lot. S.M.T.-25. Put up at Fort Mifflin February '91. Appearance of grains on examination normal.

4th lot. S.M.T.-28. Put up at Fort Mifflin March '91. On examination grains found mouldy & whitish but dry.

Each charge had 2 grains black ignition powder

S.L.P.

- (1) ~~Three~~ rounds Smt-30, 44.9⁷⁵ gave 13.6, 13.4, 13.6, + m.v.s of 1930, 1918, 1928. In original test 45⁷⁵ gave 15 tons + 2002 ft.
- (2) Three rounds 42.6⁷⁵ Smt-29 gave 13.2, 13.7, 13.6, with m.v.s 1903, 1907, 1912. Original test 45⁷⁵ gave 14.9 and 2000 ft.
- (3) Three rounds 43.5⁷⁵ Smt-25 gave 13.0, 13.1, 12.8, with 1875, 1874, 1860. Original test gave ⁽²⁾ 47.5⁷⁵, 14.3 tons 2004 ft.
- (4) Three rounds 42.5⁷⁵ Smt-28, gave 14.2, 14.2, 14.5, with 1904, 1932, 1931 ft. Original test 44.5⁷⁵ gave 14.7 and 2005 ft.

September 21. Test U.S.P.C. 6" ^{common} Steel Shell. Shell weighted with sand to 100 T₅ each. Fired at a 3" annealed steel deck plate, set up normal to line of fire and distant

A hole in
the entire but
rich was
radial cracks

Broke it up
ular to shell
base of ogival

annealed plate
& not getting
ted out even
ked longer -

dially from base of ogival to band above. Shortened
3.23, maximum diameter at base of ogival 7.6.

September 14, Test Carpenter 6" A.P. shell Lot 2B, fired against fragment of 10" nickel steel plate, representing 2d half New York's Cabbette armor. Striking velocity 1550 ft., true fire inclined about 8° to normal. Shell penetrated about 10" in line of impact, rebounded 4' and fell to ground uncracked and very little set up, easily being entered in muzzle of gun.

Dimensions shell # 2157 Lot 2B.

Length	17.53	17.41	.12	Maximum diameter and in crease in middle of barrel Shell symmetrical and uniformly
Body	5.945	5.98	.035	
Body 1	5.91	5.94	.03	
Body 2	5.91	5.93	.02	
Body 3	5.91	5.92	.01	
Base	6.11	—	—	



- (1) ~~Three~~ rounds Smt-30, 44.9^{lb} gave 13.6, 13.4, 13.6, + m.v.s of 1935, 1918, 1928. In original test 45^{lb} gave 15 tons + 2002 ft.
- (2) Three rounds 42.6^{lb} Smt-29 gave 13.2, 13.7, 13.6, with m.v.s 1903, 1907, 1912. Original test 45^{lb} gave 14.9 and 2000 ft.
- (3) Three rounds 43.5^{lb} Smt-25 gave 13.0, 13.1, 12.8, with 1875, 1874, 1860. Original test gave 47.5^{lb}, 14.3 tons 2004 ft.
- (4) Three rounds 42.5^{lb} Smt-28, gave 14.2, 14.2, 14.5, with 1904, 1932, 1931 ft. Original test 44.5^{lb} gave 14.7 and 2005 ft.

September 21. Test U.S.P.C. 6" ^{common} Steel Shell. Shell weighted with sand to 100^{lb} each. Fired at a 3" annealed steel deck plate, set up normal to line of fire and distant 385 feet.

Round (1) ^{Shell # 18-5} Striking velocity 1000 ft/s. Punched out hole in plate 16" in diameter, recovered from both entire but very much set up at base of ogival, which was flattened down and distorted. Two longitudinal cracks in bulge, diameter 6"8. Shell shortened 3"38.

Round (2) ^{Shell # 18-4} Same S.V. & plate. Struck plate and broke it up but recovered entire & very much set up similar to shell in round (1). One crack over bulge & one at base of ogival. Diameter 6"94 shortened 3"67.

Round (3) ^{Shell # 18-3} Same charge & S.V. but another 3" annealed plate impact near center of plate & dish-shaped shell not getting through. Shell recovered entire, ogival flattened out even more than in previous round. Shell cracked longitudinally from base of ogival to band score. Shortened 3"23, maximum diameter at base of ogival 7"6.

Shell #18-b

Round (4) S.T. 1450 ft. at same plate. Penetrated plate and broke it up, shell recovered in two pieces, breaking at swelling point near base of ogival.

Two shells were exploded in explosion chamber

Weight empty

92 $\frac{1}{2}$ $\frac{1}{16}$ 93 $\frac{1}{2}$ $\frac{1}{16}$

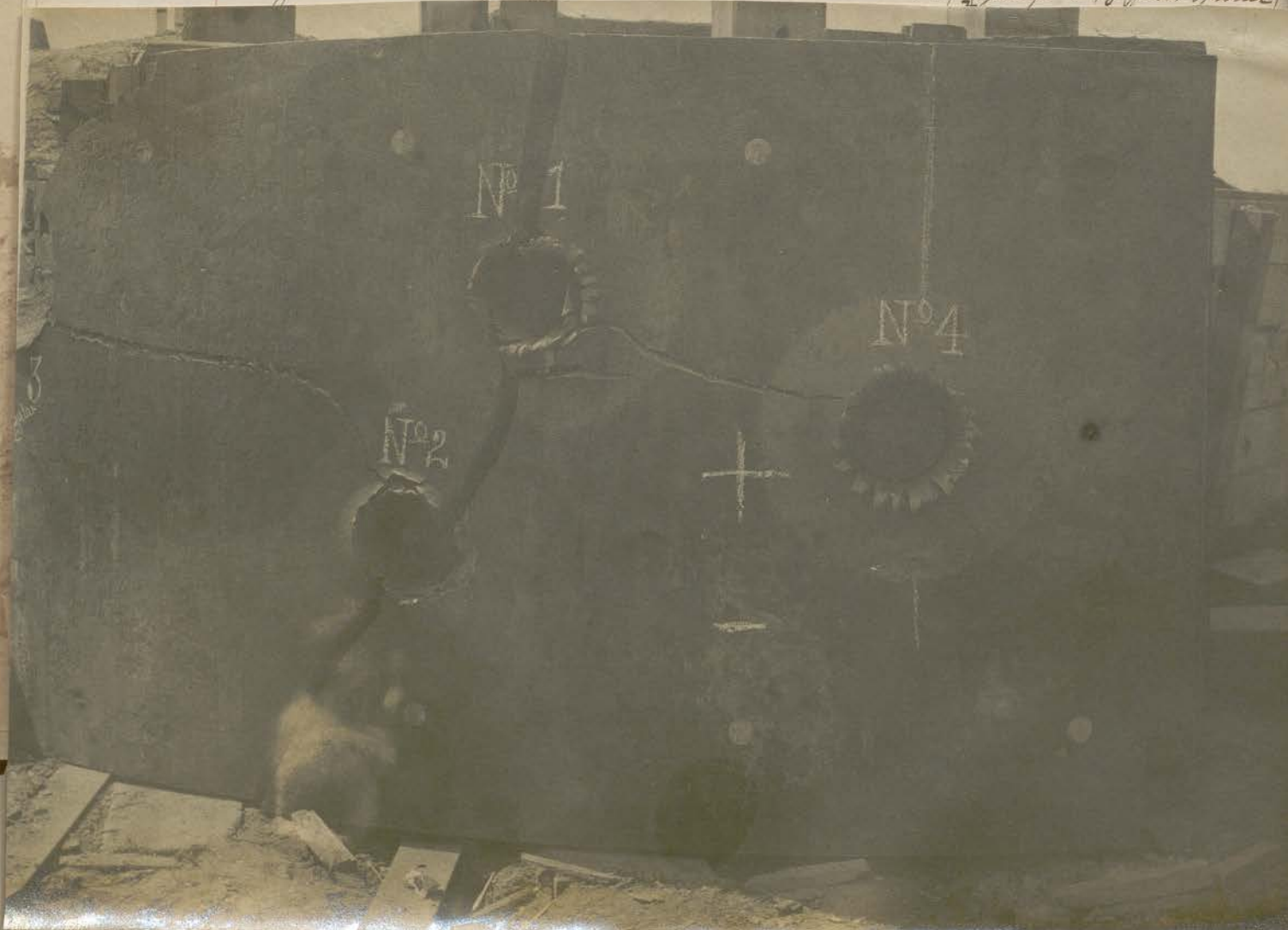
Weight charge of shell powder

53 $\frac{3}{8}$ $\frac{1}{16}$ 53 $\frac{3}{8}$ $\frac{1}{16}$

No. pieces shell

29 21

Weight heaviest piece

16 $\frac{1}{2}$ (ogival) 14 $\frac{1}{8}$ (part of wall)

and backing wrecked. Shell entire but cracked. 13 longitudinal cracks running from the lower part of ogival over bounulet, and 7 similar cracks in body. As a

keel of round (1) was found
 evenly about 1" below
 several longitudinal cracks
 & caused by shearing by
 could be seen from the
 marks of surfaces rubbing

Number 51
 St. Anne
 8 N. 2000



Shell #18-6

Round (4) ^{S.V. 1450 fs.} at same plate. Penetrated plate and broke it up, shell recovered in two pieces, breaking at swelling point near base of ogival.

Two shells were exploded in explosion chamber

Weight empty	92 $\frac{1}{2}$ $\frac{1}{16}$	93 $\frac{1}{2}$ $\frac{1}{16}$
Weight charge of shell powder	53 $\frac{3}{8}$ $\frac{1}{16}$	53 $\frac{3}{8}$ $\frac{1}{16}$
No. pieces shell	29	21
Weight heaviest piece	16 $\frac{1}{2}$ (ogival) 14 $\frac{1}{8}$ (part of wall)	
Weight of ten heaviest pieces	79 $\frac{1}{2}$ $\frac{1}{16}$	82 $\frac{1}{2}$ $\frac{1}{16}$
Weight of all fragments	86 $\frac{1}{16}$	89 $\frac{1}{2}$ $\frac{1}{16}$

Sept. 22. Test Wheeler Stealing 8" H.P. shell lot 2.

Loaded to 250 $\frac{1}{16}$ and fired at 8" nickel steel curved plate of the "Oregon"

Round (1) Struck plate normally 30" from ^{S.V. 1500 fs.} top, 24.3" from right edge. Penetrated plate, and about 12" oak backing and remained stuck in hole base in 3" from face of plate. One crack opened out from impact to that of 1st test round of plate, and another small crack 6" long from lower side impact to right edge. The base of shell showed one or two fine cracks.

Round (2) Charge 20 $\frac{1}{16}$ W-22, ^{#995-2} S.V. 1500 fs. Struck normally 19.5" from bottom, 25" from right edge, and about 15" below last impact. Penetrated plate and backing rebounded and dropped in front of plate. Plate and backing wrecked. Shell entire but cracked. 13 longitudinal cracks running from the lower part of ogival over bounlet, and 7 similar cracks in body. As a

Cell of round (1) was found
 evenly about 1" below
 several longitudinal cracks
 & caused by shearing by
 could be seen from the
 marks of surfaces rubbing

W. 51
 No. 51
 No. 51



Shell #18-6

Round (4) S.T. 1400 fs. at 6
 and broke it up, shell u
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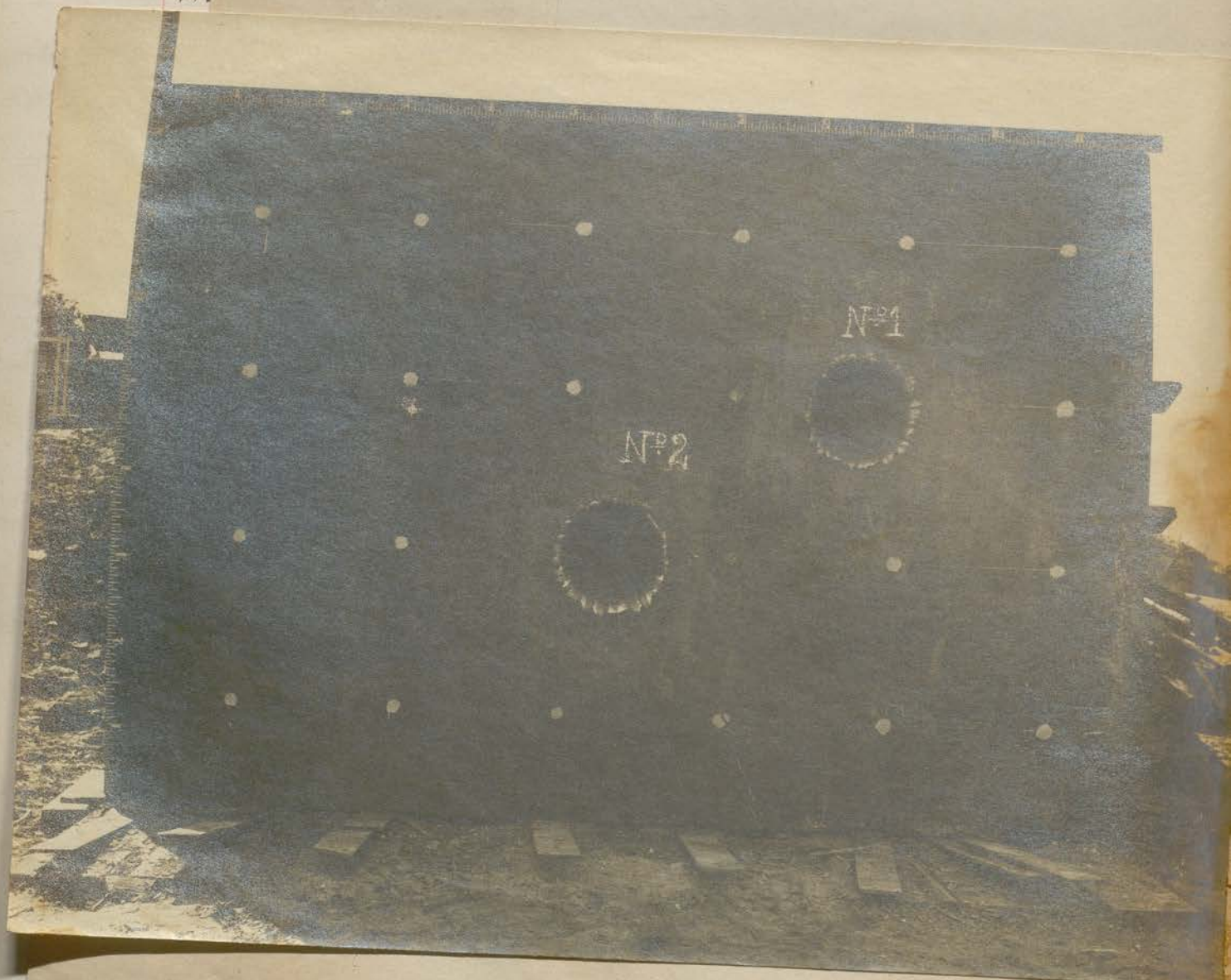
over course

result of this round, the shell of round (1) was found to have been broken transversely about 1" below lowerlet and to have several longitudinal cracks in body. That this was not caused by shearing by plate due to 2d round could be seen from the fracture which showed no marks of surfaces rubbing



Shell #186

Round (4) S.T. 1400 ft.
 and broke it up, she
 at swelling point n
 Two shells were ea
 71.



result of this round, the shell of round (1) was found to have been broken transversely about 1" below binnacle and to have several longitudinal cracks in body. That this was not caused by shearing by plate due to 2d round could be seen from the fracture which showed no marks of surfaces rubbing together, and that the point was still firm in wood backing.

Dimensions shell # 295-2

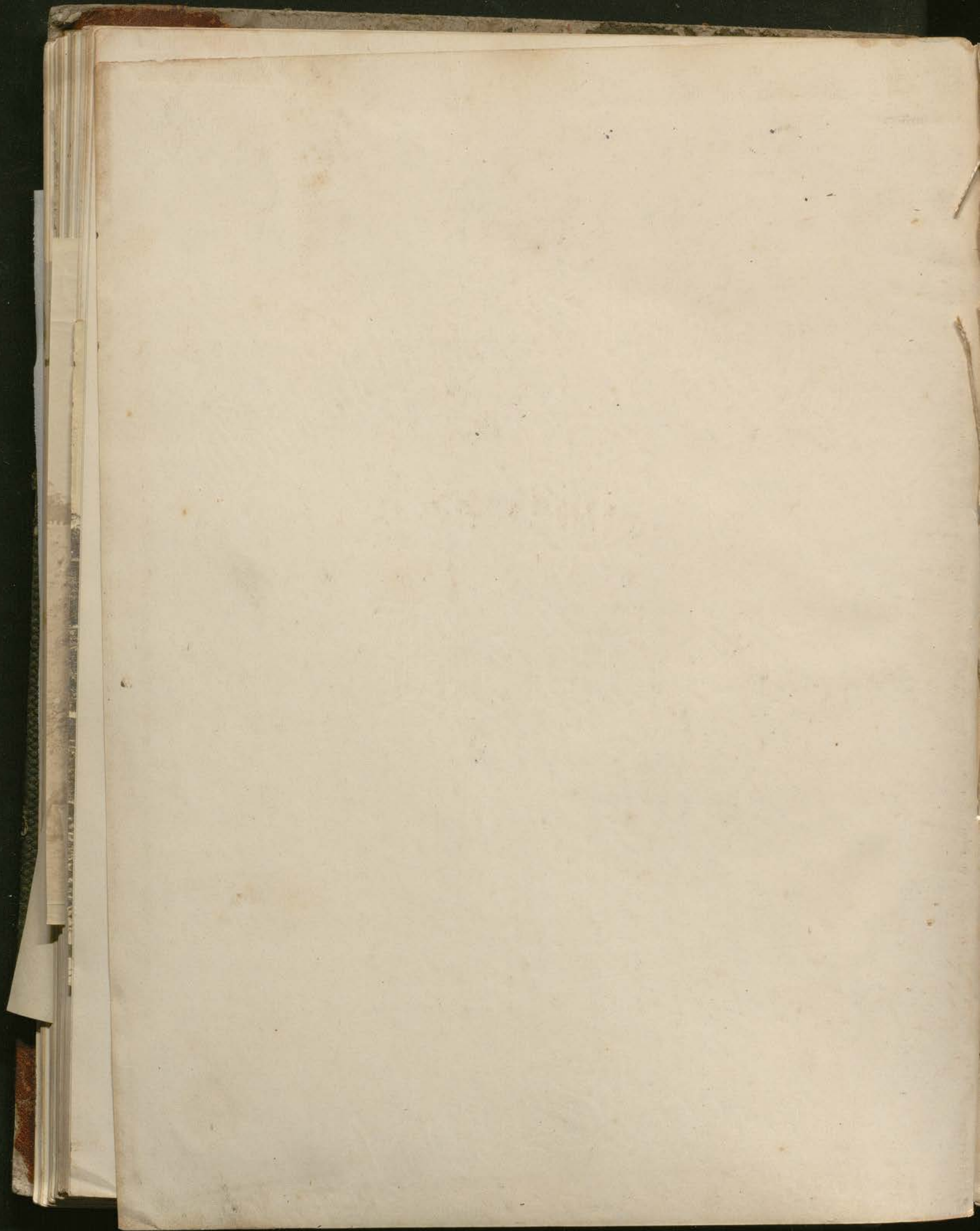
Length	24.54	23.89	.65	Maximum increase and maximum diameter middle of binnacle. Shell symmetrical and uniformly set up.
Band	7.95	8.20	.25	
Body ₁	7.92	8.12	.20	
Body ₂	7.92	8.00	.08	
Body ₃	7.91	7.92	.01	
Rear	7.89	7.88	.00	

Sept. 30. Test of Indiana's 2d binnacle plate, nickel steel 17" thick. Distance plate to gun 320'.

Round (1) S.V. 1022 ft., shell 850 to Carpenter S.P. #29-lot 1. Struck plate 40" from top, 42" from right edge, penetrated 15.5", and rebounded 60' entire & uncracked, but slightly set up. Bulge 38" diameter, gun 35" high. A few bulge cracks about mouth of shot hole. One armor bolt directly in rear of impact driven out, and another started. Projectile shortened .89". Plate set back 1/2"

Dimensions 12" S.P. shell # 29-1

Length	36.13 - 35.24 - .89
Band	11.935 - 12.15 - .21
Body ₁	11.90 - 12.18 - .28
Body ₂	11.905 - 12.33 - .43
Body ₃	11.905 - 11.94 .04
Band	12.14 -
Rear	11.85 - 11.85 - .00



Check Price & Lynch 104585

